



# Bridging the Skill Gap in Vocational Agricultural Education: A Heuristic-Based Instructional Intervention for Improving Students' Employability Competencies

Toochukwu Collins Nwakile <sup>1\*</sup> 

<sup>1</sup> Department of Agricultural Education, University of Nigeria, NIGERIA

\* Correspondence: [toochukwu.nwakile@unn.edu.ng](mailto:toochukwu.nwakile@unn.edu.ng)

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## ABSTRACT

The persistent mismatch between the competencies acquired by graduates of vocational agricultural education and the evolving demands of the labour market has remained a critical concern in developing economies, particularly in Nigeria. Despite the strategic role of vocational agricultural education in promoting employability and self-reliance, evidence suggests that many graduates lack the practical, digital, and entrepreneurial skills required for sustainable engagement in the agricultural sector. This study examined the effectiveness of a heuristic-based instructional intervention in enhancing the employability competencies of university students enrolled in agricultural education programmes. A quasi-experimental research design involving pre-test and post-test measures was adopted. The study was conducted among undergraduate students in selected Nigerian universities, with participants exposed to structured heuristic-based learning modules tailored to agribusiness problem-solving and decision-making. Data were collected using a validated employability competency assessment instrument and analysed using mean, standard deviation, and paired t-test statistics. The findings revealed a significant improvement in students' employability competencies following the intervention, particularly in areas of problem-solving, innovation, and practical skill application. The results support the argument that context-driven and strategy-oriented instructional approaches can effectively bridge the gap between theoretical knowledge and workplace expectations. The study recommends the integration of heuristic-based instructional models into vocational agricultural education curricula to enhance graduate readiness for the labour market and promote sustainable agricultural development.

**Keywords:** vocational agricultural education, heuristic-based learning, employability skills, skills gap, agricultural education, Nigeria

## INTRODUCTION

Vocational agricultural education is widely recognised as a critical driver of workforce development, particularly in developing economies where agriculture remains a dominant sector. It is designed to equip learners with practical competencies, entrepreneurial skills, and adaptive capacities required for productive engagement in agricultural value chains. In countries such as Nigeria, vocational agricultural education is expected to contribute significantly to employment generation, food security, and rural transformation (Okoli et al., 2020). This expectation is further reinforced by national education policies that position vocational training as a tool for fostering self-reliance and reducing youth unemployment (Nigerian Educational Research and Development Council, 2013). However, despite these expectations, concerns continue to emerge regarding the extent to which vocational agricultural education fulfils its intended objectives in preparing graduates for the labour market.

The increasing complexity of the global agricultural sector has intensified the demand for a workforce that possesses not only technical knowledge but also transferable skills such as critical thinking, innovation, and 'problem-solving' (Nwakile et al., 2017). Advances in agricultural technologies, including precision farming and digital agriculture, have redefined the competencies required of graduates entering the sector (Lioutas et al., 2021). At the same time, climate change and market uncertainties have introduced new challenges that require adaptive and context-specific decision-making skills (Food and Agriculture Organization of the United Nations [FAO], 2022). Despite these evolving demands, instructional practices within many vocational agricultural education programmes remain largely traditional, with a strong emphasis on theoretical knowledge rather than practical application (Adukaite et al., 2016). This misalignment between training and industry expectations has contributed to growing concerns about graduate preparedness.

Empirical evidence from developing economies indicates that many graduates of vocational and technical education programmes experience difficulties transitioning into the workforce. A significant proportion of graduates are either underemployed or engaged in occupations that are unrelated to their field of study, reflecting a disconnect between acquired competencies and labour market needs (Okoli et al, 2020). In the agricultural sector, this challenge is particularly pronounced, as graduates often lack exposure to modern farming practices, agribusiness management, and digital tools (World Bank, 2015). Furthermore, employers frequently report that graduates are deficient in essential soft skills such as communication, teamwork, and entrepreneurial thinking, which are critical for workplace success (Jackson, 2016). These challenges underscore the need for a re-evaluation of instructional approaches within vocational agricultural education.

One of the key factors contributing to the skills gap in vocational agricultural education is the dominance of teacher-centred pedagogies that limit active student engagement. Traditional lecture-based methods often fail to provide learners with opportunities to apply knowledge in real-life contexts, thereby reducing the effectiveness of skill acquisition (Kolb, 2014). In contrast, contemporary educational approaches emphasise experiential learning, problem-based instruction, and competency-based frameworks that promote active participation and practical application (Biggs & Tang, 2018). These approaches are particularly relevant in vocational education, where the development of practical skills and workplace readiness is paramount. However, the adoption of such innovative instructional strategies remains limited in many educational institutions.

Heuristic-based learning has emerged as a promising instructional approach that focuses on guiding learners through problem-solving processes using simplified strategies and experiential reasoning. This approach enables students to develop cognitive flexibility and practical competence by engaging with real-world problems in structured ways. In applied disciplines such as vocational education, heuristic learning supports the development of decision-making skills and enhances learners' ability to transfer knowledge across contexts (Jonassen, 2017). Moreover, heuristic strategies are particularly useful in environments characterised

by uncertainty and complexity, such as agriculture, where practitioners must continuously adapt to changing conditions (Hmelo-Silver, 2004). Despite its potential, the application of heuristic-based learning within vocational agricultural education remains underexplored.

Given the persistent challenges associated with graduate employability and the limitations of existing instructional approaches, there is a need for evidence-based interventions that can enhance skill acquisition and application. Integrating heuristic-based instructional strategies into vocational agricultural education may provide a viable pathway for bridging the gap between theory and practice. Such an approach aligns with global calls for educational reforms that prioritise competency development and labour market relevance (Organisation for Economic Co-operation and Development [OECD], 2019). It also reflects the growing emphasis on equipping learners with the skills required to navigate complex and dynamic work environments (UNESCO, 2021).

Although previous studies have examined employability skills and vocational training outcomes, limited attention has been given to the application of heuristic-based instructional strategies within vocational agricultural education in the Nigerian context. This study therefore contributes to existing literature by empirically examining how heuristic-guided learning activities may enhance problem-solving, practical, and entrepreneurial competencies among agricultural education students. Unlike many previous employability studies that focused primarily on curriculum outcomes or general vocational training challenges, the present study specifically evaluates the effectiveness of a structured heuristic-based instructional intervention on multiple dimensions of employability competencies. Therefore, this study investigates the effectiveness of a heuristic-based instructional intervention in improving the employability competencies of students in vocational agricultural education programmes.

## Objectives of the Study

The main objective of this study is to examine the effectiveness of a heuristic-based instructional intervention in bridging the skill gap and improving employability competencies among students in vocational agricultural education programmes. Specifically, the study seeks to:

1. Determine the effect of heuristic-based instruction on students' problem-solving skills in vocational agricultural education.
2. Assess the influence of heuristic-based learning on students' practical skill application in agricultural contexts.
3. Evaluate the impact of heuristic-based instruction on students' entrepreneurial competencies in agribusiness.
4. Examine the overall improvement in employability competencies of students exposed to heuristic-based instructional strategies.

## Research Questions

The following research questions guided the study:

1. What is the effect of heuristic-based instruction on students' problem-solving skills in vocational agricultural education?
2. How does heuristic-based learning influence students' practical skill application in agricultural contexts?
3. To what extent does heuristic-based instruction enhance students' entrepreneurial competencies in agribusiness?

#### 4. What is the overall impact of heuristic-based instruction on students' employability competencies?

## Research Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

**H01:** There is no significant difference in the mean scores of students' problem-solving skills before and after exposure to heuristic-based instruction.

**H02:** There is no significant difference in the mean scores of students' practical skill application before and after exposure to heuristic-based instruction.

**H03:** There is no significant difference in the mean scores of students' entrepreneurial competencies before and after exposure to heuristic-based instruction.

**H04:** There is no significant difference in the overall employability competencies of students before and after exposure to heuristic-based instruction.

The following literature and theoretical review provide the conceptual and empirical foundation upon which the study hypotheses were formulated.

## LITERATURE REVIEW

### Concept of Vocational Agricultural Education and Employability Competencies

Vocational agricultural education is fundamentally oriented towards the development of practical skills, technical knowledge, and entrepreneurial capabilities required for effective participation in the agricultural sector. It emphasises hands-on training, problem-solving, and the application of scientific principles to real-life agricultural practices. The primary objective of this form of education is to produce graduates who are not only knowledgeable but also capable of creating employment opportunities for themselves and others (Okoli et al., 2020). In developing economies, vocational agricultural education plays a crucial role in addressing unemployment and enhancing food security by equipping learners with relevant competencies (FAO, 2022). However, the effectiveness of these programmes depends largely on the extent to which they align with labour market expectations and industry needs (World Bank, 2015).

Employability competencies within vocational agricultural education extend beyond technical skills to include a range of transferable abilities such as critical thinking, communication, adaptability, and entrepreneurship. These competencies are increasingly recognised as essential for navigating the complexities of modern agricultural systems. Employers in the agricultural sector now demand graduates who can integrate technological innovations, manage agribusiness ventures, and respond effectively to environmental challenges (Lioutas et al., 2021). Despite this, many educational programmes continue to prioritise theoretical knowledge at the expense of skill application, leading to graduates who are inadequately prepared for the workforce (Jackson, 2016). Recent studies have further shown that employers increasingly expect agricultural graduates to possess digital adaptability, innovation capacity, and enterprise management skills that extend beyond traditional technical competencies (Seti et al., 2025; Oyewole et al., 2025). This gap highlights the need for instructional approaches that promote holistic competency development.

Recent empirical studies have raised concerns about the preparedness of graduates from vocational agricultural education programmes in Nigeria. Evidence suggests that while students acquire foundational knowledge, they often lack the practical and entrepreneurial skills required for meaningful engagement in the

labour market (Ejiofor & Nwakile, 2016). This challenge is further compounded by the limited integration of emerging technologies and industry-relevant practices into the curriculum. Studies have also shown that graduates frequently struggle with applying learned concepts to real-world agricultural problems, which limits their productivity and employability (Nwakile et al., 2026). These findings suggest a pressing need to rethink curriculum design and instructional delivery in agricultural education.

Furthermore, the issue of employability is closely linked to the broader socio-economic context within which vocational education operates. High levels of unemployment and underemployment among graduates reflect structural challenges within both the education system and the labour market. In many cases, graduates resort to self-employment as a survival strategy rather than a deliberate entrepreneurial choice (Ekenta et al., 2026). This trend underscores the importance of equipping students with not only technical skills but also the capacity to innovate and adapt in uncertain environments. Consequently, there is a growing emphasis on educational reforms that focus on competency-based training and labour market alignment (OECD, 2019).

## Skills Gap in Vocational Agricultural Education

The concept of a skills gap refers to the disparity between the competencies possessed by graduates and those required by employers in the labour market. In vocational agricultural education, this gap has become increasingly evident as the demands of the agricultural sector continue to evolve. Technological advancements, climate change, and global market integration have transformed the nature of agricultural work, requiring a workforce that is both technically proficient and adaptable (FAO, 2022). However, many educational programmes have struggled to keep pace with these changes, resulting in graduates who are ill-equipped to meet contemporary industry demands (World Bank, 2015).

One of the major contributors to the skills gap is the outdated nature of curricula in many vocational agricultural education programmes. Traditional curricula often fail to incorporate emerging areas such as digital agriculture, precision farming, and agribusiness management. This limitation restricts students' exposure to modern agricultural practices and reduces their competitiveness in the labour market (Lioutas et al., 2021). Recent evidence also suggests that the growing integration of artificial intelligence and digital technologies into vocational education has intensified the need for instructional models that support adaptive and technology-oriented competencies among learners (Nwakile et al., 2026). In addition, inadequate infrastructure and limited access to practical training facilities further constrain the development of hands-on skills among students (Adukaite et al., 2016). These challenges highlight the need for curriculum reform and investment in educational resources.

Empirical evidence from Nigeria indicates that the skills gap in vocational agricultural education is not only technical but also behavioural. Graduates often lack essential soft skills such as communication, teamwork, and problem-solving, which are critical for workplace success (Jackson, 2016). Studies have also shown that the mismatch between training and labour market needs contributes to graduate unemployment and job dissatisfaction (Nwakile et al., 2025). This situation is exacerbated by the limited involvement of industry stakeholders in curriculum development, which reduces the relevance of educational programmes (Okoli et al, 2020). Addressing these issues requires a more collaborative approach that integrates industry perspectives into educational planning.

In addition to curriculum-related challenges, instructional methods play a significant role in shaping students' competencies. Traditional teaching approaches that emphasise rote learning and passive participation are inadequate for developing the skills required in modern agriculture. Such methods limit students' ability to think critically, solve problems, and apply knowledge in practical contexts (Biggs & Tang, 2018). In contrast, innovative instructional approaches that promote active learning and experiential engagement have been shown to enhance skill acquisition and retention (Kolb, 2014). Therefore, improving instructional practices is essential for bridging the skills gap in vocational agricultural education.

## Heuristic-Based Instruction and Skill Development

Heuristic-based instruction is an educational approach that focuses on guiding learners through problem-solving processes using practical strategies and experiential reasoning. Unlike traditional methods that emphasise memorisation and theoretical understanding, heuristic learning encourages students to actively engage with problems and develop their own solutions. This approach is particularly relevant in vocational education, where the ability to apply knowledge in real-world contexts is essential. By breaking down complex problems into manageable steps, heuristic strategies enable learners to develop confidence and competence in their skills (Jonassen, 2017).

In recent years, heuristic-based learning has gained attention as a means of enhancing students' cognitive and practical abilities. Research has shown that this approach improves learners' problem-solving skills, critical thinking, and ability to transfer knowledge across different contexts (Hmelo-Silver, 2004). In applied disciplines such as agriculture, where practitioners must deal with uncertainty and variability, heuristic learning provides a flexible framework for decision-making (FAO, 2022). This makes it a valuable tool for preparing students for the challenges of the agricultural sector.

The effectiveness of heuristic-based instruction has been demonstrated in various educational settings, particularly in fields that require applied knowledge and practical skills. Studies have shown that students exposed to heuristic learning strategies perform better in problem-solving tasks and exhibit higher levels of engagement and motivation (Taja-on & Roble, 2025). Similarly, contemporary instructional intervention studies have demonstrated that learner-centred and experiential approaches contribute significantly to competence development, teamwork abilities, and employability readiness among students in applied disciplines (D'Isanto et al., 2022; Seti et al., 2025). These outcomes suggest that heuristic-based instruction can play a significant role in enhancing employability competencies among students. However, there is limited research on its application within vocational agricultural education, particularly in the Nigerian context.

Given the potential of heuristic-based learning to improve skill acquisition and application, its integration into vocational agricultural education warrants further investigation. This approach aligns with contemporary educational trends that emphasise learner-centred instruction and competency development. It also addresses the limitations of traditional teaching methods by providing students with opportunities to engage in meaningful learning experiences. Therefore, this study seeks to explore the effectiveness of heuristic-based instructional intervention in bridging the skills gap and enhancing employability competencies among students in vocational agricultural education.

## THEORETICAL FRAMEWORK

This study is anchored on Constructivism Theory and Prosser's Sixteen Theorems of Vocational Education. These theories provide a comprehensive foundation for understanding how learners acquire, apply, and transfer skills within vocational agricultural education, particularly in relation to employability competencies.

### Constructivism Theory

Constructivism theory posits that learning is an active process in which learners construct knowledge through experience, interaction, and reflection. Rather than passively receiving information, learners actively engage with their environment to build understanding based on prior knowledge and new experiences (Bruner, 1966). This perspective emphasises learner-centred instruction, problem-solving, and contextual learning, all of which are critical in vocational education settings (Fosnot, 2013). In the context of agricultural education, constructivism supports the idea that students develop meaningful competencies when they are exposed to real-life agricultural problems and guided to generate solutions.

The relevance of constructivism to this study lies in its emphasis on experiential and applied learning. Vocational agricultural education requires students to integrate theoretical knowledge with practical skills in dynamic and often unpredictable environments. Constructivist learning environments encourage learners to explore, experiment, and reflect, thereby enhancing their ability to apply knowledge in real-world situations (Vygotsky, 1978). This approach aligns with the need to develop employability competencies such as critical thinking, adaptability, and problem-solving among students.

Empirical studies have demonstrated that constructivist-based instructional approaches improve students' engagement, retention, and transfer of learning. Learners exposed to active and contextualised learning environments tend to develop deeper understanding and are better equipped to apply their knowledge in practical contexts (Hmelo-Silver, 2004). In vocational agricultural education, this translates into improved competence in handling agricultural tasks, making decisions, and adapting to changing conditions (Kolb, 2014). These outcomes are essential for bridging the gap between classroom learning and workplace expectations.

Furthermore, constructivism provides a strong foundation for heuristic-based learning, which is central to this study. Heuristic instruction encourages learners to develop strategies for solving problems rather than relying solely on memorised procedures. This aligns with the constructivist principle that knowledge is constructed through active engagement and reflection (Jonassen, 2017). By integrating heuristic strategies into instruction, students are guided to think critically and develop practical solutions to agricultural challenges.

### *Prosser's Sixteen Theorems of Vocational Education*

Prosser's Sixteen Theorems of Vocational Education provide a foundational framework for understanding the effectiveness of vocational training. The theory emphasises that vocational education is most effective when the training environment closely replicates the actual work environment (Prosser & Quigley, 1950). This principle highlights the importance of realism and relevance in instructional design, particularly in fields such as agriculture, where practical application is crucial.

One of the central tenets of Prosser's theory is that vocational education must develop habits, skills, and thinking patterns that are directly applicable to the workplace. This implies that instructional methods should focus on hands-on training, problem-solving, and the use of tools and techniques that mirror real-world practices (Finch & Crunkilton, 1999). In the context of vocational agricultural education, this means exposing students to authentic agricultural scenarios and equipping them with the competencies required for effective performance in the field.

The theory also emphasises that vocational training is effective only when learners are taught in ways that reflect the conditions under which they will work. This includes the use of real-life problems, industry-relevant tools, and practical experiences that prepare students for employment (Okoli et al, 2020). When these conditions are not met, there is a high likelihood of a mismatch between training and job requirements, resulting in reduced employability of graduates. This aligns with the observed skills gap in vocational agricultural education.

In relation to this study, Prosser's theorems provide a justification for the use of heuristic-based instructional strategies. Heuristic learning creates simulated real-world problem-solving environments that enable students to develop practical competencies. By engaging students in tasks that resemble actual agricultural challenges, heuristic instruction enhances their readiness for the labour market. This approach ensures that learning is not only theoretical but also directly applicable to workplace situations.

### *Integration of Theories into the Study*

The integration of Constructivism Theory and Prosser's Sixteen Theorems provides a robust framework for understanding how heuristic-based instruction can improve employability competencies. While

constructivism emphasises active learning and knowledge construction, Prosser's theory focuses on the alignment between training and workplace realities. Together, these theories highlight the importance of experiential, contextual, and practice-oriented learning in vocational education.

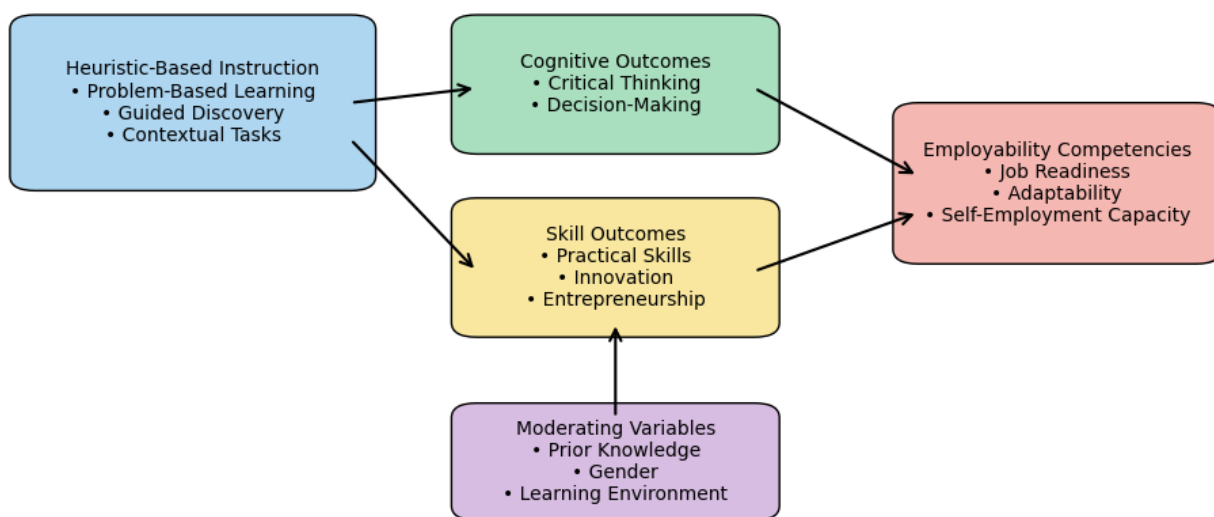
In this study, heuristic-based instructional intervention serves as the bridge between these theoretical perspectives. It creates a learning environment where students actively construct knowledge through problem-solving while simultaneously engaging in tasks that reflect real-world agricultural practices. This dual approach enhances both cognitive and practical competencies, thereby improving students' employability.

The framework suggests that when students are exposed to heuristic-based learning within a constructivist and practice-oriented environment, they are more likely to develop relevant skills that align with labour market demands. This leads to improved problem-solving abilities, practical skill application, and entrepreneurial competencies. Consequently, the integration of these theories supports the central argument of this study that innovative instructional strategies are essential for bridging the skills gap in vocational agricultural education.

## CONCEPTUAL FRAMEWORK

**Figure 1** presents a conceptual framework illustrating the directional relationships between heuristic-based instructional strategies and students' employability competencies in vocational agricultural education. The model identifies heuristic-based instruction as the independent variable, represented in blue, and operationalised through problem-based learning, guided discovery, and contextualised instructional tasks. Arrows originating from this construct indicate its direct influence on two mediating variables: cognitive outcomes and skill outcomes. The directional arrows emphasise that instructional strategies actively drive both cognitive development and practical skill acquisition.

Cognitive outcomes, which include critical thinking and decision-making abilities, are positioned as higher-order mental processes that enable students to analyse and respond to complex agricultural problems. Skill outcomes, on the other hand, represent applied competencies such as practical agricultural skills, innovation, and entrepreneurial capabilities. The dual pathways highlight that both domains independently contribute to students' overall competence. Both mediating constructs are linked through directional arrows to employability competencies, which serve as the dependent variable.



**Figure 1.** Schematic representation of the conceptual framework (Source: Author's own summary of reviewed literature)

This indicates that improvements in cognitive and skill domains translate into enhanced job readiness, adaptability, and self-employment capacity among graduates. The framework further incorporates moderating variables, including prior knowledge, gender, and learning environment. The upward arrow from this construct signifies its influence on the relationship between instructional strategies and learning outcomes, suggesting that these factors may strengthen or weaken the effectiveness of heuristic-based instruction.

## METHODOLOGY

### Research Design

This study adopted a quasi-experimental research design, specifically the one-group pre-test and post-test design, to examine the effect of heuristic-based instructional intervention on students' employability competencies in vocational agricultural education. The design was considered appropriate because it allows for the measurement of changes in participants' competencies before and after exposure to the instructional intervention. Quasi-experimental designs are widely used in educational research where random assignment is not feasible due to institutional constraints (Creswell, 2018). The design also enables researchers to establish causal inferences by comparing pre-intervention and post-intervention outcomes (Ary et al., 2019). In this study, students were assessed prior to the intervention, exposed to heuristic-based instructional strategies, and then re-assessed to determine the extent of improvement in their competencies.

### Area of the Study

The study was conducted in universities offering vocational agricultural education programmes in South-East Nigeria. The region was selected due to its strong presence of agricultural education institutions and its relevance to agricultural production and rural development. South-East Nigeria is characterised by a high level of youth participation in agriculture and related activities, making it a suitable context for examining employability competencies (National Bureau of Statistics, 2023). The choice of universities in this region also reflects accessibility and the researcher's familiarity with the academic environment. Furthermore, the institutions selected have established agricultural education programmes with structured curricula, providing an appropriate setting for implementing instructional interventions.

### Population of the Study

The population of the study comprised all undergraduate students enrolled in vocational agricultural education programmes in selected universities in South-East Nigeria. These students are considered appropriate for the study because they are at the stage of acquiring both theoretical knowledge and practical skills required for employment. Vocational education students are expected to develop competencies that align with labour market demands, making them a relevant population for examining employability outcomes (Okoli et al, 2020). The population included students across different levels of study, ensuring a comprehensive representation of learners within the programme.

### Sample Size and Sampling Technique

The sample size for the study was determined using Taro Yamane's formula for finite populations:  $n = N / (1 + N(e)^2)$

Where:

n = sample size

N = population size

e = level of significance (0.05)

Based on an estimated population of 300 students across the selected universities, the calculated sample size was approximately 171 students. This sample size is considered adequate for ensuring statistical reliability and generalisability of findings (Yamane, 1967). A multi-stage sampling technique was employed for the study. First, purposive sampling was used to select universities offering vocational agricultural education programmes. Second, simple random sampling was used to select participants from the identified institutions. This approach ensured that all students had an equal chance of being selected while maintaining the relevance of the sample to the study objectives (Etikan & Bala, 2017). A total of 171 students were initially selected and participated in the pre-test phase of the study. All selected participants completed the instructional intervention and participated in the post-test assessment, resulting in no attrition during the study period.

## Instrument for Data Collection

Data for the study were collected using a structured instrument titled Employability Competency Assessment Questionnaire (ECAQ). The instrument was specifically developed by the researcher following an extensive review of literature on employability skills, vocational education competencies, and agricultural skill requirements (Jackson, 2016; Lioutas et al., 2021). The development process involved three stages: identification of key competency domains, generation of items based on real-life agricultural contexts, and refinement of items to ensure clarity and relevance.

The instrument comprised two main sections. Section A elicited demographic information such as gender, level of study, and prior exposure to agricultural training. Section B consisted of 30 items structured on a 5-point Likert scale ranging from Strongly Agree (5) to Strongly Disagree (1). The items were distributed across three sub-dimensions of employability competencies as follows:

*Problem-solving skills (10 items):* focused on students' ability to analyse agricultural problems, generate solutions, and make informed decisions. Sample item includes: "I can identify practical solutions to challenges encountered in agricultural production."

*Practical skill application (10 items):* measured students' ability to apply theoretical knowledge in real-life agricultural tasks. Sample item includes: "I can effectively apply classroom knowledge during field-based agricultural activities."

*Entrepreneurial competencies (10 items):* assessed students' capacity for innovation, opportunity recognition, and agribusiness decision-making. Sample item includes: "I can identify viable agribusiness opportunities within my local environment."

All items were contextually framed to reflect realistic agricultural scenarios in order to enhance ecological validity and ensure that responses accurately represent students' competencies in practical settings. The structure of the instrument ensured comprehensive coverage of the constructs under investigation while maintaining clarity and ease of response for participants.

## Validation of the Instrument

The instrument was subjected to face and content validation by three experts in agricultural education and two experts in measurement and evaluation. The validators examined the instrument for clarity, relevance, appropriateness of language, and alignment with the objectives of the study. Their observations and suggestions were used to modify ambiguous items and improve the overall structure of the instrument.

In addition, exploratory examination of the instrument structure showed that the items clustered appropriately under the three competency domains of problem-solving skills, practical skill application, and entrepreneurial competencies, indicating acceptable construct representation of the measured variables.

Inter-subscale correlation analysis further revealed moderate positive relationships among the three competency domains, suggesting that the subscales were related but conceptually distinct measures of employability competencies.

## Reliability of the Instrument

The reliability of the instrument was determined using the Cronbach Alpha method. A pilot test was conducted with 30 students who were not part of the main study. Responses obtained from the pilot administration were analysed using SPSS Version 25 to determine the internal consistency of the instrument. The overall Cronbach Alpha reliability coefficient for the Employability Competency Assessment Questionnaire (ECAQ) was 0.87, indicating a high level of internal consistency. The subscale reliability coefficients were 0.84 for problem-solving skills, 0.81 for practical skill application, and 0.85 for entrepreneurial competencies. These values exceeded the minimum acceptable reliability threshold of 0.70 recommended for educational and behavioural research (Taber, 2018).

In addition, inter-subscale correlations ranged from 0.56 to 0.71, indicating moderate relationships among the competency dimensions without evidence of redundancy. These results suggest that the instrument possessed acceptable reliability for measuring employability competencies among students in vocational agricultural education.

## Procedure for Data Collection

The data collection process involved three major stages: pre-intervention, intervention, and post-intervention. In the pre-intervention stage, the ECAQ was administered to participants to establish baseline data on their employability competencies. The intervention stage involved the implementation of heuristic-based instructional strategies over a period of six weeks. The instructional content was drawn from core areas of vocational agricultural education, including crop production, agribusiness management, and sustainable farming practices. These content areas were carefully selected to reflect real-world agricultural challenges and align with the competencies being measured.

The heuristic-based instruction was delivered through structured learning activities designed to guide students in solving practical problems. These activities included problem-based tasks, guided discovery exercises, case analyses, and small-group discussions. For instance, students were presented with scenarios such as pest infestation in crops, farm resource allocation, and market decision-making in agribusiness. They were then guided through step-by-step problem-solving processes, including problem identification, generation of alternative solutions, evaluation of options, and selection of the most viable solution.

The roles and responsibilities of participants were clearly defined to ensure effective implementation. The researcher coordinated the overall intervention, developed instructional materials, and monitored the implementation process. The course lecturers (facilitators) were responsible for delivering the instructional activities, guiding students through heuristic processes, and providing feedback during learning sessions. The students (participants) actively engaged in the learning process by analysing problems, participating in discussions, collaborating in groups, and applying learned strategies to solve practical agricultural tasks.

The instructional sessions were conducted twice weekly, with each session lasting approximately 90 minutes. During each session, facilitators introduced a problem scenario, guided students through heuristic questioning techniques, and encouraged reflective thinking. Emphasis was placed on student-centred learning, where learners were encouraged to explore multiple solutions rather than rely on predetermined answers.

To ensure consistency in implementation, a structured instructional guide was developed and used across all sessions. This guide outlined the sequence of activities, expected learning outcomes, and facilitation strategies. Regular monitoring was carried out by the researcher to ensure adherence to the instructional model. At the end of the six-week intervention, the ECAQ was re-administered as a post-test to measure changes in students' employability competencies. This procedure ensured consistency in measurement and enabled accurate comparison between pre-test and post-test results.

## Method of Data Analysis

Data collected from the study were analysed using both descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, providing insights into the level of students' competencies before and after the intervention. The hypotheses were tested using paired sample t-test at a 0.05 level of significance. The choice of paired t-test was based on its suitability for comparing the means of two related groups, in this case, pre-test and post-test scores (Field, 2018). Prior to hypothesis testing, the normality of the difference scores was assessed using the Shapiro–Wilk test and inspection of skewness and kurtosis values. The results indicated that the data did not significantly violate the assumption of normality. Statistical analysis was subsequently carried out using the Statistical Package for the Social Sciences (SPSS), ensuring accuracy and reliability of results.

Although multiple paired sample t-tests were conducted across the competency domains, the analyses were guided by distinct research objectives and hypotheses. To minimise the risk of inflated Type I error, the interpretation of results considered both statistical significance and effect size estimates.

## RESULTS

### Research Question 1: What is the Effect of Heuristic-Based Instruction on Students' Problem-Solving Skills in Vocational Agricultural Education?

The results in **Table 1** indicate a noticeable improvement in students' problem-solving skills following exposure to heuristic-based instructional strategies. The mean score increased from 2.84 in the pre-test to 3.96 in the post-test, suggesting that students developed stronger abilities in analysing and solving agricultural problems. The reduction in standard deviation from 0.62 to 0.54 further indicates that students' performance became more consistent after the intervention. This implies that heuristic-based instruction not only improved overall performance but also reduced disparities among learners.

### Research Question 2: How Does Heuristic-Based Learning Influence Students' Practical Skill Application in Agricultural Contexts?

**Table 2** shows that heuristic-based learning had a significant positive effect on students' practical skill application. The mean score increased from 2.91 in the pre-test to 4.08 in the post-test, indicating that students became more proficient in applying agricultural knowledge in real-life contexts. The decrease in standard deviation from 0.58 to 0.49 suggests improved uniformity in skill acquisition among students. This finding highlights the effectiveness of heuristic strategies in promoting hands-on learning and practical competence.

**Table 1.** Mean and Standard Deviation of Students' Problem-Solving Skills (Pre-test and Post-test)

Group	N	Mean ( $\bar{x}$ )	SD
Pre-test	171	2.84	0.62
Post-test	171	3.96	0.54

**Table 2.** Mean and Standard Deviation of Students' Practical Skill Application

Group	N	Mean ( $\bar{x}$ )	SD
Pre-test	171	2.91	0.58
Post-test	171	4.08	0.49

**Table 3.** Mean and Standard Deviation of Students' Entrepreneurial Competencies

Group	N	Mean ( $\bar{x}$ )	SD
Pre-test	171	2.76	0.61
Post-test	171	3.88	0.53

**Table 4.** Mean and Standard Deviation of Overall Employability Competencies

Group	N	Mean ( $\bar{x}$ )	SD
Pre-test	171	2.84	0.60
Post-test	171	3.97	0.51

### Research Question 3: To What Extent Does Heuristic-Based Instruction Enhance Students' Entrepreneurial Competencies in Agribusiness?

The data in **Table 3** reveal that heuristic-based instruction contributed to a marked improvement in students' entrepreneurial competencies. The mean score rose from 2.76 in the pre-test to 3.88 in the post-test, indicating enhanced ability in identifying business opportunities and making agribusiness decisions. The reduction in standard deviation suggests that students' entrepreneurial understanding became more consistent after the intervention. This demonstrates that heuristic learning supports the development of innovation and enterprise skills among learners.

### Research Question 4: What is the Overall Impact of Heuristic-Based Instruction on Students' Employability Competencies?

**Table 4** presents the overall impact of heuristic-based instruction on employability competencies. The results show a substantial increase in the mean score from 2.84 to 3.97, indicating that students became more employable after the intervention.

The lower standard deviation in the post-test suggests greater consistency in students' competencies. This finding suggests that heuristic-based instructional strategies may be effective in enhancing the overall readiness of students for the labour market.

## Test of Hypotheses

The results in **Table 5** indicate that there are significant differences between the pre-test and post-test mean scores across all measured variables. The calculated t-values for problem-solving skills, practical skills, entrepreneurial competencies, and overall employability competencies are all high, indicating strong effects of the intervention. Therefore, all the null hypotheses are rejected. This implies that heuristic-based instructional strategies had a significant positive impact on students' competencies.

**Table 5.** Paired Sample t-test Analysis of Students' Employability Competencies

Variable	Mean Difference	t-value	df	Cohen's d	Decision
Problem-solving skills	1.12	18.45	170	1.41	Significant
Practical skills	1.17	19.02	170	1.45	Significant
Entrepreneurial competencies	1.12	17.88	170	1.37	Significant
Employability competencies	1.13	18.76	170	1.43	Significant

The effect size estimates (Cohen's  $d$ ) indicate that the heuristic-based instructional intervention had large practical effects across all competency domains. According to Cohen's (1988) benchmark for interpreting effect sizes, values above 0.80 represent large effects. The observed effect sizes, therefore, suggest that the improvements recorded were not only statistically significant but also educationally meaningful.

## DISCUSSION

The findings of this study revealed that heuristic-based instructional strategies were associated with significant improvements in students' problem-solving skills in vocational agricultural education. This outcome suggests that when learners are actively engaged in structured problem-solving tasks, they develop stronger analytical and decision-making abilities. The improvement observed aligns with the principles of constructivist learning, which emphasise active knowledge construction through experience and interaction (Bruner, 1966). It also supports earlier findings that learner-centred instructional approaches enhance cognitive development and critical thinking among students (Hmelo-Silver, 2004). Furthermore, the result corroborates previous studies indicating that innovative teaching methods can improve students' engagement and academic performance in vocational education (Nwachukwu et al., 2020).

The study also found that heuristic-based instruction was associated with improvements in students' practical skill application. This indicates that exposing students to real-life agricultural scenarios enhances their ability to transfer theoretical knowledge into practice. The result is consistent with experiential learning theory, which posits that knowledge is best acquired through active participation and reflection (Kolb, 2014). It also aligns with research showing that practical and context-based learning approaches improve skill acquisition and retention among learners (Biggs & Tang, 2018). In addition, the finding supports earlier work highlighting the importance of hands-on training in enhancing the competence of agricultural education students.

In terms of entrepreneurial competencies, the findings revealed notable improvements among students exposed to heuristic-based instruction. This suggests that heuristic learning not only enhances technical skills but also fosters innovation and entrepreneurial thinking. The result is in line with studies indicating that problem-based and strategy-oriented learning approaches promote entrepreneurial mindset and opportunity recognition among students (Jonassen, 2017). It also supports the argument that vocational education should focus on equipping learners with the skills required for self-employment and business creation (OECD, 2019). Moreover, this finding is consistent with previous research showing that agricultural education can play a vital role in developing entrepreneurial competencies when appropriate instructional strategies are employed (Nwakile et al., 2026).

The overall findings of the study showed that heuristic-based instructional strategies were associated with significant improvements in students' employability competencies. This indicates that the integration of innovative teaching approaches can effectively bridge the gap between classroom learning and labour market expectations. The result supports Prosser's assertion that vocational education is most effective when training reflects real-world work conditions (Prosser & Quigley, 1950). It also aligns with global perspectives that emphasise the importance of competency-based education in improving graduate employability (World Bank, 2015). Furthermore, the finding reinforces earlier studies highlighting the need for curriculum and instructional reforms to address the persistent mismatch between education and employment outcomes (Ekenta et al., 2026).

Another important implication of the findings is the role of instructional innovation in addressing systemic challenges within vocational agricultural education. The improvement observed across all competency domains suggests that the skills gap is not solely a structural issue but can also be addressed through effective teaching strategies. This aligns with research indicating that pedagogical approaches significantly influence learning outcomes and skill development (Jackson, 2016). It also supports the view that integrating emerging

approaches such as heuristic learning can enhance the relevance of vocational education programmes (Lioutas et al., 2021). In addition, the findings are consistent with previous studies that emphasise the need for continuous curriculum improvement to meet the demands of a changing labour market (Nwakile et al., 2025).

An important implication of the findings is the practical significance of the observed improvements across the competency domains. The increase in students' mean competency scores from approximately 2.8 in the pre-test to about 4.0 in the post-test suggests substantial improvement in students' perceived readiness for problem-solving, practical agricultural tasks, and entrepreneurial engagement. Furthermore, the large effect size estimates recorded across all domains indicate that the intervention produced educationally meaningful outcomes beyond statistical significance. These findings are comparable with previous instructional intervention studies that reported strong improvements in learner engagement, teamwork, and applied competencies following learner-centred and experiential teaching approaches (D'Isanto et al., 2022; Seti et al., 2025). However, alternative explanations such as increased motivation arising from study participation, familiarity with assessment procedures, or repeated exposure to instructional activities may also have contributed to the observed gains. Consequently, while the findings provide evidence supporting the potential value of heuristic-based instructional approaches, the results should be interpreted within the methodological limitations of the study design.

Overall, the discussion highlights that heuristic-based instructional strategies provide a viable pathway for improving students' competencies and enhancing their readiness for employment. The findings demonstrate that when students are actively engaged in problem-solving and practical tasks, they develop both cognitive and technical skills required for success in the agricultural sector. This supports the growing call for educational reforms that prioritise innovation, skill development, and labour market alignment (UNESCO, 2021). It also reinforces the argument that vocational agricultural education must evolve to remain relevant in a rapidly changing world (FAO, 2022). Therefore, adopting heuristic-based instructional approaches may contribute to bridging the skills gap and improving employability outcomes among graduates within similar educational contexts.

## Limitations of the Study

Despite the positive outcomes observed in this study, certain limitations should be acknowledged. First, the study employed a one-group quasi-experimental design without a control group, which limits the strength of causal interpretations. Although improvements were observed after the heuristic-based instructional intervention, other factors such as maturation, repeated testing exposure, and increased participant motivation may also have contributed to the changes recorded.

In addition, the study relied on self-reported responses obtained through the Employability Competency Assessment Questionnaire (ECAQ). Consequently, responses may have been influenced by social desirability bias and participants' subjective perceptions of their competencies. Although preliminary construct representation was examined through expert validation and inter-subscale relationships, advanced validation procedures such as exploratory or confirmatory factor analysis were not conducted and may be considered in future studies.

Furthermore, the study was conducted among students in selected universities within South-East Nigeria. Therefore, the findings may not be fully generalisable to vocational agricultural education programmes in other geopolitical zones or educational contexts. Information regarding participant attrition and long-term retention of competencies was also limited because the study focused primarily on immediate post-intervention outcomes. Despite these limitations, the study provides important insights into the potential value of heuristic-based instructional approaches in enhancing employability-related competencies among students in vocational agricultural education

# IMPLICATIONS

## Educational Implications

The findings of this study have important implications for vocational agricultural education in universities and other tertiary institutions. The observed improvements in students' problem-solving abilities, practical skill application, and entrepreneurial competencies suggest that heuristic-based instructional approaches may enhance the effectiveness of vocational training programmes. This indicates the need for a shift from predominantly teacher-centred instructional methods towards learner-centred and competency-based approaches that encourage active participation, experiential learning, and real-world problem-solving. Integrating heuristic learning activities into vocational agricultural education curricula may therefore contribute to improving graduate employability and labour market readiness.

The study also highlights the importance of aligning instructional practices with the evolving demands of modern agriculture. Contemporary agricultural systems increasingly require graduates who possess not only technical knowledge but also adaptive thinking, innovation capacity, and decision-making skills. Consequently, vocational agricultural education programmes may need to incorporate more contextualised and practice-oriented learning experiences capable of preparing students for technologically driven and dynamic agricultural environments.

## Teacher Training Implications

The findings further suggest important implications for teacher preparation and professional development in vocational agricultural education. Since heuristic-based instruction relies heavily on facilitation, guided inquiry, and problem-solving techniques, educators require adequate pedagogical training to effectively implement such instructional approaches. This underscores the need for universities, teacher education institutions, and educational administrators to organise continuous professional development programmes focusing on learner-centred methodologies, heuristic learning strategies, and competency-based instruction.

In addition, the increasing integration of digital technologies into agriculture implies that educators must also develop competencies in digital agricultural education and technology-supported teaching practices. Strengthening teachers' instructional capacity in areas such as digital farming tools, precision agriculture, and technology-enhanced learning may improve the relevance and effectiveness of vocational agricultural education programmes in preparing students for emerging workplace realities.

## Industry and Policy Implications

The study also has implications for educational policy and industry collaboration. The findings suggest that stronger partnerships between universities, agricultural industries, agribusiness organisations, and technology-driven farming enterprises may enhance the alignment between educational training and labour market expectations. Such collaborations may provide students with greater exposure to real-world agricultural practices, emerging technologies, and workplace competencies required within the agricultural sector.

Furthermore, policymakers and curriculum planners may consider integrating heuristic-based and experiential instructional strategies into vocational education policies and curriculum frameworks. Emphasis on employability competencies, innovation, entrepreneurship, and digital adaptability may contribute to reducing graduate unemployment and improving workforce preparedness within the agricultural sector. The study therefore contributes to existing literature by extending heuristic-based instructional research into vocational

agricultural education within the Nigerian context, where empirical studies on instructional interventions and employability competencies remain relatively limited.

## CONCLUSION

This study examined the effectiveness of heuristic-based instructional strategies in bridging the skill gap and improving employability competencies among students in vocational agricultural education. The findings indicate that heuristic-based instruction is associated with significant improvements in students' problem-solving abilities, practical skill application, entrepreneurial competencies, and overall employability readiness. These outcomes indicate that instructional strategies play a crucial role in shaping the competencies of graduates and their preparedness for the labour market.

The results highlight the limitations of traditional teaching approaches that emphasise theoretical knowledge without sufficient opportunities for application. In contrast, heuristic-based learning provides a more dynamic and engaging learning environment that encourages active participation, critical thinking, and real-world problem-solving. This approach not only improves students' understanding but also equips them with the skills required to navigate the complexities of modern agricultural systems.

Furthermore, the study reinforces the importance of aligning educational practices with labour market demands. The improvement observed in students' competencies suggests that the skills gap in vocational agricultural education can be effectively addressed through instructional innovation. By integrating heuristic-based strategies into the curriculum, vocational agricultural education programmes may enhance the relevance and effectiveness of their instructional practices.

Overall, the study concludes that heuristic-based instructional intervention is a viable and effective approach for improving employability outcomes among students in vocational agricultural education. It provides empirical evidence that supports the need for pedagogical reforms aimed at bridging the gap between education and employment.

## RECOMMENDATIONS

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

1. Universities offering vocational agricultural education programmes should consider integrating heuristic-based instructional strategies into vocational agricultural education curricula to enhance students' practical and employability skills.
2. Teachers and lecturers should be trained on the use of innovative instructional approaches, particularly heuristic and problem-based learning methods, to improve teaching effectiveness.
3. Institutions should provide more opportunities for hands-on training, fieldwork, and real-life agricultural problem-solving activities to strengthen students' practical competencies.
4. Universities should collaborate with agricultural industries and stakeholders to ensure that training programmes are aligned with current labour market needs and technological advancements.
5. Future studies should explore the long-term impact of heuristic-based instruction on graduate employability and extend the research to other regions and disciplines.

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**AI statement:** The author used ChatGPT for proofreading and to improve fluency. After using the AI tool, I reviewed and verified the final version of the work. I, as the author, take full responsibility for the content of the published work.

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