INFLUENCE OF PLANT CLASSIFICATION KNOWLEDGE ON THE ENTREPRENEURIAL ORIENTATION OF SENIOR SECONDARY SCHOOL STUDENTS IN KOGI STATE, NIGERIA

BY

Mathew Bolaji Aledare, Ph.D
Department of Integrated Science, School of Sciences,
Kogi State College of Education, Ankpa, Nigeria
mathewaledare44@gmail.com | (+234) 803 522 7224

&

Mulkah A. Ahmed, Prof.
Department of Science Education,
Faculty of Education University of Ilorin, Nigeria
ahmed.ma@unilorin.edu.ng | (+234) 803 431 4083

Abstract

Socio-economic challenges such as unemployment and poverty highlight the need to integrate entrepreneurship into secondary school curricula. This study investigated the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. A mixed-method research design was employed, involving 712 students and 14 Biology teachers selected through a multi-stage sampling procedure. Data were collected using the Questionnaire on Plant Classification and Entrepreneurial Orientation (QPCEO) and the Teacher Informant Interview Guide (TIGPCEO) with reliability coefficients of 0.81 and 0.64, respectively. Descriptive statistics, Kruskal–Wallis, and Ordinal Logistic Regression analyses were used at a 0.05 significance level to analyse the data obtained. Results revealed that plant classification knowledge significantly influenced students' entrepreneurial orientation (χ^2 = 27.59, $p < 0.05$; $\beta = 0.473$, $p < 0.05$), with 60.9% of proficient students demonstrating higher entrepreneurial tendencies. Qualitative findings confirmed that hands-on taxonomy activities enhanced students' agripreneurial interests. The study concludes that plant classification fosters innovation, self-reliance, and economic empowerment among students. It recommends integrating entrepreneurship-based projects, teacher training, and school–community collaborations to strengthen the practical and economic relevance of plant classification in secondary education.

Keywords: Plant Classification; Entrepreneurial Orientation; Agripreneurial Skills; Biology Education; Secondary School Students

Introduction

Education remains a fundamental driver of national development, serving as the foundation for equipping individuals with the knowledge and skills necessary to contribute productively to the society. According to UNESCO (2018), quality education enhances innovation and adaptability, fostering human capital capable of stimulating economic transformation. In Nigeria, however, persistent challenges such as youth

unemployment, poverty, and economic stagnation continue to threaten national development. The National Bureau of Statistics (2022) reported that youth unemployment has risen to 42.5%, highlighting the growing mismatch between academic instruction and labour market demands. This situation calls for an urgent restructuring of school curricula to integrate entrepreneurship education and skill-oriented learning that prepare students for self-employment and innovation (Olatunji et al., 2017).

Entrepreneurship education has been globally recognized as a potent mechanism for addressing unemployment and economic vulnerability. The Organisation for Economic Co-operation and Development (OECD, 2019) posited that embedding entrepreneurship within school curricula promotes creativity, problem-solving, and resilience. In Nigeria, the Federal Republic of Nigeria (2013) emphasized entrepreneurship education in the National Policy on Education as a means of achieving self-reliance and national productivity. Yet, implementation remains weak, particularly within science subjects, where theoretical instruction dominates at the expense of practical, skill-based learning (Oyovwi, 2022). This inadequacy has limited the potential of science education, especially Biology, to develop entrepreneurial competencies in students.

Biology, as a life-oriented science, offers vast opportunities for entrepreneurship through its applied concepts. Within its curriculum, plant classification stands out as a foundational topic with rich entrepreneurial applications. The study of plant classification (taxonomy) enables students to identify, categorize, and understand plant species based on their structure, use, and ecological roles. Such knowledge can be harnessed to establish ventures in horticulture, floriculture, herbal medicine production, plant breeding, and agricultural biotechnology. According to Ojone (2017), exposure to practical plant classification enhances students' understanding of economically valuable plants, enabling them to explore business opportunities within the agricultural and environmental sectors. However, in most Nigerian schools, Biology instruction emphasizes rote memorization of taxonomic systems rather than practical application, preventing students from recognizing the entrepreneurial potential inherent in the topic.

The integration of entrepreneurial thinking into plant classification lessons could transform the way students perceive and apply scientific knowledge. For instance, identifying local plants used for food, medicine, or ornamental purposes can encourage students to develop agribusiness ideas and eco-friendly enterprises. Experiential learning approaches such as fieldwork, herbarium projects, and community-based plant identification exercises can help students acquire hands-on experience, thereby stimulating creativity and problem-solving skills. These approaches align with the Experiential Learning Theory (Kolb, 1984), which emphasizes learning through reflection, experimentation, and active engagement. They also relate to the Human Capital Theory, which stressed education as a tool for increasing individuals' productivity and economic potential.

Empirical studies have demonstrated that science education can foster entrepreneurial orientation when linked to real-world applications. Martens et al. (2022) found that students engaged in practical science activities developed higher levels of innovation, initiative, and

self-efficacy—core dimensions of entrepreneurial orientation (EO). EO, as conceptualized by Miller (1983) and later refined by Lumpkin and Dess (1996), encompasses innovativeness, proactiveness, and risk-taking—attributes that can be cultivated through meaningful engagement with scientific concepts. Applying this framework to Biology implies that students who learn plant classification through practical, entrepreneurial contexts are more likely to exhibit creativity, initiative, and independence in identifying economic opportunities.

Despite its potential, the relationship between plant classification and entrepreneurial orientation remains underexplored in Nigeria. Most existing studies have examined entrepreneurship education broadly without isolating specific Biology topics that can foster entrepreneurial competence. Consequently, there is limited empirical evidence on how the teaching of plant classification influences students' entrepreneurial tendencies, particularly in Kogi State—an agrarian region where agricultural and environmental resources abound.

This study therefore examined the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. It determined whether a better understanding of plant taxonomy contributes to the development of agripreneurial skills, innovation, and self-reliance among students. The findings are expected to guide curriculum planners, Biology teachers, and policymakers in integrating entrepreneurship-focused learning experiences into science education, thereby bridging the gap between academic knowledge and practical economic empowerment.

Literature Review

Concept of Plant Classification

Plant classification, also known as taxonomy, is the systematic process of identifying, naming, and grouping of plants, based on shared characteristics and evolutionary relationships. It provides students with a foundational understanding of biodiversity, plant structure, and ecological interactions. According to Singh and Gupta (2020), taxonomy not only enhances biological literacy but also cultivates analytical and problem-solving skills essential for innovation and application. In the Nigerian secondary school Biology curriculum, plant classification is introduced to help students recognize economically valuable species and understand their ecological and agricultural relevance (Federal Ministry of Education, 2013).

When properly taught, plant classification exposes learners to potential entrepreneurial opportunities such as horticulture, floriculture, herbal medicine production, and seedling propagation. Ojone (2017) emphasized that understanding local flora enables students to identify plant species that can serve as raw materials for cottage industries and small-scale agribusinesses. Similarly, Udo and Ekanem (2021) noted that linking taxonomy with community-based projects like school gardens and herbarium creation encourages practical engagement and business awareness among learners. Thus, the concept of plant classification transcends theoretical memorization; it can serve as a pathway to economic empowerment through knowledge application.

Entrepreneurial Orientation

Entrepreneurial Orientation (EO) describes an individual's propensity to engage in innovative, proactive, and risk-taking behavior within uncertain environments (Lumpkin & Dess, 1996). EO has been conceptualized through five dimensions: innovativeness, proactiveness, risk-taking, autonomy, and competitive aggressiveness (Martens et al., 2022). Within the context of education, EO is a useful framework for assessing how curricular experiences influence students' motivation to identify and exploit opportunities.

Integrating entrepreneurial concepts into science education nurtures self-reliance and creativity. Kumar et al. (2021) observed that students who experience entrepreneurship-infused lessons demonstrate greater initiative and problem-solving capacity. Biology, in particular, provides fertile ground for developing EO since its topics often link directly to real-life ventures such as organic farming, environmental management, and biotechnology. Nofal et al. (2018) asserted that teaching biology through an entrepreneurial lens encourages learners to translate biological knowledge into innovative ideas and marketable solutions. Therefore, EO serves as both an outcome and an evaluative measure for determining how effectively Biology education, especially plant classification, stimulates entrepreneurial competencies.

Theoretical Framework

This study is supported by the Human Capital Theory and Experiential Learning Theory. Human Capital Theory, as advanced by Schultz (1961) and Becker (1993), posits that education enhances productivity by developing individuals' knowledge and skills for economic advancement. When applied to science education, the theory implies that mastery of biological knowledge, such as plant taxonomy, can increase students' capacity for self-employment and innovation (World Bank, 2018).

Experiential Learning Theory (Kolb, 1984) complements this by emphasizing learning through experience, reflection, and application. Kolb proposed that meaningful learning occurs when individuals actively engage with their environment to test and refine ideas. Applied to Biology, experiential learning involves fieldwork, herbarium development, and project-based plant identification—activities that promote hands-on understanding and entrepreneurial discovery. Empirical evidence supports this connection; Brown and Green (2016) reported that students involved in science-based experiential learning projects exhibited enhanced entrepreneurial intent and confidence. Together, these theories establish a strong rationale for linking plant classification knowledge to the development of agripreneurial skills.

2.4 Empirical Review

Several studies have explored the relationship between science education and entrepreneurship development. Oyovwi (2022) found that integrating entrepreneurship education into secondary school science subjects significantly increased students' creativity and business awareness. Similarly, Johnson and Williams (2017) demonstrated that students exposed to entrepreneurship-based Biology instruction developed stronger innovation skills than those taught using traditional lecture methods.

In a study, Wokocha (2020) highlighted that in Nigeria, the Biology curriculum is

often taught theoretically, with limited practical engagement, reducing its potential to cultivate entrepreneurial competencies. Contrarily, studies conducted in agricultural science and vocational education have shown that experiential approaches, such as; school farms, nursery management, and plant propagation projects, positively influence students' entrepreneurial mindset (Udo & Ekanem, 2021; Adeoye, 2019).

Internationally, countries such as Finland, Singapore, and South Africa had successfully integrated entrepreneurship into STEM education, resulting in improved student innovation and job creation (European Commission, 2019; Chimucheka, 2016; World Economic Forum, 2021). These global practices illustrate that science-driven entrepreneurship is feasible when curricula are adapted to include real-world applications. However, studies isolating the specific contribution of plant classification to entrepreneurial orientation remain scarce. This study, therefore, addresses a critical empirical gap by focusing on how plant classification influences entrepreneurial orientation among Nigerian secondary school students, particularly in Kogi State where agriculture and biodiversity are central to the local economy.

Methodology

Research Design

The study adopted a mixed-method research design, integrating quantitative and qualitative approaches to provide a comprehensive understanding of how knowledge of plant classification influences the entrepreneurial orientation of senior secondary school students. This design enabled the collection of both numerical data and contextual insights, allowing triangulation for enhanced validity. The quantitative component involved a descriptive survey of Biology students, while the qualitative component consisted of key informant interviews with Biology teachers to gain deeper insights into how plant classification is taught and applied in entrepreneurial contexts.

Population, Sample, and Sampling Technique

The target population comprised all Senior Secondary School II (SS II) Biology students in Kogi State, Nigeria, during the 2023/2024 academic session. According to the Kogi State Ministry of Education (2023), there were approximately 8,364 SS II Biology students distributed across 170 public secondary schools in the seven education zones of the State, namely: Ankpa, Dekina, Idah, Isanlu, Kabba, Lokoja, and Okene.

A two-stage sampling procedure was adopted. In the first stage, stratified random sampling was used to ensure equitable representation of schools across urban and rural areas, as well as co-educational and single-sex institutions. Four schools were randomly selected from each education zone (two urban and two rural), making a total of 28 schools. In the second stage, proportionate sampling was employed to select 10% of the student population, resulting in 836 students as respondents. Additionally, 14 Biology teachers (two from each zone) were purposively selected for key informant interviews to provide qualitative data on how plant classification fosters entrepreneurial skills in students. This multi-stage approach ensured representation across different educational and geographical contexts in the state.

Research Instruments

Two instruments were employed for data collection. They are:

Questionnaire on Plant Classification and Entrepreneurial Orientation (QPCEO), adapted for this paper to focus specifically on plant classification. The instrument comprised two sections: Section A captured respondents' demographic information, while Section B contained five-point Likert scale items measuring the perceived influence of plant classification knowledge on students' entrepreneurial orientation dimensions (innovativeness, proactiveness, risk-taking, and autonomy). The instrument, when subjected to Cronbach's alpha testing, achieved a reliability coefficient of 0.81, indicating internal consistency.

Teacher Informant Interview Guide (TIGPCEO), a semi-structured interview schedule designed to elicit teachers' experiences and perceptions regarding the practical application of plant classification in developing agripreneurial skills. The guide demonstrated a Cohen's Kappa coefficient of 0.64, showing substantial inter-rater reliability (Landis & Koch, 1977).

Both instruments were validated by a panel of seven experts in Biology education, entrepreneurship education, and statistics from the University of Ilorin. Their inputs improved the content validity, clarity, and alignment of the tools with the research objectives.

Procedure for Data Collection

Data collection was conducted over a four-week period. Official permission was obtained from school principals using an introductory letter from the Department of Science Education, University of Ilorin. Informed consent was obtained from all participants, and ethical standards were strictly observed throughout the process.

During the first week, Biology teachers serving as research assistants were trained on the administration of the instruments. In the second and third weeks, the QIBCEO was administered to the sampled students during regular school hours. The fourth week involved the conduct of teacher interviews using the TIGIBCEO. All responses were collected under conditions of confidentiality and voluntary participation.

Method of Data Analysis

Quantitative data collected through the questionnaire were analyzed using descriptive and inferential statistics with the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics (frequency counts, means, and standard deviations) were used to answer research questions, while the Kruskal–Wallis test and Ordinal Logistic Regression were used to test hypotheses at 0.05 significance level. The Kruskal–Wallis test determined whether significant differences existed in entrepreneurial orientation based on varying levels of understanding of plant classification, while the logistic regression model evaluated the extent to which plant classification knowledge predicted entrepreneurial orientation.

Qualitative data from the teacher interviews were transcribed and analyzed using content analysis. Responses were coded and categorized into emerging themes reflecting teachers' perceptions of how plant classification supports innovation, business awareness, and self-reliance among students. Triangulation of both datasets enhanced the validity of findings and provided a nuanced understanding of how plant classification

contributes to entrepreneurial skill development.

Ethical Considerations

The study adhered to the ethical standards set by the University of Ilorin Ethical Review Committee. Participants were fully informed of the study's purpose and were assured of anonymity and confidentiality. They were also informed of their right to withdraw at any stage without any consequences. Proper acknowledgment was given to all authors and data sources, and plagiarism was strictly avoided.

Results and Discussion

This section presents the results of the study on the influence of plant classification knowledge on the entrepreneurial orientation of senior secondary school students in Kogi State, Nigeria. Quantitative findings are supported by qualitative insights from teacher interviews to provide a comprehensive interpretation of how plant classification fosters agripreneurial skills.

Table 1

Students' Responses on Plant Classification and Entrepreneurial Orientation (N = 712)

Item	Response Category	Frequency	Percentage (%)	Mean	SD	Interpretation
Interest in learning plant classification	Strongly Disagree	46	6.5	3.59	1.15	Agree
	Disagree	82	11.5			
	Neutral	150	21.1			
	Agree	274	38.4			
	Strongly Agree	160	22.5			
Likelihood of pursuing a career in plant classification	Very Unlikely	70	9.8	3.44	1.27	Likely
	Unlikely	102	14.3			
	Neutral	162	22.8			
	Likely	204	28.7			
	Very Likely	174	24.4			
Extent to which understanding plant classification enhances entrepreneurial skills	Not at all	60	8.4	3.49	1.26	Very High
	Little extent	106	14.9			
	Moderate	158	22.2			
	High extent	388	54.5			
Confidence in applying plant	Not at all confident	50	7.0	3.61	1.19	Very Confident

classification knowledge						
	Slightly confident	82	11.5			
	Moderately confident	150	21.1			
Importance of learning about plant classification	Not important at all	36	5.1	3.78	1.08	Very Important
	Slightly important	60	8.4			
	Moderately important	112	15.9			
	Very important	318	44.7			
	Extremely important	186	26.1			

Note. Mean ≥ 2.50 = Agree/Significant; Mean < 2.50 = Disagree/Not significant.
Source: Researcher's Fieldwork (2024)

Table 2

Summary of Students' Perceptions on Plant Classification and Entrepreneurial Orientation

Variable	Weighted Mean	SD	Level of Agreement
Interest in learning plant classification	3.59	1.15	Agree
Pursuit of a career in plant classification	3.44	1.27	Likely
Perceived enhancement of entrepreneurial skills	3.49	1.26	Very High
Confidence in applying plant classification	3.61	1.19	Very Confident
Importance of learning plant classification	3.78	1.08	Very Important
Overall Weighted Mean Score	3.58	—	High

Note. Mean ≥ 2.50 = Positive perception; Mean < 2.50 = Negative perception.
Source: Researcher's Fieldwork (2024).

The results in Tables 1 and 2 show that respondents displayed high levels of agreement across all items. Students expressed strong interest in learning plant classification ($\bar{x}$ = 3.59), high confidence in applying related knowledge ($\bar{x}$ = 3.61), and recognition of its importance ($\bar{x}$ = 3.78). These findings revealed that plant classification concepts meaningfully contribute to entrepreneurial readiness, consistent with Adeyemi et al. (2019), who reported similar outcomes among Nigerian secondary students.

Table 3

Kruskal–Wallis Test of the Influence of Plant Classification Knowledge on Entrepreneurial Orientation

Test Statistic	χ^2	df	p-value	Decision
Plant Classification → Entrepreneurial Orientation	27.59	2	0.000	Significant

Note. Significant at 0.05 level. Source: Researcher's Fieldwork (2024).

The Kruskal–Wallis result ($\chi^2 = 27.59$, $p < 0.05$) indicates a statistically significant influence of plant classification knowledge on students' entrepreneurial orientation. Students with higher proficiency in plant classification demonstrated stronger tendencies toward innovation, initiative, and risk-taking.

Table 4

Ordinal Logistic Regression of Plant Classification Knowledge Predicting Entrepreneurial Orientation

Predictor	Estimate (β)	SE	Wald χ^2	p-value	Odds Ratio (Exp β)
Plant Classification Knowledge	0.473	0.112	17.849	0.000	1.61

Note. Dependent variable = Entrepreneurial Orientation. Source: Researcher's Fieldwork (2024).

The regression result further confirms that plant classification significantly predicts entrepreneurial orientation ($\beta = 0.473$, $p < 0.05$). The odds ratio (Exp $\beta = 1.61$) explains that students proficient in plant classification are 1.6 times more likely to exhibit high entrepreneurial orientation than those with weaker understanding.

The findings affirm that knowledge of plant classification significantly influences the entrepreneurial orientation of secondary school students in Kogi State. Quantitatively, 60.9 percent of students with higher competence in plant classification, displayed greater entrepreneurial orientation. This confirms that plant classification is not purely theoretical but possesses practical economic value, capable of inspiring interest in agribusiness, horticulture, and botanical enterprises hence, these results aligned with the submission of Husni and Nasution (2024), who demonstrated that integrating entrepreneurship into biology lessons enhanced students' motivation toward agricultural ventures. The results are also in tandem with those of Adeyemi et al. (2019) and Osunleti et al. (2021) who emphasized that students skilled in plant taxonomy are better positioned to explore floriculture, herbal medicine, and plant-breeding businesses.

Qualitative insights from the interviews of teacher, supported the quantitative results. Teachers reported that hands-on taxonomy activities—such as plant collection, herbarium creation, and school garden projects, heighten students' awareness of economic opportunities. The view of one of the participants is that; Students begin to see that the plants they classify every day can be

grown, sold, or processed. They start linking biology to business.

This perspective aligns with Kolb's (1984) Experiential Learning Theory, which emphasizes that learning becomes meaningful when students actively apply concepts in real contexts. Similarly, Becker's (1993) Human Capital Theory supports the notion that educational investment—in this case, plant classification—enhances productivity and self-reliance. Comparative studies also provide further validation. Kumar et al. (2021) found that entrepreneurship-integrated science curricula improve students' initiative and opportunity-recognition skills. Udo and Ekanem (2021) observed that school-garden projects develop learners' business orientation and practical competencies. Collectively, these findings reinforce that connecting biology content to entrepreneurship strengthens innovation and employability.

Conclusion

Grounded in Human Capital and Experiential Learning theories, the study concluded that effective teaching of plant classification can serve as a catalyst for producing scientifically literate and economically active citizens capable of contributing to sustainable development.

Recommendations

Based on the findings, the following recommendations are made:

Curriculum Integration: The Biology curriculum should explicitly integrate entrepreneurship-oriented activities within plant classification topics. These could include identifying economically valuable plant species, developing mini-herbaria, and organizing school-based botanical exhibitions.

Experiential Learning Strategies: Teachers should adopt project-based and hands-on learning approaches, such as; school gardens, nursery management, and field excursions, to reinforce the practical applications of plant taxonomy.

Teacher Training and Resources: The Ministry of Education and educational agencies should provide regular training for Biology teachers on entrepreneurship pedagogy and supply instructional resources (plant samples, herbarium tools, garden plots) to support experiential learning.

Community and Industry Collaboration: Schools should partner with local agricultural agencies, herbal product companies, and floriculture businesses to expose students to real-world entrepreneurial opportunities derived from plant classification knowledge.

Policy Implementation: Education policymakers should strengthen the entrepreneurship component of science subjects, ensuring that students acquire both scientific literacy and business acumen before graduation.

By implementing these recommendations, secondary schools can transform plant classification instruction into a powerful vehicle for promoting agripreneurial competence, innovation, and sustainable livelihood among Nigerian youths.

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