

## CROSS-RELATIONAL INFLUENCE OF INSECTS DIVERSITY ON SCIENCE STUDENTS LEARNING OUTCOMES IN NORTH CENTRAL STATES COLLEGES OF EDUCATION, NIGERIA

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**Abstract:** The cross-relational influence of terrestrial versus aquatic insects' activities on the learning outcomes of science students in colleges of education was conducted in north central states. 3 research questions and 2 hypotheses were focused for findings. It covered 480 science students within 3 purposefully sampled colleges, checklists of insects' Direct distribution to science students of structured questionnaire whose validity was ascertained and the reliability coefficient of .891 was computed through Cronbach Alfa was used to obtain data for this study. Data obtained from the instrument were analysed descriptively and inferentially. It was discovered among other things that, there were harmful and beneficial effects from the various interactions that existed between science students and the terrestrial as well as aquatic insects that were present within their college's premises. This study established the possibility of adopting eco-friendly ways like; exposing insects to their natural enemies as a means of keeping their populations within ecologically permissive limits while curtailing the devastating activities of these insects even as science students co-exist harmoniously with them in the same physical environment. Recommendations made include adopting the use of natural phyto-chemicals to control the activities of insects.

**Key words:** Insects diversity, Learning outcomes, Physical environment, Science students',

### Introduction

With regards to the critical role of science teacher education in manpower development of a country, the environment of the institution providing the education is expected to consider and promote the state of health of the science teachers in training as more efforts are geared towards gingering their cognitive capabilities. This becomes necessary so as to ensure quality delivery in producing professional science Teachers capable of educating, teaching, guiding, training and evaluating students in basic-9 and senior secondary education science programmes. It has therefore become prerogative that interactions between the environment of colleges of

education specifically which harbor all species of insects' diversity be enabling and supportive of science students to live in and learn progressively.

It has been stated among the idealistic goals of science education as enshrined in the National Policy on Education that there is the need for conscientious science educators to be abreast of the ever-dynamic factors/demands of the environment within which learning take place (FRN, 2008). The whole essence of any adequately developed science curriculum might be defeated when the objectives are not achieved owing to the activities of diverse insects around the college environment which summarily reduces/hampers students overall learning outcomes.

There is no contrary view that science education plays an important role in the furtherance of scientific literacy and technological advancement of Nigerians as cut across other races. Hence, the need to be able to subdue the environment and all its components in such a way that it will facilitate all-out efficiency and active learning among science-teachers and scientists in training. This being so because it forms a positive correlate to achieving a scientifically developed nation that can compete with other advanced nations of the world. In like manner, adequate understanding of the diversity of insects will permit the opportunity to maximally harness their potentials and curb their harmful roles within the environment while ensuring the prevention of their extinction or total emigration from the college learning environment or vicinity.

The expected learning outcomes included in the curriculum framework, communicates what teachers and learners should achieve because it is a description of what, why, when, and how well students should learn in a systematic and intentional way (IBE, 2013). Expected learning outcomes describe the totality of information, knowledge, understanding, attitudes, values, skills, competencies, or behaviours a learner should master upon the successful completion of the curriculum (IBE, 2013). Achieving the dictates of the curriculum is however impossible without an enabling physical environment that provides for intuitive and didactic learning of scientific concepts. It is in this regard that this research becomes pertinent.

It is a known fact that by improving upon the physical learning surrounding translates to better retention. Research has also suggested that students learn more in classrooms with healthy surroundings which fosters better learning outcomes provided other factors of learning are made available (UNESCO, 2015). In many colleges of education, science teachers in training in particular suffer due to exposure to certain areas of their physical environment like: ponds, outdoor laboratories, rangeland, botanical and zoological gardens and their likes which further predisposes them to terrestrial and aquatic insects (UNESCO, 2015).

A good number of terrestrial and aquatic insects are reservoirs of a number of pathogenic diseases. As a matter of fact, the very common fevers like: malaria, typhoid, zika virus, lymphatic filariasis, leishmaniasis and yellow fever are all vectored at one point or the other of their life cycle by insects. The foregoing underscores the need to educate students and particularly science students the mode of interactions with particular emphasis on the vectors and at the same time best ecologically friendly ways to keep these insect vectors at bay. In the words of Akinsola (2004) no meaningful learning can occur in an unhealthy environment. Variety of organisms at all levels, from genetic variants, belong to the same species through arrays of species to arrays of genera, families, and still

higher taxonomic levels; includes the variety of ecosystems, which includes communities of organisms within particular habitats and the physical conditions under which they live.

Biodiversity describes the richness and variety of life on earth (Anwadike, 2020). It is the most complex and important feature of our planet. Without biodiversity, life would not sustain. Biodiversity deals with variability among plants, animals and microorganism species. Akpabio (2016) described biodiversity to be the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels. Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Insect biodiversity accounts for a large proportion of all biodiversity on the planet—over half of the estimated 1.5 million organism species described are classified as insects (Amakiri, 2016). Amakiri, (2016) has opined that the class Insecta belong to the Phylum Arthropoda and as outlined by Anwadike (2016) an alphabetical list of insect orders in current usage with examples of insects include: Blattodea (Cockroaches), Coleoptera (Beetles), Diptera (Flies), Hemiptera (Bugs), Hymenoptera (Ants, bees, wasps), Odonata (Dragonflies), Orthoptera (Grasshoppers, locusts and crickets). Anwadike (2016) documented that insects are adaptable creatures that live in almost every habitat on Earth. They live in hot deserts, freshwater streams, tropical rainforests, up snowy mountains and of course, in gardens. While some insects do live in water, about 97% of insect habitats are on land. They may fly to different places, but they still primarily live on land. Since insects are found all across the world, they also have lots of different habitats.

Aquatic insects make their homes near or inside water. Aquatic habitats have been categorised by Akpabio (2016) according to size as macro-habitats which are large, complex areas such as oceans, lakes, and ponds and micro-habitats which are much smaller environments such as the single blade of a submerged plant. Microhabitats are the specific places where individuals of a particular species or group prefer to live. From top to bottom of water are three distinct micro-habitats: the surface, the water column, and the benthos or bottom community (Akpabio, 2016). The water surface is home to insects adapted to living on the layer between air and water such as the water striders, or those using the surface from below to breathe like the mosquito larvae. Still others may live half in and half out of the water like some of the beetles. The water column itself is a busy place. Insects and many other organisms like fish are found in the water column. Nutrients that are food for the insects are found here as well as pollutants. These materials travel through the system as the water circulates. Insects may also be carried along with the water flow from one place in the water column to another. The bottom or benthos however make insects homes in the muddy or sandy bottom sediments. Scientists study the distribution of insects from the shore through the splash zone, to the deeper water zones.

Some other insects live in all possible environment on Earth with many making a home in the trees, such as the weaver ants that construct habitats from silk and leaves. Honeybees build hives in trees or rock crevices. Other insects burrow underground, such as the termites that construct large, complicated mounds filled with subterranean tunnels. Terrestrial insect populations and communities make excellent models for basic ecological

studies because they are present in virtually every habitat on the planet, including the Antarctic, and they fill every feeding guild in a community (Amakiri, 2016).

Students' academic performance is a fundamental indicator to be taken into account especially when considering the environmental co-existing biotic factors alongside educational intervention provided. Ozel et al. (2013) have observed that although it is well established that academic performance is a complex and multivariate issue with numerous variables contributing simultaneously as predictors for its' explanation, most researchers tend to analyze each variable separately. This has prevented the possibility of getting a full picture of the situation (Byrnes & Miller, 2007). Most school irrespective of level and society usually customarily do assign cognitive abilities the preponderant role when defining school curricula or when explaining and evaluating student's success or failure, Efklides (2009) and Kahveci (2015) posited that the importance of the affective domain in education is acknowledged for a long time. Affective indicators can only manifest under the atmosphere of interactions on the part of the students. Newer approaches to the comprehension of learning processes and its outcomes could be linked to a broader range of relevant variables at the personal level such as the interactive effect of environmental biotics and abiotics on the learners' metacognitive knowledge and skills, as related to what Efklides (2011) viewed as perceptions of how good is performance in learning, attitudes, emotions, and motivation. The relational aspects of school living, in particular the importance of insects of both terrestrial and aquatic relationships is another area to be considered as relevant variables to understand achievement on students' process of developing a meaningful understanding of scientific concepts (Nieswandt, 2007).

### **Problem Statement/Justification**

The teacher is the primary actor who interacts directly with the students in the process of teaching and learning activities. The success or otherwise of all the efforts to improve the quality of science education is largely determined by a list of factors of which the ability of the teacher stands out penumbra. To therefore carry out the main task of being the manager of learning activities in the classroom requires that they are mindful of their ability to generate reliable outcome while in training. This is very crucial since it directly has a link with how much they learn and are able to impart in their learners eventually when they get to the field to practice. To this regard, this study identified a variety of insects whose interactions can hinder or promote science students' learning outcomes, with a view to better understand how the activities of insects generally could be properly managed without necessarily causing any discordance in their biological relevance in the ecosystem. In view of the foregoing, the present study focused on ascertaining the cross-relational influence that insects have on the learning outcomes of science students in colleges of education in North central states of Nigeria.

### **Objectives of the Study**

The study specifically worked out:

- An evaluation of the extent to which the diversity of terrestrial and aquatic insects affected the learning outcome of science students in colleges of education.
- The intimation of students and colleges authorities on ecologically friendly ways of keeping insect vectors away from the physical learning environment.

- A deduction of the ways of continued harmonious coexistence of terrestrial and aquatic insects and science students that could promote learning outcomes.

### **Research Questions**

1. What influence does the diversity of terrestrial and aquatic insects have on the learning outcome of science students in colleges of education?
2. What are the ecologically friendly ways of keeping insect vectors away from the physical learning environment of students and colleges authorities?
3. What are the possible eco-friendly ways of curbing the activities of pathogenic and insect pests that may hinder students' learning outcomes such that it still facilitates continued harmonious coexistence of terrestrial and aquatic insects and science students?

### **Research Hypotheses**

1. The diversity of terrestrial and aquatic insects does not affect the learning outcome of science students in colleges of education.
2. Eco-friendly interactions and of means control for facilitating continued harmonious coexistence of terrestrial and aquatic insects and science students learning outcome does not exist.

### **Methodology**

The study adopted a descriptive survey design. Science students' teachers in training in colleges of education in North Central Nigeria made up the population. One (1) federal, state and private colleges of education were each purposefully selected proportionally along institution, department, terrain and residence. These tertiary institutions were also purposefully selected with regards to availability of both terrestrial and aquatic habitat sites capable of breeding diverse insects. Checklist of possible probable insects found around selected State were obtained from the Institute of Entomological Studies in Shika, Zaria to serve as a guide for the researchers who went to the various endemic sites of these study areas to ascertain their presence and availability.

Structured questionnaire tagged Insect Habits and Science Students Wellness and Performance (IHSSWP) comprise section A on biodata with a focus on institution, department, terrain and residence whereas, section B bothered on knowledge of insects, their prevalence, endemicity, mode of action, feeding habits, habitats, reproduction, pathogenicity, beneficial and harmful roles among others was used for data collection. The response options (Strongly Agree, SA; Agree, A; Disagree, D and Strongly Disagree, SD) of the 25 items in section B of the questionnaire were developed according to 4-points Likert Scale format. The questionnaire was presented to individuals in the areas of parasitology, entomology and pedagogy for validation: face, construct and content. The research instruments were served on science students' teachers in training around the study area from among the population for a pilot study and trial testing. The sample used in the pilot study was not included in the investigation proper. Data collected from the pilot/trial testing were analysed using Guttman Split-Half test for its reliability coefficient that yielded .87.

## Results

**Table 1a: Institutions Vs Insect Diversity by Learning Outcome**

Institution	Number of Respondents Sampled	$\bar{x}$	Std. Dev.
State	338	9.26	1.69
Federal	131	8.85	1.95
Private	11	8.45	2.02
Total	480	9.1292	1.78

**Table 1b: X<sup>2</sup> test of Institutions Vs Insect Diversity by Learning Outcome**

Statistics	value	df	Phi value	Asymp sig. (2-sided)
Pearson Chi-Square	68.657 <sup>a</sup>	14	.378	.000
Likelihood Ratio	68.539	14		.000
Linear-by-Linear Association	6.698	1		.010
N of Valid Class	480			

A X<sup>2</sup> of 68.657 at degree of freedom of 14 on Table 1b was obtained on the association of institution versus insect diversity and science students learning outcome with phi value of .378 at alpha (p) = .000. This phi value close to zero (0) shows that there was no strong degree of relationship, though the alpha value indicated a significant association existed.

The two variables of institution versus insect diversity by learning outcome were not independent of one another. Learning outcome depends on the diversity of insects per institution. Hence, the diversity of insects in the sampled institutions had a corresponding influence on the various learning outcome among science students.

**Table 2a: Residence Vs pathogens eco-friendly activities and students' co-existence**

Residence	Number of Respondents Sampled	$\bar{x}$	Std. Dev.
Regular sanitation	251	7.82	1.04
No sanitation	229	7.83	.68
Total	480	7.82	.89

**Table 2b: X<sup>2</sup> test of Residence Vs pathogens eco-friendly activities and students' co-existence**

Statistics	value	df	Phi value	Asymp sig. (2-sided)
Pearson Chi-Square	34.754 <sup>a</sup>	6	.269	.000
Likelihood Ratio	42.298	6		.000
Linear-by-Linear Association	000	1	.990	
N of Valid Class	480			

A X<sup>2</sup> of 34.754 at degree of freedom of 6 on Table 2b was obtained on the association of Residence versus pathogens eco-friendly activities and students' co-existence with phi value of .269 at alpha (p) = .000. This phi

value close to zero (0) shows that there was a low degree of relationship, though the alpha value indicated a significant association existed.

The two variables of students' residence versus eco-friendly activities and students' co-existence outcomes are very dependent on one another. That is, the two categories of organisms (students and insects) are very dependent on each other. In other words, the ability of students to live healthily while co-existing with the various diversities of insects is dependent on adopting eco-friendly ways or means to co-inhabit without rancor which invariably influenced the extent of their engagement and attention in academic activities.

### **Discussion of Findings**

It was discovered across the sampled colleges that science students co-inhabited with both terrestrial and aquatic insects regardless of the category of the college whether federal, state or private. It was also agreed by the respondents from the departments within the school of sciences that the activities of these insects were both beneficial and harmful to their academic activities and learning outcomes. This finding reflected a similar position of Akpabio (2016) who maintained that insects diversity holds both ecological and economic importance in such areas as nourishment, fuel resources and the likes. The respondents also concurred that insects were present on the dry land and water-logged areas of their college having direct and indirect impact on them and vice-versa. Lastly from tables 1, it was deduced that the respondents agreed that regular and proper sanitation reduces the risk of exposure to harmful insects as well as harmful activities of beneficial insects. This could explain why man is prompted to control mosquito as a vital public health practice and especially in the tropics because mosquitoes spread many diseases, such as malaria and the zika virus (Connelly & Borchert, 2020). From the foregoing, it becomes clear that aquatic and terrestrial insects are present within north central states and their activities have effects on science students' state of health and learning outcomes.

Specifically, it can be seen that the two variables of institution versus insect diversity by learning outcome were not independent of one another. Learning outcomes depended on the diversity of insects per institution. Hence, the diversity of insects in the sampled institutions had a corresponding effect on the various learning outcome among science students within that institution.

The study also discovered that regardless of the difference in departments of the respondents, the influence which the activities of insects have on their learning outcomes was devastating and highly correlated. This means that regardless of the students' department, the effects of insect activities on their learning outcomes were associatively high, more of harmful than beneficial.

The results showed that the two variables of students' residence versus eco-friendly activities and students' co-existence outcomes are very dependent of one another as eco-friendly ways can be used to tackle the excesses (harmful) activities of beneficial insects just like can be done to harmful insects. That is, the two categories of organisms (students and insects) are very dependent on each other whether harmful or beneficial as they play active roles in maintaining balance in the ecosystem. In other words, the ability of students to live healthily while co-existing with the various diversities of insects is dependent on adopting eco-friendly ways or means to co-inhabit without rancor while maximizing benefits from the diversity of insects. Just as Bees can sting painfully

and produce honey which contains about 18% water, it is water soluble and may granulate between 50 to 65<sup>0</sup>F (10-18<sup>0</sup>C), somewhat acid, it has mild antiseptic properties and has been used in the treatment of burns and lacerations. One of the most easily assimilated foods, widely used in baked foods, candies, prepared fruits, cereals and medicines (World book, 2004).

Lastly, this study established the possibility of adopting eco-friendly ways like; exposing insects to their natural enemies as a means of keeping their populations within ecologically permissive limits while curtailing the devastating activities of these insects even as science students co-exist harmoniously with them in the same physical environment. This human activity on insects according to Daura (2000) permit biodiversity and its maintenance to be very important for sustaining life on earth. Similarly, it has been found that house flies have been pests of humans and animals since antiquity. Recent research by Gogarten et al (2019) suggested that the relationship between humans and flies may predate recorded history for many millennia. These authors reported that muscid and calliphorid flies are closely associated with social groups of highly mobile nonhuman primates in the tropical forests of Ivory Coast. The flies appear to move with the primates and are rarely found outside of their immediate vicinity. Moreover, the flies carry and presumably spread pathogens that cause disease in the associated animals. The authors conclude that ‘attraction of flies might represent a previously underappreciated cost to forming social groups. The association between humans and flies was undoubtedly strengthened once humans began to form more permanent settlements with domesticated animals and the concomitant manure accumulations occasioned by organic wastes littered everywhere on students’ institutions of learning.

## **5.2 Conclusion**

Insects being the most successful group of invertebrates play very crucial roles in maintaining balance in nature. Their ability to occupy all habitat types further testifies to their success levels. The harmful or useful roles some of the insects play within the institutions environment have made turn for man’s enemy and friend, a situation that is gradually sending some of them extinct. This study however stemmed out of the need to help science students and the diversity of insects within their schooling environment co-inhabit without stress while maximizing benefits from each other. This study concludes that adopting eco-friendly ways of co-living with beneficial and harmful insects is the best approach at assuring significant learning outcomes of science students within colleges of education and by extension at all educational levels in Nigeria.

## **5.3 Recommendations**

This study has the following recommendations:

1. There is need for improved sensitization on the need to conserve insect biodiversity by the appropriate agencies and ministries of government, NGO’s, media houses, school authorities and at an individual level as well.
2. Eco-friendly ways of tackling the negative activities of beneficial insects as well as those of harmful effects need to be circulated by the aforementioned persons in recommendation No. 1 above and adopted by all. Eco-friendly ways like use of phyto-chemicals to stop harmful activities of beneficial insects, use of natural enemies to control the population of harmful insects, barriers to keep insect pests away from crops and humans.

3. The mass media and various local authorities need to create more awareness to rural dwellers and villagers on the need for adequate environmental sanitation, avoiding natural wild breeding sites of harmful insects.

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