

EFFECT OF FUTURES WHEEL AND DEMONSTRATION INSTRUCTIONAL STRATEGIES ON STUDENTS' ACHIEVEMENT IN BIOLOGY (ECOLOGICAL MANAGEMENT) IN KATSINA-ALA LOCAL GOVERNMENT AREA OF BENUE STATE

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Abstract

This study investigated 'Effect of futures wheel and demonstration instructional strategies on students' achievement in Biology in Katsina-Ala Local Government Area of Benue State'. Two research questions were raised and two hypotheses were formulated for the study. The population of the study was all the 112 senior secondary school two students offering biology from the two secondary schools in the local government area during the 2022/2023 academic session. The study was a complete census since all the SS 2 students offering biology in the two sampled schools were used. The researcher made use of the whole population because of homogeneity of subjects, cost, and adequacy. The researcher constructed a Biology Achievement Test (BAT) based on the biology curriculum on ecological management for data collection. The research use Mean scores and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The study found that there was a mean difference in the achievement scores of senior secondary students taught ecological management with Futures wheel instructional strategies and those taught by demonstration method. Also, there is the interaction effect of instructional strategies and gender (male and female) on students' achievement in senior secondary school Biology (ecological management). The study recommends that the government and administrative structure of secondary schools should retrain teachers on the use of Futures wheel in teaching biology and that teachers should pay particular attention to the female students in the course of teaching to assist them resolve their learning difficulties and enhance their performance.

Keywords: Effect, Instructional Strategies, Academic Achievements, Secondary Education, Biology.

Background to the Study

Science is an organized body of knowledge in form of concepts, laws, theories and generalization. It is the study of the natural world based on observation and experimentation, which result in the understanding of what the natural world is all about. Uregbunam (2011) defines science as 'a study of nature and natural phenomenon in order to discover their principles and laws'. It is through science and technology, our mode of farming, travelling, health care, business and even politics are made better. For any nation to be part of advanced technology of the world, the role of science and technology is inevitable. In most countries of the world, emphasis is placed on development of science and technology. They do this by giving incentives for students who are offering science subjects in the secondary schools and

science based disciplines such as medicine, pharmacy, engineering, architecture and others are not less than 80% in the universities of technology.

Nigerian government is also inclusive in these kinds of incentives to science students. For instance, government admission policy in all tertiary institutions in Nigeria is 60% of the admission for sciences and 40% for arts, humanities and social sciences (Abifarín & Ajayi, 2016). Despite all these incentives and favourable government policies for development of science disciplines, the number of students offering science subjects and disciplines is still very small compared with those offering humanities and social sciences in most secondary and tertiary institutions. This is a major educational problem in Nigeria today. Biology as a core subjects offered at the secondary school level is not alienated from this problem.

Biology as a subject is important to humanity in many spheres of life. For instance, in agriculture, biology has helped in the production of high quality plants and animals in large quantities as well as resistant varieties of crops and breeds of livestock. In the areas of medicine, biology has helped in the production of vaccines and drugs for preventing and curing many illnesses. Nowadays, we have medical breakthroughs such as organ transplant, test tubes babies (in vitro fertilization), artificial limbs among others (Ojora, 2019). The knowledge of genetics which is a branch of biology has revolutionized determination of paternity disputes and identification of crime suspects with precision and certainty through deoxyribonucleic acid (DNA) sequencing and profiling. Furthermore, biology also addresses the problem of pollution through the application of bio-fuel produced from simple foods like cassava and other cereals in place of petroleum products which are costly and pose ecological problems. These bio-fuels are more environmental friendly and have been used to power all kinds of vehicles and machinery (Adejo, 2013). Aina (2017) observes that the study of biology is expanded into various fields such as Genetics, Biochemistry, Physiology, Microbiology, Biotechnology and Ecology.

The word Ecology is derived from Greek words 'Oikos' meaning 'home' and 'Logos' meaning 'Study'. Ecology therefore means a study of the home life of living organisms (Mijopu, 2018). It can also be defined as the scientific study of organisms and their environment (Sarojini, 2013). The study of ecology as a biological concept has contributed towards the conservation of the environment and endangered species, meeting with important ecological issues affecting the environment such as erosion, deforestation, climate change and global warming as well as methods of mitigating them. It also enables man to understand the diversity of life forms, conservation and sustainable use of natural resources. Consequent upon the emergence of varieties of human activities, series of ecological problems have arisen and are being felt globally. This calls for concerted efforts to study ecology as a means of understanding the emergence of ecological problems. The ecological problems have arisen mainly due to various human activities emanating from enormous scientific and technological growth which has embraced every field of human endeavour, with its devastating effect on the environment as a result of rapid industrialization as the means of achieving rapid increase in the nation's productive capacity, as well as improving the standard of living of her people. Unfortunately, there are no functional laws regulating industrial activities most of which have generated considerable industrial pollution and hazardous wastes (Hanora, 2017). Industrialization has, although erroneously, actively encouraged the growth of various kinds of industries like textile, cement, building materials, dairy products, cigarettes, furniture,

tanneries, soap, breweries, iron and steel, glass, oil refineries, petrochemical complexes and pharmaceuticals with concomitant waste materials emitted from their production. The industrial solid and liquid wastes emitted from industrial pollutions significantly overwhelm the ability of urban centres to collect and properly dispose of those wastes.

The problem of solid waste collection and disposal has become one of the most intractable environmental problems facing us today. In the view of Agber (2011), our cities, towns and even the rural communities are decorated with monumental heaps of stinking solid wastes littered on the streets, markets, bus stops, motor parks, and any available space. Some of the affected streets or roads have been rendered impassable for several weeks and months as a consequence or have resulted to permanent closure of such streets or roads. Where dumpsites are available, they are hardly evacuated by the authorities concerned. Same is the case where waste bins are provided they overflow the bin and form ugly heaps along the streets. In many cases however, dump sites and refuse bins are not even available and in such circumstances the waste is dumped indiscriminately anywhere and by so doing backyards, gutters, and any available space are converted into unauthorized dump-sites. These refuse dumps form habitats for worms, flies, rates, rodents, snakes and all sorts of pathogenic micro-organisms and vermin. According to Okonkwo (2012), gases emitted from these heaps of refuse pollute the air with offensive stinking odour. It is hoped that the knowledge of biology will bring to bare the dangers of industrial pollution and assist the students to engage and educate the public on ecologically friendly practices that reduces pollution and environmental degradation.

Despite these laudable socio-biological values in boosting the scientific and technological advancement as well as the educational system of the nation, there is persistent poor interest and achievement of students in biology. Persistent poor achievement of students has been observed in Biology national and international examinations as shown in Table 1 in appendix A. This persistent poor performance might be attributed to low interest of students in the subject which leads to poor academic performance. The lack of interest leading to poor achievement may be exacerbated by gender of the students as well as the school location. Biology as an academic discipline in Nigerian secondary schools which is one of the subjects into which ecological issues/concepts for Environmental Education have been infused, is plagued with such problems as poor achievement of candidates in public examinations. The poor achievement may be attributed to lack of interest in the subject by the students. Achievement according to Iwundu (2011) is academic accomplishments of students as a result of exertion of efforts, skills, perseverance and practice. It is the degree or level of success attained at the end of an academic endeavour. Corroborating this view, Uroko (2010) asserts that academic achievement of the individual is learning outcome of the individual. This includes the knowledge, skills and ideas acquired and/ or gained through the course of the study within and outside the classroom situations. It could be seen as the success students make in their academic pursuit. For example, if a student is able to pass West African School Certificate Examination (WASCE) at A, B and C levels, it can be said that the student has made success in the said examination. But if the student in question has made Ds, Es and Fs, it can be said that the student did not succeed in the said examination. This implies that the yardstick for measuring students' level of academic achievement is by assessing the academic performance of the individual through test (Ernest-Ehibudu & Opurum, 2013).

Gender is a fundamental variable in teaching and learning especially in the natural sciences. Gender according to Uzoegwu (2004) is varied socially and culturally constructed roles, qualities and behaviours that are ascribed to men and women of different societies. Okeke (2008) refers to gender as the social or cultural characteristics, roles or behaviour which males and females are known for by society. Onyegegbu (2008) defines gender as the sum total of cultural values, attitudes, roles practices and characteristics based on gender. Thus, attributing failures or successes of students to some prejudices that some subjects are made for males (masculine subjects) while others are made for females (feminine subjects). On the issue of gender and achievement, many researchers shared divergent views (Okeke, 2013). In this manner, Onuoha (2010) found that male and female students have almost equal achievement in social studies when exposed to demonstration instructional strategy.

Students' achievement in Biology around the globe could be encouraged through futures wheel. Futures wheel is a method for graphical visualization of direct and indirect future consequences of a particular change or development. It involves brainstorming, flowcharting, questioning, seeking knowledge or information about a phenomenon, it also involves investigating, searching, defining a problem, formulating hypothesis, gathering and interpreting data and arriving at a valid and acceptable conclusion. Students with minimum guidance by teacher make their own observation develop basic scientific concepts, use and interpret different forms of scientific representation (Rober, 2018). This agrees with constructivist approach to the teaching-learning process.

Demonstration instructional strategy is a teaching method used to communicate an idea with the aid of visual such as flip charts, posters, power point, pictorials and diagrams among others. It is a process of teaching learners how to make or do something in a step-by-step process. It is a traditional method of teaching that can raise the interest and encourage learners to think about a topic. In practical life situations, demonstration can be used to teach interpreting blueprints, driving vehicles, welding, building, repairing, solving problems, using a slide rule and filling out a form among others. Futures wheel differs from and is presumed to be more effective in enhancing students' achievement in learning than demonstration method because it utilizes ideas from Vygotsky's constructivism and Ausubel's assimilation theory of cognitive learning and places high value on the harmonization of previous and present knowledge and participation for effective performance. However, literature on the efficacy of futures wheel and demonstration method in determining students' achievement in science subjects with particular reference to biology is sparse. This direction of argument draws attention to the necessity of exploring the effect of futures wheel and demonstration instructional strategies on students' achievement in the selected ecological management in Biology.

Statement of the Problem

One of the problems that the Nigeria society has been grappling with for a long time now is the issue of waste disposal. World Health Organization (WHO, 2019) report mentions Nigeria as one of the countries with a high rate of open defecation and improper waste management system. Similarly, Uba (2021) laments the indiscriminate disposal of waste across Nigeria as one of the environmental hazards bedeviling the nation. With the level of massification of education in Nigeria especially in the science-based subjects like biology, Zaki (2018) opines that most environmental problems in the country should have been a thing of the past.

Unfortunately, the transfer of science-based knowledge from the school to the provision of common practical solutions to the environmental problems has been problematic.

There are indications that more and more Nigeria students are opting for the arts and humanities as well as non-science subjects owing to lack of interest in the science subjects. This is assumed to be responsible for their lack of knowledge in ecological management culminating into ecological degradation perpetrated by the students. Similarly, there is persistent low achievement in Biology in external examinations like the West African Senior Secondary Certificate Examination (WASSCE) and the National Examination Council of Nigeria (NECO) over the years among secondary school graduands. Most stakeholders in the education industry lay the blame on the government for its negligence in the provision of necessary instructional materials, employing qualified teaching manpower as well as paying lip service to the welfare of the teachers which affects their performance in the teaching and learning process. A large chunk of the blame is pointed towards the students for their nonchalant attitudes towards their studies and their parents' ineptitude in the provision of basic educational needs of their wards. The war of blame seems to be unending with no improvement on the students' achievement in biology especially in its content areas that border on the management of the ecosystem.

Furthermore, WAEC chief examiners' reports have consistently lamented students' persistent weak performance in ecological management segments of the biology examination. Public opinions have attributed the cause of poor achievement of the students in the effective comprehension and application of knowledge of ecological management in real life situations to dwindled interest of the learner on the subject matter, and other factors like gender and the pedagogical strategy employed in the teaching-learning process of the subject matter. Although, there has been the utilization of many instructional strategies over the time in the implementation of the biology curriculum, the researcher speculates that most of these ancient or rather conventional instructional strategies have not been capable of eliciting the desired interest in the students in the study of biology with specific reference to ecological and management, hence, their below-average performance in assessment in the subject area. This calls for experimentation on some novel instructional strategies assumed to be capable of generating the desired interest and yielding maximum performance in the subject. Thus, the problem of this study put in question form is 'what is the effect of futures wheel and demonstration instructional strategies on students' interest and achievement in Biology in Benue State?

Objectives of the Study

The main objective of this study is to find out the effects of futures wheel and demonstration instructional strategies on students' achievement in ecological management in Biology. Specifically, the research seeks to:

1. Determine the mean achievement scores of students taught ecological management with futures wheel and demonstration method instructional strategies.
2. Identify the mean achievement scores of male and female students taught ecological management with futures wheel and demonstration method instructional strategies.

1.4 Research Questions

The following research questions were raised for this study.

1. What are the mean interest ratings of students taught ecological management with futures wheel and demonstration instructional strategies?
2. What are the mean achievement scores of male and female students taught ecological management with futures wheel and demonstration method instructional strategies?

Hypotheses

The following hypotheses will be tested at the 0.05 level of significance

1. There is no significant difference in the mean achievement of students taught ecological management with futures wheel and demonstration method instructional strategies.
2. There is no significant difference in the mean achievement scores of male and female students taught ecological management with futures wheel and demonstration method instructional strategies.

Methodology

This section discusses the research methodology adopted in the study. It includes design of the study, area of the study, population, sample and sampling techniques, instrument for data collection, validation, reliability, and method of data analysis. **Design of the study:** The design adopted for the study is a quasi-experimental research design. A quasi-experimental research design is a research design where there is no complete randomization of subjects used in the study. This method was adopted in order to avoid disruption of school programmes and schedules. The research made use of use two streams of SS2 students as experimental and control groups respectively. Hence, non-equivalent intact classes were randomly assigned to the two groups.

Area of the Study: This study was conducted in Katsina-Ala Local Government Area of Benue State. The local government area consist of secondary schools located in the rural areas of Ikurav-Tiev, Tongov and Shitile socio-cultural segments as well as certain urban centres like Katsina-Ala township, Tor Donga, Gbor, Abaji-Kpav and Amaafu. The researchers chose the area for the study because the presence of both primary and post primary educational institutions which are both publicly and privately owned. The area also houses College of Education, Katsina-Ala which produces teachers in different areas of specialization biology inclusive; has a Centre for Undergraduate Studies affiliated with the University of Calabar, Calabar and also frequently organizes seminars, conferences and workshops for teachers' retraining. In the midst of these advantages, senior school students' achievement in Biology appears worrisome and dwindling in the area of study.

Population of the Study: The population of the study was all the 112 senior secondary school two students offering biology from the two secondary schools in the local government area. The researcher chose the population because the students in the area have been exposed to the senior secondary school Biology curriculum in which the theme and topics covered in this study were incorporated in the SS2 scheme of work and as such were deemed appropriate for the study.

Sample and sampling techniques: The study was a complete census since all the SS 2 students offering biology in the two sampled schools were used. The researcher made use

of the whole population because of homogeneity of subjects, cost, and adequacy. All the schools used for the study had previously presented students for SSCE/WASCE or NECOSSCE for more than five consecutive academic sessions.

Instrument for Data Collection: The researcher constructed a Biology Achievement Test (BAT) for data collection. The BAT consisted of 25 multiple choice-objectives questions. The questions were culled from the West African Senior School Certificate Examination (WASCE) past question papers and Biology textbooks on ecological management. The question numbers were reshuffled for post-post administration.

Reliability of the Instrument: A trial test was conducted on 26 SS2 Biology students who did not constitute the research population. Using Kuder-Richardson formula twenty [K-R20] for reliability test, a reliability coefficient of 0.78 was obtained, thus, the instrument was adjudged to be reliable for the study.

Method of Data Collection: A pre-test was conducted in the two sampled schools during the fifth week of resumption in the third term when it was discovered that all those weeks were scheduled for assessment in the sampled schools. At the end of the ninth week of the term, a post-test was administered on the experimental groups. The BAT scripts were marked and scored between the minimum of 0 and maximum of 100 percentage (%).

Method of Data Analysis: Mean scores and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. Results were presented in tables followed by brief interpretation.

Presentation of Results

Research question 1: What are the mean achievement scores of senior secondary school biology students taught ecological management with Futures wheel and those taught with demonstration instructional strategies?

Analysis of data relating to the above research question is presented on Table 1.

Table 1: Mean Achievement Scores of Senior Secondary School Biology Students taught ecological management with Futures wheel Instructional Strategy and those taught with demonstration method instructional strategy.

Strategy	Pretest		Post test	
	Mean	SD	Mean	SD
Futures wheel	44.64	9.43	78.25	14.11
Lecture method	12.44	3.13	22.22	6.25

Table 1 shows the mean achievement scores of SS2 students taught ecological management with Futures wheel and demonstration instructional strategies. The table shows that students' achievements [posttest] scores of 78.25 is higher as against their pretest score of 44.64 in the Futures wheel strategy group. The table also revealed that a higher achievement score of 22.22 for those taught with demonstration method strategy as against their pretest score of 12.44.

This therefore, indicated a mean post-test achievement difference of 56.03. The high achievement was as a result of using and comparing the two instructional strategies.

Ho1: There is no significant difference in the mean achievement scores of senior secondary school Biology students taught ecological management with Futures wheel instructional strategy and those taught with demonstration method strategy.

Analysis of data relating to the above hypothesis is presented in table 2.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	32275.527 ^a	3	71142.222	13.262	.000
Intercept	526842.633	1	526842.633	373.742	.000
Pretest	42642.384	1	42642.384	75.843	.000
Strategy	537.846	1	537.846	.824	.337
Error	455733.227	111	224.661		
Total	2332560.00	112			
Corrected Total	339812.371	111			

(Significant $p < 0.05$, Ho rejected)

Table 2: ANCOVA for the Difference in Mean Achievement Scores of Senior Secondary School Biology Students taught ecological management with Futures wheel Instructional Strategy and those taught with Demonstration Instructional Strategy.

Table 2 shows the ANCOVA result for the difference in mean achievement scores of senior secondary school Biology students taught with Demonstration instructional strategy and those taught with Futures-wheel strategy. From the table, F value (.824) is significant at .337. This level is greater than 0.05 significant level hence the null hypothesis was rejected. This implies that there is a significant difference in the mean achievement scores of senior secondary school Biology students taught with Futures wheel instructional strategy and those taught with demonstration instructional strategy.

Research question 2: What are the mean achievement scores of male and female students taught ecological management with futures wheel and demonstration method instructional strategies?

Data relating to the above research question is presented in Table 3.

Strategy	Pretest		Post test	
	Mean	SD	Mean	SD
Male	32.48	7.42	83.11	11.57
Female	17.26	2.13	37.72	4.25

Table 3: Mean achievement scores of male and female students taught ecological management with Futures wheel and demonstration instructional strategies.

Table 3 shows the mean interaction effect of Futures wheel and demonstration instructional strategies on gender (male and female) senior secondary school Biology students taught basic ecological management. The table reveals that male students' achievement [posttest] scores of 83.11 and 37.72 are higher than their pretest scores of 32.48 and 17.26 for both genders respectively. The result indicates that males had higher achievements than their female counterparts when exposed to the two instructional strategies. This shows that the efficacy [interaction effect] of the two instructional strategies on gender as was employed in the study.

Ho2: There is no significant difference in the mean achievement scores of male and female students taught ecological management with futures wheel and demonstration method instructional strategies.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	38324.473 ^a	3	62232.272	27.271	.000
Intercept	218345.441	1	218345.441	428.423	.000
Pretest	46144.647	1	46144.647	44.812	.000
Strategy	353.248	1	353.248	.703	.368
Error	611410.204	111	247.673		
Total	2367120.06	112			
Corrected Total	672212.511	111			

(Significant $p < 0.05$, H_0 rejected)

Table 4: ANCOVA Results for the Difference in Mean Interaction Effect of Futures-wheel and Demonstration Instructional Strategies and Gender on Senior Secondary School Students Achievement in Biology

Table 2 shows the ANCOVA results for the difference in mean achievement scores of senior secondary school Biology students taught with Futures-wheel instructional strategy and those taught with Demonstration strategy. The table showed an F value of .703 that is significant at 0.000. This level is greater than 0.05 significant level thus the null hypothesis is rejected. This implies that there is a significant difference in the mean achievement scores of senior secondary school Biology students taught with Futures-wheel instructional strategy and those taught with Demonstration strategy.

Discussion of Findings

The findings on research question one show that there was a difference in the mean achievement scores of senior secondary students taught Biology with Futures wheel and demonstration instructional strategies in Katsina-Ala Local Government Area of Benue State as indicated by the standard deviation and the mean difference. Findings further show that the mean achievement [posttest] students score of those in Experimental Group one (EG1: Futures wheel) were higher than their counterparts in the Experimental Group two (EG2: demonstration). On the other hand, the hypothesis shows a significant difference in the mean achievement scores of senior secondary school Biology students taught ecological management with Futures wheel instructional strategy and those taught with demonstration instructional strategy. This result agrees with Adedipe (2020) who found out that students who were taught biology through Futures-wheel had higher achievement mean scores than

their counterparts taught with demonstration method. This result can be accepted in the area of study because Futures wheel instructional strategy encourages ingenuity among the students in the course of finding solutions to problems and thus have a higher potential for enhancing maximum performance in assessment after the teaching-learning process.

The second finding of the research shows the interaction effect of Futures-wheel and demonstration instructional strategies and gender (male and female) on students' achievement in senior secondary school Biology. The result indicates that males showed higher achievement than their female counterparts in the two experimental groups. Similarly, the result of the hypothesis tested at 0.05 level of significance shows that there is a significant difference in the interaction effect of the two instructional strategies and gender on students' achievement in senior secondary school Biology. This result rhymes perfectly with the findings of Udennia (2016) who found out that males' academic performance improved significantly higher than their female counterparts when exposed to Futures wheel instructional strategy. This result could be accepted in this area of study because personal observation and performance-evaluation assessment have revealed the male persistently responding more positive to insight-inspiring instructional strategies than their female counterparts.

Conclusion

The findings arrived at from the study indicate that the two instructional strategies were all effective, comparing their pretest scores, but specifically revealed that futures wheel instructional strategy was more effective due to the high achievement scores of students than their counterparts in demonstration instructional strategy. Also, there was an interaction effect of the two instructional strategies with Futures wheel male learners performing higher than their female counterparts when exposed to the instructional strategies.

Recommendations

Based on the findings of this study, the researcher recommendations that:-

1. The government and teacher-training institutions should train teachers on the use of Futures wheel in the teaching-learning process. This can be done by engaging schools and teachers in capacity-building programmes such as seminars and conferences.
2. Premium and individualized attention should be placed on the female students while in the teaching-learning process as their performance in the research was found to be comparatively lower than their male counterparts.

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