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Competencies in Edible Insects Production for Training of Vocational Agricultural Education Students in Kogi State

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Abstract

In an effort to meet up with animal nutrient shortfall and ever increasing human populacewhile managing the attendant health challenges of meat consumption, various unconventional sources of nutrients, exceptionally micro-livestock, has been recommended to form integral part of the nation's traditional farming system and consumption. Therefore, thefarming and consumption of edible insects are seen as an essential tool in improving the

animal nutrient supply in the country.This study therefore aimed at identifying the competencies required in the production of edible insects to train the students of Vocational Agricultural Education (VAE) for considerable economic empowerment post graduation. Thisstudy adopted a survey research design implemented on a population of 104 respondents. It was found that VAE students required all the competencies identified in the entomological literacy, housing, planning, and maintenance of edible insects for economic empowerment psotgraduation. The finding of the test of hypotheses showed no significant difference ($p>0.05$) in the respondents' mean responses on the entomological literacy, housing, planning, and maintenance competencies needed in the production of edible insects. From this findings, it was therefore recommended that all the identified competencies of edible insect production be applied in the training of VAE students.

Keywords: Edible insects, competencies, economic empowerment, training, Vocational Agricultural Education students

1. Introduction

There is global evidence that as a potential supply of protein, safe to eat (edible) insects are becoming generally accepted for food and feeds despite their ill-disposed appearance. The eatable forms of edible insects are the most sustainable animal protein sources for addressing the global food (protein) demand (van Huis et al., 2017; FAO, 2013). Dangles and Casas (2019) noted that edible insect production contributes to the attainment of 17 various sustainable development goals with respect to zero hunger potential. Therefore, domesticating certain species of edible insect under conducive environmental conditions is efficient to boost proteins and other micronutrients' availability for global market values.

Thoughtful domestication of edible insects leads to increase growth rates, and higher feed efficiency and the insect become more tolerant to handling by humans in crowded conditions.Consequently, as it were just those insect species with ideal characteristics like taste, resistance to disease, manageability, efficiency, and nutritional composition are expected to be gainful for farmers(Lecocq, 2019).

According to Liceaga (2021), the global market value for edible insects would keep soaring to above $1.2 billion by the year 2023. Hence, venturing into edible insects' production is an attractive source of livelihood for women and children, because insects are easier to handle and their care is not time-consuming (FAO, 2013). Presently, the conventional species of edible insects available in world market are those from the wild (FAO, 2013), whereas just about five to ten of them from about 2100 species are domesticated (Jongema, 2017).

According to the European Union (EU) Regulation on novel foods (2015) and US food regulations, incoporating insect-based foods into human diets is massively gaining ground so insect farming should be in high gear to meet customers' demand instead of depending on the wild sources that are not generally accepted. However, in Africa including Nigeria, edible insects widely consumed by people and livestock are majorly harvested from the wild (Jongema, 2017). This implies that full utilization of edible insects is not yet achieved in Nigeria not to talk of supplying the global markets where demands are higher. To offer edible

insects for global recognition, the over-dependence on wild collection should be discontinued to pave way for raising more insect farmers that would align with its globally accepted domestication system. This would curb the over-collection of wild insects, increase insect populations, propagate insect species, and improve environmental conditions (van Huis et al., 2017). Therefore, edible insect farmers require some competencies to manage insect farms efficiently to maximize insects' performance in terms of good health, growth, and output.

A bunch of competencies that have to do with the knowledge, attitudes, skills, and practice acquirable by individuals to influence the main part of edible insect production are indispensable to the success of this venture (Pang et al., 2018). Within the setting of this study, competencies are the understanding, skills, and expertise required within the awareness, housing, feeding, and maintenance of captive edible insects to offer a feasible elective source of animal protein within the count calories of man and other animals.

Therefore, production of edible insects needs to be practically taught in Colleges of Education and Universities offering Vocational Agricultural Education (VAE) so that students can gain a rudimentary knowledge of edible insect production. However, the VAE students lack practical skills in the identified edible insect species, as the current curriculum of instruction does not cover such training. In addition, the dominant lecture method of teaching witnessed in preparing VAE students does not improve students' skills acquisition concerning exploring other insect production that ends in the graduation of unskilled students in the production of insects.

VAE is an advanced arrangement of items, events, actions, and activities which at any educational levelinvolved in the impartation of agricultural knowledge, skills, and attitudes to students, especially at Colleges of education or Universities (Ekele et al., 2020). Ukonze et al. (2009) noted that the VAE equips the students with proficiencies in education and practical areas of agriculture whuch are intended to help VAE students to establish insect farms after graduation and tap into the numerous benefits of edible insect farming with other farmers in Kogi-east agricultural zones. Insect farmers in Kogi-east agricultural zones of Kogi state receive updated information on insect farming from agricultural extension workers (AEWs) in the zones. Usually, AEWs transmit agricultural innovationsas well as train local farmers on the superlative means to embrace the innovative practices, they also form important links between research institutions and farmers (Mansoor et al., 2007). Since AEWs train rural farmers on what they know, lecturers in animal science also instruct students about insecthusbandry. Lecturers in animal science are knowledgeable both practically and theoretically about the welfare, growth, behaviour, nutrition, genetics, reproduction, and health of mini-livestock such as insects, which they impart to the students who directly or indirectlyexplore mini-livestock production or services for livelihood after graduation. In the same manner, edible insect farmers require some competencies to manage insect farms efficiently to maximize insects' performance in terms of good health, growth, and output.

1.1 Study Context

VAE students in Nigeria are able individuals who enroll formally to study and acquire skills, awareness, values, and attitude in the production and processing of goods, marketing of

agricultural and other allied products at tertiary levels (Amadi et al., 2020). Hence, students of VAE systematically undergo vocational programmes of school instruction meant for student teachers to improve their agricultural methods by acquiring knowledge, skills, and interest to set up and manage agricultural farms after school for massive food supply. In any case, Osinem et al. (2010) kept up that there are developing concerns among agrarian industrialists that the understudies of VAE needed satisfactory competencies required for progression in agrarian businesses and for sel-engagements. Ekele et al. (2020) observed that students of VAE in Nigeria facechallenges of rearing and formulating feeds for livestock, raising nurseries for crops and are ineffective in crop and animal husbandry due to over concentration of theory mode of course delivery. This background makes the VAE students unable to match up with the requirements of the reality at work and the socio-economic development of Nigeria (Ademu et al., 2018). The persistent behaviour of VAE students shying away from agricultural engagements in Nigeria due to incompetencies obstructs their productive inputs in mini-livestock production (Isiwu et al., 2016) and increases unemployment rates after graduation.Therefore, this study sought to distinguish competencies required for producing edible insects to train VAE students for economic empowerment following graduation.

2. Literature Review

2.1 Professional Competencies for Edible Insect Production

In general, professional competencies have direct and/or indrectimpacts on many fields of endeavoursdue to the corresponding level of expertise, attitude, and abilities. Knowledge is created by interaction with the environment, and people build their own worldviews through personal experience. Its interchange is a crucial component of learning and aids the person in molding his or her capabilities by transforming theoretical and practical knowledge into new knowledge. Therefore, knowledge as a cognitive approach to competency comprises all mental resources that people employ to master tasks, learn, and perform well (Weinert, 2001). This focuses on information-processing models, the Piagetian model of cognitive development and psychometric models of human intelligence which holds that learning occurs when people organize their past experiences and make sense of environmental cues (Marquardt and Waddill, 2004).

On the other hand, skill is described as an established practice of readily and well performing a particular business. It includes acquiring performance ability and performing gained skills that are learned through application. According to Idoko (2014), the indication of maintaining performance ability should be by creating a particular skill through continuous exercise. That is to say, one must practice a certain way of doing and behaving so often that it becomes second nature (Schmidt, Lee, Winstein, Wulf & Zelaznik, 2018). To achieve this, tools, instruments, machines and equipment are needed to enable the various body parts accomplish performance ability.

While, behaviour as an approach of competency is characterized by demonstration, observation and assessment of performance over time. These, according to behaviourists, refer to individuals' ability to perform basic skills, which are evaluated by demonstration of

those skills specific to a job or function. The demonstration of these core skills in specific functions is what behaviourists stressed as attaining successful and effective job performance - key elements that differentiate individuals from less successful counterparts (Mulder et al. 2007). These discussed competency domains are prerequisites that VAE students must possess to perform well in edible insect production.

According to Van Huis (2013), intake of edible insects is a common practice over the African continent, with about 209 varieties being eaten either as luxuries or as essential parts of the daily meal rather than as a coping mechanism in times of hunger crisis (Illgner et al., 2000). In spite of their many benefits, insect resources are frequently ignored in Africa, in part because there is little documentation, little knowledge, and outdated technology for breeding, producing, and processing insects. Because of this, it is challenging to include insects in modern management. Indigenous people in the area have knowledge about edible bug species and traditional collection, processing, and preservation techniques that are passed down from one generation to the next (Hanboonsong, 2010).

Insects are little marvels of diversity, beauty, and complexity, and entomologists inhabit this world. How much information about insect a student can access might affect their level of love and appreciation of insects. There are fewer possibilities for humans to interact with a broad variety of wild insects due to the global fall in insect biomass and biodiversity (Basset et al., 2019), which reduces our ability to learn about and exploit them.The benefits and drawbacks of insects for the ecosystem (Ameixa et al., 2018) is of paramount importance to human life, to address the present global concerns, delve into insect-centric solutions is extremely valuable (Dangles et al., 2019). However, this goal is facing threatdue toloss in insect science, including reductions in or discrimination against research funding (Basset et al., 2019), a lack of entomology courses offered at institutions (Leather, 2009), a decline in the number of entomologists (Holden, 1989), and subsequently, entomology outreach initiatives. If we are to meet the rising demands of sustainability, insect science needs to be revitalized from below entomological literacy as it centers currently. Entomological literacy advancement, with the aim of providing quality education for the sustainability and development of edible insect productionhas been advocated (Idsardi et al., 2019). In addition to promoting entomological literacy, researching insects is crucial to science in general because it advances knowledge of more general scientific ideas and applications (Idsardi et al., 2019).

The species of insect, the method of production, and the type of feed used all affect the nutritional content of insects. Several factors affect the quality and saleability of edible insects (Meyer-Rochow et al., 2021). Thus, thoughtful the nutritional content of feed is fundamental to the growth of the insect farming industry. In general, it is possible to feed insects a variety of feedstocks, such as primary biomass that cannot be used and agricultural processing waste, in order to reduce the seasonality of the insect feed supply (Weiner et al., 2018). There is little information on edible insect production methods, and producers have little experience with the marketing and sale of edible insects in Europe (Stull and Patz, 2020).

According to Bakula and Galecki (2021) efficient growth, dietary flexibility, low chitin substance, efficient bio-conversion of feed, high entomoremediation potential, high reproductive performance, a short reproductive cycle, and low maintenance needs should all be present in insect species used for large-scale production. Also, they should be easy to breed, should not need specialized equipment, have to consume a variety of resources, as well as leftovers from agricultural making and the agri-food plant and animal products, must be resistant to changes in the micro-climate of breeding facilities, and should have a high potential for use in human and animal nourishment (Bakula and Galecki, 2021). Insect rearing decisions are frequently made based on the feed's availability (restricted, seasonal, year-round), form (liquid, dry), rearing surroundings (location concerns), managerial principles in farming facilities, and the application of safety, sanitation, and neatness procedures (Kok, 2021).

The knowledge, skill, attitude and practice of VAE students concerning the protection of biological and chemical residues should be extended, which creates the greatest obstacle in the rearing of edible insects. Insectssuch as *H. illucens* may build up heavy metals. Moreover, Knowledge is scanty on insect metabolic pathways, and even in the absence of toxic substances, their metabolites may persist (Lievens et al., 2021). It is important to note that insects may be a reservoir of selected stuff and pathogens directly after exposure (Doi et al., 2021). Insectsmay pose a biological threat (Gałecki and Sokół, 2019), and they have even been studied for the capacitytospread COVID-19 infections (Doi et al., 2021). Therefore, insect farms must obey with obligatory rules in connection with those that set microbiological measures for food and feed production.

Available infrastructure and resources, such as buildings, machinery, and employees, are needed for sustainable edible insect farming (Specht et al., 2019). Water, electricity, a feed logistics network, and waste and waste water handling systems should be available to edible insect production facilities (Zuk-Goaszewska et al., 2022). Their farms should not be established in close proximity to landfills or waste processing facilities, and they should be situated in areas free from chemical, odor, and dust pollution. Insect pests should be kept out of insect farms by fencing them in.

To maximize yields, revenues, and to produce edible insect products that adhere to food safety regulations, the production of edible insects should be managed correctly (Gravel and Doyen, 2020). Implementing specialized management systems, such as HACCP, appropriate breeding techniques, and good hygiene standards, is necessary for the production of safe food (Fraqueza, 2017). Subsequent to the release of product to the food distribution chain, food traceability and recall processes should be implemented as a risk management tool to detect hidden issues and contain food safety issues (Bosona and Gebresenbet, 2013). Farm structures and production facilities must adhere to the biosecurity and hygiene requirements set forth in the applicable rules (Higgins et al., 2018). Each and every location must be free from contamination and simple to sanitize. Facilities for producing edible insects should be built with cross-contamination from other animal production locations in mind. Zones should be designated as clean (white) and dirty (black) in edible insect farms (Thermote, 2006). Buildings ought to have working area that is ample and air filters. Every facility needs to be

checked for pests, leaks, and dust contamination. Systems for pest prevention and eradication are essential to the production of food and feed (Zuk-Goaszewska et al., 2022). Such systems should guard edible insect farms against pests that come from outside sources and should stop farmed insects from fleeing.Other insect species, spiders, birds, rodents, and small animals are the most prevalent pests in edible insect farms, and they could have a substantial impact on the safety of the final product (Savary et al., 2019). To reduce these dangers, measures for rodent eradication and disinfection should be developed. Production facilities must be kept in high-quality condition and must meet all necessary standards. Organic waste containers must be firmly closed, unneeded materials and equipment ought to be removed from production facilities, and food leftovers should be removed right away (Zuk-Goaszewska et al., 2022).

2.2 Research Hypotheses

The following hypotheses served as the study's foundation and were evaluated at a significance level of 0.05.

H1: On the entomological literacy competences, there is a significant difference between the mean response of Agricultural Extension Workers and Animal Science lecturers.

H2: There is a significant difference between the mean responses of lecturers in animal science and Agricultural Extension Workers on the abilities in the planning of edible insects.

H3: The mean replies of lecturers in animal science and Agricultural Extension Workers on the skills related to housing edible insects varied significantly.

H4: There is a significant difference in the mean scores of lecturers in animal science and Agricultural Extension Workers regarding their knowledge of how to maintain edible insect populations.

3. Methodology

A quantitative survey research method was employed to gather information from Agricultural Extension Workers (ASWs) and Animal Science lecturers through the use of questionaire (Anyakaoha, 2009). Statistical Package for Social Science (SPSS) version 22was used to analyze the data based on the survey on edible insect production competencies.The study was conducted in Kogi-east agricultural zones that comprise nine (9) Local Government Areas (LGAs) that includeAnkpa, Bassa, Dekina, Ibaji, Idah, Igala-mela, Ofu, Olamaboro, and Omala. Both groups of respondents were selected to respond to thestudyquestionaire since they have a broad range of experiences and training in general livestock production. A purposive sampling technique was adopted to achieve a population size of 104 ASWs and Lecturers (Kogi ADP Annual Statistic, 2022; Personnel Service department of Kogi State College of Education, Ankpa, and Prince Abubakar Audu University, Ayingba).

A structured questionnaire consisting of 55 items was used to collect information from the respondents in accordance with the research questions. The instrument was on a five-point Likert rating scale with response options: Very Highly Required, Highly Required, Moderately Required, Somewhat Required, and Not Required with corresponding values of 5, 4, 3, 2, and 1 respectively. Three experts validated the instrument. Two of the experts were

drawn from the Department of Animal Science, Prince Abubakar Audu University, Ayingba, and an expert was chosen from the Department of Agricultural Education, Kogi State College of Education, Ankpa. The comments and suggestions for the validation were used to modify the final instrument. A Cronbach alpha statistical method was employed to test the reliability of the instrument, which yielded a coefficient of 0.86. The four research questions were answered using Mean and standard deviation. Interpretative values were assigned to different scaling items of the questionnaire and corresponding Mean scores were interpreted using a real limit of numbers (Robert, 2006). Competency statements that had a Mean score of 2.50 and above were upheld as Highly Required while rejection was any rating below 2.50. ANOVA was used to test the formulated hypotheses at a 0.05 level of significance.

4. Result

4.1 What Are Entomological Literacy Competencies Required by VAE Students?

The mean rating of respondents in this study on entomological literacy competencies required by VAE studentsis presented in Table 1.

Table 1. Mean rating and standard deviation of respondents on entomological literacy competencies required by VAE students (n=104)

S/N	Competencies required for entomological literacy	X	SD	Remarks
A1	Insects offer economic values such as pollinators of crops and animal feed	3.51	0.61	HR
A2	Insects pollinate most crops	3.55	0.64	HR
A3	Insects are valuable environmental indicators since they are sensitive to habitat change	3.70	0.72	HR
A4	Insects encourage sexual reproduction in many plants as they carry their pollen grains to other plants	3.98	0.82	HR
A5	Insects are research organisms that are valuable in the study of genetics and ecology	3.87	0.53	HR
A6	Insects offer important economic resources like silk, honey, lacquer, and dyes	3.98	0.82	HR
A7	Insects provide critical protein diets for vertebrates like birds and fish	4.27	0.65	HR
A8	Insects offer an important association between producers and vertebrate predators in terrestrial and freshwater food webs	3.22	0.82	HR
A9	Identify an insect before embarking on a technique of controlling it	3.25	0.81	HR
A10	Use insect repellent to avoid insect-transmitted diseases	3.90	0.23	HR
A11	Some insect and plant species have a symbiotic relationship	3.70	0.72	
A12	Allergic reactions to insect stings can lead to death in some people	3.68	0.85	HR
A13	Insects transmit diseases like malaria, yellow fever, typhus plague, dengue, and West Nile virus	3.85	0.66	HR

A14	Insect-borne diseases have greatly affected humans and changed the course of history	3.54	0.58	HR
Overall grand mean scores for entomological literacy competencies		3.71	0.67	HR

X = Mean, SD = Standard Deviation, HR = Highly Required at cut off Mean Scores of 1 – 2.33 = Low, 2.34 – 3.66 = Moderate, 3.67 – 5 = High

4.2 What Are the Competencies VAE Students Required in Planning for Edible Insect Production?

The result on the mean measurement of VAE students about their competency to plan edible insect farming is shown in Table 2.

Table 2. Mean rating and standard deviation of respondents on competenciesrequired in planning edible insect production (n=104)

S/N	Competencies required for planning edible insect production	X	SD	Remarks
B1	Formulate specific objectives for the insect production enterprise	4.25	0.44	HR
B2	Review the objectives of insect production enterprise periodically based on changes in the market demand and supply	4.22	0.61	HR
B3	Identify the source of insect for stocking	4.02	0.71	HR
B4	Identify the source of feed	3.51	0.61	HR
B5	Make budget to cover the cost of production and expected income	4.64	0.48	HR
B6	Identify the source of material for the cage construction	3.96	0.80	HR
B7	Identify market for the sale of the larvae, pupa and adult insect	4.72	0.45	HR
B8	Identify the source of finance for the insect production enterprise	4.28	0.62	HR
B9	Draw schedule of duty plan for the enterprise	4.27	0.65	HR
B10	Start insect new colonies with new eggs or nymphs from other farmers	4.01	0.66	HR
B11	Sell insects to wholesalers or to vendors	3.55	0.64	HR
B12	Adds value and shelf life to whole insects through processing	4.08	0.75	HR
B13	Use pressing, boiling, or organic solvents to separate the insect oil or fat from the meal	4.76	0.43	HR
Overall grand mean scores on competencies for planning edible insect production		4.17	0.60	HR

X = Mean, SD = Standard Deviation, HR = Highly Required at cut off Mean Scores of 1 – 2.33 = Low, 2.34 – 3.66 = Moderate, 3.67 – 5 = High

4.3 What Are the Competencies VAE Students Required in Housing Edible Insects?

Table 3 shows the results of respondents on competencies required by VAE students for housing edible insects.

Table 3. Mean rating and standard deviation of respondents on competencies required for housing edible insects (n=104)

S/N	Competencies required for housing edible insects	X	SD	Remarks
C1	Keep insects in stacked crates of any dimension	4.60	0.57	HR
C2	Transfer newly hatched juveniles to racks made with bamboo or round wood	3.51	0.64	HR
C3	Provide a netted cage to ease swarm and mating	3.68	0.80	HR
C4	Use net-breeding system	4.40	0.53	HR
C5	Place dry straw or dry fern below the larva so it can settle	3.51	0.76	HR
C6	Use artificial light to stimulate mating and oviposition	4.32	0.62	HR
C7	Use open containers of organic substrate to attract flies	4.27	0.65	HR
C8	Raise female and male insects in an enclosure for mating	3.52	0.61	HR
C9	Observe mating time in daylight	3.99	0.82	HR
C10	Provide nest boxes	4.36	0.64	HR
C11	Design and construct containment structures for optimal egg laying and hatching rates	4.03	0.74	HR
C12	Keep the egg hatching and first instar stages of nymphs in different containers	4.32	0.66	HR
C13	Grow hatched insects and nymphs to adults in the same container	3.52	0.61	HR
C14	Maintain optimal temperature between 25℃ and 30℃	3.99	0.82	HR
Overall grand mean scores on competencies for housing edible insects		4.0	0.67	HR

X = Mean, SD = Standard Deviation, HR = Highly Required at cut off Mean Scores of 1 – 2.33 = Low, 2.34 – 3.66 = Moderate, 3.67 – 5 = High

4.4 What Are the Competencies VAE Students Required in the Maintenance Practices of Edible Insects?

Table 4 shows presents the results of respondents on competencies required by VAE students to maintain practices of edible insects in captivity.

Table 4. Mean rating and standard deviation of respondents on competencies required in the maintenance practices of edible insects (n=104)

S/N	Competencies required in the maintenance of edible insects	X	SD	Remarks
D1	Feed insects with fruits, vegetables, and weeds	4.03	0.74	HR
D2	Meet the insects' nutritional requirements from available substrates	4.32	0.62	HR
D3	Feed larvae with organic substrates	4.28	0.62	HR
D4	Feed insects with wheat bran, cereal substrates, and	4.27	0.65	HR

	vegetable substrates			
D5	Grind and ferment the fibrous materials before feeding insects	4.64	0.48	HR
D6	Feed larvae three to four times a day	2.89	0.85	HR
D7	Provide animal or human wastes as feeds	2.85	0.84	HR
D8	Supplement with fresh forages, tubers, grains and nuts	4.02	0.71	HR
D9	Provide concentrate feed	3.57	0.69	HR
D10	Provide and leave substrates open for adult females to lay eggs	3.85	0.66	HR
D11	Turn one kilogram of dry organic waste into 150 to 200 grams of insect larvae	3.22	0.82	HR
D12	Harvest wild adult insects by trapping them in buckets laced with a pheromone	3.25	0.81	HR
D13	Dispose insects at maturity or instar stage	4.56	0.61	HR
D14	Separate larvae from the unconsumed substrates	4.10	0.86	HR
Overall grand mean scores on competencies in the maintenance of edible insects		3.84	0.71	HR

X = Mean, SD = Standard Deviation, HR = Highly Required at cut off Mean Scores of 1 – 2.33 = Low, 2.34 – 3.66 = Moderate, 3.67 – 5 = High

Table 5. Summary of Analysis of variance (ANOVA) of respondents' ratings of competencies required by VAE students in entomological literacy, planning, housing, and maintenance of edible insects in captivity

Hypotheses (H)	Responses	Sum of Squares	df	Mean squares	F	Sig.	Decision
H1	Between Groups	28.927	2	14.463	3.944	.064	Rejected
	Within Groups	231.018	102	3.667			
H2	Between Groups	91.467	2	45.732	4.470	.051	Rejected
	Within Groups	276.400	102	10.240			
H3	Between Groups	6.541	2	3.271	5.633	.063	Rejected
	Within Groups	22.199	102	0.58			
H4	Between Groups	10.866	2	52.343	5.295	.068	Rejected
	Within Groups	74.135	102	24.222			

*Significant at .05

The table 5 presented the results of the tested hypotheses. The H1's findings revealed that there was no statistically significant difference ($p>0.05$) between the respondents' responseson the entomological literacy competencies required by VAE students in edible insect production. Therefore, the alternate hypothesis was rejected, as the *p*-value of 0.64 was greater than the significance level of 0.05. The result of H2 also showed no statistical significant difference in the responses of the respondents. The alternate hypothesis was rejected, as the *p*-value of 0.51 was greater than the significance level of 0.05. Similarly, the result of H3 showed no statistical significant difference in the responses of the respondents. The alternate hypothesis was rejected, as the *p*-value of 0.63 was greater than the significance level of 0.05. And the result of H4 equally presented no statistical significant difference in the responses of the respondents. The alternate hypothesis was rejected, as the *p*-value of 0.68 was greater than the significance level of 0.05.

5. Discussion

Table 1 revealed 14 competencies required in entomological literacy were considered as highlyrequiredbecause the mean responses were high ranging from 3.22 to 4.27. The standard deviation (0.23 to 0.85) showed no significant gap in the opinions of the respondents. These findings were in agreement with Makkar et al. (2014) who said that insects are domesticated, as far back as the 1960s, as live feed for pet animals and zoo reptiles in Western countries. Degrandi-Hoffman et al. (2019) asserted that insects' pollination business if commercialized, has an estimated economic value of more than US$20 billion over a short period of its domestication. The findings of this study were also supported by IAEA (2020) who reported that rearing of sterile insects (fruit flies) are well known for integrated pest control in arable farmlands. Dorte et al. (2021) submitted that insect domestication has been reported as an important source of food, feed, and textile fibre throughout human history. All these submissions together contribute to a richer understanding of the importance of insects to humans.

Table 2 revealed 13 competencies required in planning for edible insect production. These competencies for planning edible insect production had mean ratings above 3.55 showing that they were all required. The standard deviation (0.44 to 0.80) did not reveal any appreciable variation in the respondents' opinions. These results concur with those of Shapiro (2021), who claimed that planning entails a systematic process of identifying a need before determining the best system to address it. The best system to achieve this need is the ability of edible insect farmers to think about the future of the enterprise by doing something towards it from now that the need is identified. Litman (2022) also reporteda manager of an enterprise needs to decide on what to do and how to do it with the target of making profits. Therefore, there is a need to stress careful planning before engaging in edible insect production. According to Dorte et al. (2021), when an edible insect production enterprise is carefully and adequately planned, it has the potential to guarantee regular and sustainable animal production to address the country's protein shortage in human diets and present good business opportunities for both individuals and the government.

The result presented in Table 3 showed that the 14 competencies identified are essential in

rearing insects in captivity. These competencies for housing edible insects had their mean ratings above 3.50 indicating that all the items were considered required by the VAE students in housing edible insects. The standard deviation (0.53 to 0.82) showed a close range in the opinions of respondents. These findings were in line with Nyakeri et al. (2016) who reported that farmers could house insects in open containers of organic substrate. Dorte et al. (2021) asserted that stacked crate systems could be used to house larva for steady growth and performance and netted cages could be used for adult insects to enhance breeding and egg laying (oviposition) as adult flies swarm and mate easily in them. Therefore, design suitable containment structures for optimal egg laying and hatching rates. The findings were also supported by van Huis et al. (2020) who reported that the newly hatched insect juveniles should be housed in racks made with bamboo or round wood. According to Dorte et al. (2021), five pairs of adult weevils of both sexes can be housed in a bucket with proper maintenance.

The outcome in Table 4 demonstrated all the skills needed for the upkeep of edible insects kept in captivity.The mean responses of 2.85 to 4.64 were high and the standard deviation of 0.48 to 0.86 showed no significant variance in the opinions of the respondents. This means all the 14 competencies were considered as required. These findings were in line with Oonincx (2017) who reported that industrial-made feeds such as fishmeal and other feeds meant for chicken can be fed to domesticated insects. According to a farm-level assessment conducted in 2019 in Dorte et al. (2021) on yam, pumpkin, cassava, and moringa trees, insects are fed on fresh plant materials. Nischalke et al. (2020) admitted that organic wastes such as decaying plant and animal materials and other household wastes can be fed to insects in captivity. Nyakeri et al. (2016) who asserted that open containers of the organic substrate should be used to attract insects also supported the findings. Similarly, Dorte et al. (2021) affirmed that when housing adult insects, about 5 kg of palm oil or raffia tree yolk, or inner core should be placed in the cages as a feed substrate with the addition of 100 grams of sugar for insects like weevils to feed on. van Huis (2019) reported that brewer-spent grains (BSG) should be provided *ad-libitum* for insects as it contains the most essential nutrients.

As further proof of the respondents' agreement on the competencies required for edible insect production for students' economic empowerment, the ANOVA result indicated no significant differences in the mean responses of the two groups of respondents on the entomological literacy competencies, planning competencies, housing competencies, and maintenance competencies for/of edible insect production (Table 5 refers).

6. Conclusion

There is great competition for alternative livestock protein needs amongst the world's rising populace. Therefore, there is a convergence of views by the global consumers of insects that whatever insects are offered for consumption should meet the globally accepted standard of rearing insects in insect-based farms instead of depending on wild sources. Tapping into this great adventure is to offer the competencies students and graduates of VAE required for economic shifts. This is feasible because growing edible insects is a business that presents rewarding chances for boosting livelihood and generating income for people who engage in it.

When properly implemented, edible insect production will guarantee regular and sustained livestock production to address the nation's animal protein shortfall issues and provide good career possibilities for both individuals and the government. If the planning, housing, and maintenance procedures for edible insects were applied, the level of economic empowerment among VAE students would increase.

7. Recommendations

According on the study's findings, the following suggestions were made:

Nigeria tertiary vocational education should integrate edible insect production skills into the programme curriculum for students' economic diversification and empowerment and for gainful engagement in edible insect production carriers after graduation.

Stakeholders such as National Commission for Colleges of Education (NCCE), National Board for Technical Education (NBTE), National University Commission (NUC) and the institutions concerned should take the lead by including in vocational agricultural education programmes the competencies identified by this research for the training of VAE students who after graduation will be employed in Universal Basic Education Schools to teach agriculture or engage in a self-employed farm business.

The tertiary vocational institutions' learning environment should be organized in such a way that students should absorb a wide range of cultures which will help them think from a wider perspective, in terms of seeking alternative animal proteins (insect production) for economic empowerment development.

8. Limitations and Direction for Future Studies

The study samples involved only ASWs and Lecturers who are experts and were willing to respond the questionnaire. The willingness of the respondents to make use of their available time and financial resources limited this study to a convenient sample size. Different views of respondents due to several experiences were either a strength or weakness of this research. The researchers with anonymity analyzed the data collected.

Further researches could be conducted in the dimension of competencies for raising edible insect entrepreneurs, competencies in edible insect processing, distribution, marketing of processed products since the knowledge about edible insect production technologies is scanty.

A research to genetically maintain healthy populations, controllingand preventing inbreeding by allowing natural selection and artificial selection and exchange of material for breeding be investigated.

In addition, further research is required on local species suitable for rearing, ideal conditions for production, techniques of disease management, and traceability of insects.

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