Interactive Influence of Cognitive Style and School Location on Secondary School Students' Acquisition of Practical Skills in Biology

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Abstract

Student's acquisition ***of*** practical skills in Biology can promote scientific and technological literacy ***of*** citizens in a nation. This could enhance the standard ***of*** living ***of*** the citizens in the nation by promoting the nation's sustainable economic development. In Nigeria the students' acquisition ***of*** practical skills in Biology is declining. Hence, the main purpose ***of*** this study was to determine the interactive influence cognitive style and school location on secondary school students' acquisition ***of*** practical skills in Biology. Two research questions and three hypotheses were formulated to guide the study. This study was carried out in Rivers State Central Education Zone. The study adopted Ex-post factor research design. The target population ***of*** the study was ***7,2577*** SS3 Biology students. A sample size ***of 540*** SS3 Biology students participated in the study. The multi stage sampling technique was carried out in three stages namely; zonal level, local government level and school level. A simple random sampling by balloting was carried out to select one zone out ***of*** the 3 zones in Rivers State. A second round ***of*** simple random sampling by balloting was used to select 3 local government areas out ***of*** the ***9*** local government areas ***in the*** zones. Disp~~r~~o***p***ort~~io~~nate stratified random sampling was carried out on basis ***of*** school location (urban and rural schools) to select ***6*** secondary schools out ***of*** the ***59*** secondary schools in the 3 selected local government areas. All the SS3 Biology students ***of*** the 6 schools participated in the study. The data collected were analyzed using mean and standard deviation for answering the research questions while Analysis ***of*** Variance ***(ANOVA)*** was used for ***testing the*** hypotheses at ***.05*** level ***of*** significant. The study found out that, cognitive styles have significant influence ***P < .05*** on students' mean scores in Biology practical skills. School location has significant influence ***P < .05*** on mean scores ***of*** students Biology practical

skills. There is no significant interaction ***of*** the influence ***of*** cognitive style and school location ***P > .05 on*** mean scores ***of*** students in Biology practiced skills. It ***was*** recommended that. Biology teachers should organize their Biology practical lessons in such a way that all students ***of*** different cognitive styles would benefit, optimally, ***irrespective of*** their school locations.

Keywords: Cognitive Style, School Location, Practical Skills, Biology

Introduction

The need for citizens of a nation to acquire Biology practical skills as indispensible indices of a nation's overall sustainable development cannot be over emphasized. Acquisition of Biology practical skills can promote the development of science and technology in a nation. This it could achieve by carrying out one of its major roles of stressing the potential of science as to promote intellectual qualities and skills among citizens rather than knowledge of particular scientific facts and theories as has been the status quo. Pursuit of Biology education leads to material reconstruction and development of self reliance skills and modernization. Basically, the economic and social development of both developed and developing nations like Nigeria depend largely on the level of scientific and technological literacy of her citizens. Although, all branches of science have contributions to make in a nation's scientific and technological development.

Above all, Biology is the pivot on which science and technology discipline and careers hinged for national development, (Juncture, cited in Njoku and Ezinwa 2014). This is due to the fact that, many materials that are used in our modem society today are inventions resulting from practical works in Biology laboratories. Chemical analyses were used in production of fertilizers, insecticides and weed killers. In order to safeguard public health there is constant checking of food, drugs, cosmetics and water supply which is done by the process of analytical Biology. Hence there is hardly any branch of national economy which does not make use of the analytical Biology technique **(verma, 2010).**

Despite, the enormous importance of Biology to national development and the careers available for the people with qualifications in Biology and Biology related

disciplines, students still perform poorly in Biology at the secondary school level, (Nbina ,2011). More than half the number, of students who take science subjects each year fail the subjects at West African Senior School Certificate Examination (WASSCE), **(Alozie, 2012).**

Biology is a practical subject and effective learning of Biology may take place when the subject is taught through medium of practical work. Hence, there is the probable feeling that, the cause of students' failure in Biology and other science subjects could be due to lack of practical skills in Biology (Hirvonen and Viri, 2002, Nbina, 2011). West African Senior School Certificate Examination (WASSCE) chief examiners **report (2012)** stated that, in Biology 1A and IB (practical) the candidates raw mean score was 24 with a standard deviation of 9.59, this shows that their achievement was a bit poorer than that of May /June 2011 (WASSCE) which mean score of candidates was 24 with a standard deviation of 9.27. Some of the inadequacies in the achievement of candidates were attributed to; poor mathematical skills, use of wrong litre and inconsistency in burette readings, (WAEC, 2012).

Nbina (2011) notes that the lack of practical skills in Biology among young school leavers could be due to lack of exposure to practical activities. Although for students to be exposed to such learning experiences, laboratory materials and apparatus have to be made available for both teachers and students. In Rivers State, the laboratories of most schools are not well equipped. The teachers purchase or borrow laboratory materials when they receive practical instructions papers for senior secondary school examination. Some Biology teachers in urban areas of Rivers State complain of difficulty in handling large number of students during practical activities. The most painful is that some laboratories in the urban schools in Rivers State are not spacious enough to accommodate all the Biology students during practical activities. The students are most times separated into two or more groups to carry out practical work in different days due to their large number. The poor laboratory situation can contribute to students' low acquisition of practical skills in Biology.

Skill is the expertness, dexterity, a talent or craft accomplishment, naturally acquired or developed through training. While practical skill is the manual

expression of dexterity or aptitude or ability appropriate for specific job (Neil, Aldus, Brooke, Brepling, Graherty, Echallier and Maclean 2007). Hence, practical skill is the manual expression of competence appropriate for a specific job, which is innate in a person or developed through training. Biology practical skills are subsets of science process skills. They are taught or enshrined in Biology curriculum. They are activity based skills which can be acquired through training or direct experience. In this study Biology practical skills are manipulative skills, controlling extraneous variables, measurement skills, work habit, safety skills, inference, interpretation of observation, mathematical skills and observation, recording of data and communication. People who are thoroughly trained and have adequate practical skills will have good feeling about science subjects and such people will have confidence in their own abilities than those with purely theoretical background **(Huchings, 2008).**

Furthermore, despite the several efforts made by science educators, practical skills acquisition among students in Biology and other science subjects are still low, (Odifia, 2009). The factors that could be responsible for low acquisition of practical skills in Biology are cognitive styles of processing information and school location. Acquisition of practical skills can be determined by what the students know about science (scientific knowledge) and what strategies the students use in task performance (cognitive) Science is a human activity and scientific knowledge is a human creation **(Gbamanja, 1999).** For human creation to be achieved cognitive style of processing information cannot be ignored.

Pitcher (2002) defines cognitive style as the relatively stable strategies, preferences and attitudes that determines an individual's typical modes of perceiving, remembering and problem solving **Okoye (2004)** defines cognitive style as the individual's preferred way of processing and transforming information and organizing new knowledge and interpreting it within the memory structure. From the above ideas as related to this study, it becomes imperative to say that cognitive styles are the distinctive ways individuals process information and express thoughts in the process of knowing and understanding a particular learning content. This definition is in line with the field dependent and field independent cognitive styles which are used in this study. Field dependence and field independence refers to the degree to which the organization of the prevailing field

dominate perception **(Witkin. Moore, Godenough and Cox, 1977).** According to **Witkin. Moore, Godenough and Cox cited in Mindgarden (2013)** states that field dependent person has difficulty finding geometric shape that is hidden in the background with similar (but not identical lines and shapes. While a person who is field independent can readily identify geometric shape of the background it is set).

Furthermore, the importance of school location makes it pertinent for science educators to think that school location could interact with cognitive style to influence students' acquisition of practical skills in Biology. School location in this study refers to the situation of an educational institution or school (Whether urban or rural). Urban areas in this study refers to communities located in city or town. They include: state capital, local government headquarter of both urban and rural communities as well as communities that are close to state capital that enjoys social infrastructures like a city. While rural areas are villages or hamlet communities.

The area which a school is located can affect the students' acquisition of practical skills. In rural areas of certain culture and social construct, the choice of subjects and participation in some topics could be influenced by ways students feel at their homes. However, in urban areas of mixed cultures and social construct, the choice of subjects and participation in some topics may not be influenced by the way students feel in their homes. Thus, this means that mode of community life style (whether rural or urban) which encompasses cognitive style and gender could be a potential factor that could determine the extent of practical skills acquisition among students. Hence, Alokan and Arijesuyo (2013) notes that many schools in the area of education seem to have shifted studies from measure of individual to measure of environment. The reason is due to the probable feeling that the environment could be manipulated so as to bring about optimal good conditions for learning. The good conditions could easily affect ideational style or cognitive style of students in processing Biology information.

Above all, the concern about potential rural-urban differences in educational outcomes is not limited to one country, rather it appears to be a global issue **(Alokan and Arijesuyo,** 2013). Hence, there is the need to determine how cognitive styles could interact with school location to influence students'

acquisition of practical skills in Biology.

Purpose of the Study

The main purpose of this study was to investigate the interactive influence of cognitive styles and school location on secondary school students' acquisition of practical skills in Biology. Specifically, the study was designed to find out the:

1. Influence of students cognitive styles on acquisition of Biology practical skills.
2. Influence of school location on students acquisition of practical skills in Biology.
3. Interactive influence of cognitive style and school location on students' acquisition of Biology practical skills.

Research Questions

The following formulated research questions guided the study:

1. What are the mean scores of students of different cognitive styles in Biology practical skills?

2. What are the mean score of urban and rural school students in Biology practical skills?

Hypotheses

The following null hypotheses which were tasted at .05 level of significance further guided the study.

Hoi: Cognitive styles do not have significant influence on students mean scores in Biology practical skills.

H**02**: School location does not have significant influence on mean scores of students in Biology practical skills.

H03: There is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills.

Methodology

This study adopted ex-post facto research design. The study was carried out in Rivers State central education zone, Nigeria. A sample size of five hundred and forty (540) SS3 Biology students participated in the study. The multi stage sampling technique was carried out in three stages namely, zone level, local

government level and school level. Simple random sampling by balloting was used to select one zone out of the three educational zones in the state. A second round of simple random sampling was carried out to select three local government areas out of the nine local government areas in the zone. Disproportionate stratified random sampling was carried out on basis of school location (urban and rural schools) to select six schools out of the 59 public secondary schools in the three selected local government areas. All the SS3 Biology students of the 6 selected sample schools participated in the study. The data collected were analyzed using mean and standard deviation for answering the research questions while Analysis of Variance (ANOVA) was used for testing the hypotheses at 0.05 level of significance.

Results

Research Question I

What are the mean score of students of different cognitive styles in Biology practical skills?

Table I: Mean and the standard deviation scores of field independent students and field dependent students in Biology practical skills

Cognitive style	**N**	***X***	**SD**
Field Independent	**172**	**213.95**	**33.45**
Field Dependent	**368**	**173.75**	**30.45**
Mean Df		**40.20**	

From Table I, it can be observed that the mean score of field independent cognitive, style students in Biology practical skills was 213.95 with a standard deviation score of 33.45, while the mean score of field dependent cognitive style students was 173.75 with a standard deviation score of 30.45. The mean difference of the field independent cognitive style students and field dependent cognitive style students was 40.20.

This indicates that the field independent cognitive style students have acquired practical skills in Biology more than the field dependent cognitive style students. The higher standard deviation of the field independent cognitive style students shows that their scores deviated more from the mean than the scores of the field

dependent cognitive style students. This means that the higher mean score of the field independent cognitive style students above that of the field dependents students mean score may not be real as it appears.

Hypothesis I

Cognitive styles do not have significant influence on students' mean scores in Biology practical skills

Table 2: Analysis of Variance (ANOVA) of the influence of cognitive styles on students' mean score in Biology practical skills

Source	*Type III sum of squares*	*Df*	*Mean square*	*F*	*Sig.*
Corrected model	***22950.241″***	***7***	***32792.892***	***35.484***	***.000***
Intercept	***1.3427***	***1***	***1.3427***	***14516.627***	***.000***
Cognitive style	***155106.160***	***1***	***155106.160***	***167.834***	***.000***
Error	***491655.202***	***532***	***024.164***		
Total	***1.951***	***540***			
Corrected total	***721205.443***	***539***			

Table 2 shows that an F-ratio of 167.83 - with associated probability value of 0.0 was obtained. This probability value of 0.00 was compared with 0.05 and it was found to be significant because 0.00 was less than 0.05. The null hypothesis was therefore rejected and inference drawn that, cognitive styles have significant influence on students' mean scores in Biology practical skills.

Research Question 2

What are the mean score of urban and rural school students in Biology practical skills?

Table 3: Mean and standard deviation on scores of urban and rural school students in Biology practical skills.

Location	N	***X***	SD
Urban	404	***377.47***	61.40
Rural	136	417.33	66.17
Mean Diff.		39.86	

Table 3 shows that, the mean score of urban school students in Biology practical skills was 377.47 with standard deviation of 61.40. The mean score of rural school students in Biology practical skills was 417.33 with a standard deviation score of 66.17. The mean score differences of the rural school students and that of urban school students practical skills in Biology was 39.86. The higher mean score of the rural school students indicates that the rural school students did better than the urban school students in Biology practical skills. However, the higher standard deviation of the rural school students indicates that, the mean score of the rural students deviated from the mean more than that of the urban school students. This means that, the higher mean score of the rural school students may not be real as it appears.

Hypothesis 2
School location does not have significant influence on mean scores of students in Biology practical skills.

Table 4: Analysis of Variance (ANOVA) of the influence of school location on students' mean scores in Biology practical skills.

Source	*Type in sum of squares*	*Df*	*Mean square*	*F*	*Sig.*
Corrected model	*22950.24 l[a]*	*7*	*32792.892*	*35.484*	*.000*
Intercept	*1.3427*	*1*	*1.3427*	*14516.627*	*.000*
Location	*31183.315*	*1*	*31183.315*	*33.742*	*OOO*
Error	*491655.202*	*532*	*924.164*		
Total	*1.951*	*540*			
Corrected total	*721205.443*	*539*			

The result in Table 4 was used to determine whether school location have significant influence on the mean score of students of different cognitive styles in Biology practical skills. Table 4 shows that an F-ratio of 33.74 with associated probability value of 0.0 was obtained. The probability value of 0.0 was compared with 0.05 and it was found to be significant because 0.0 was less than 0.05. The null hypothesis was therefore rejected and inference drawn that, school location has

significant influence on the mean score of students in Biology practical skills.

Hypothesis 3

There is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills.

Table 5: Analysis of Variance (ANOVA) of the interaction of the influence of cognitive styles and school location on mean scores of students in Biology practical skills.

Source	*Type III sum of squares*	*Df*	*Mean square*	*F*	*Sig.*
Corrected model	*22950.241®*	*7*	*32792.892*	*35.484*	*.000*
Intercept	*1.3427*	*1*	*1.3427*	*14516.627*	*.000*
*Cognitive style *Location*	*2555.632*	*1*	*2555.632*	*2.765*	*.097*
Error	*491655.202*	*532*	*924.164*		
Total	*1.951*	*540*			
Corrected total	*721205.443*	*539*			

The result in Table 5 was used to determine whether there is significant interaction influence of school location and cognitive style on mean score of students in Biology practical skills. Table 5 shows F-ratio of 2.76 with associated probability value of 0.09 was obtained. This probability value of 0.09 was compared with 0.05 and it was found that 0.09 was greater than 0.05. Hence, the null hypothesis was therefore accepted and inference drawn that there is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills.

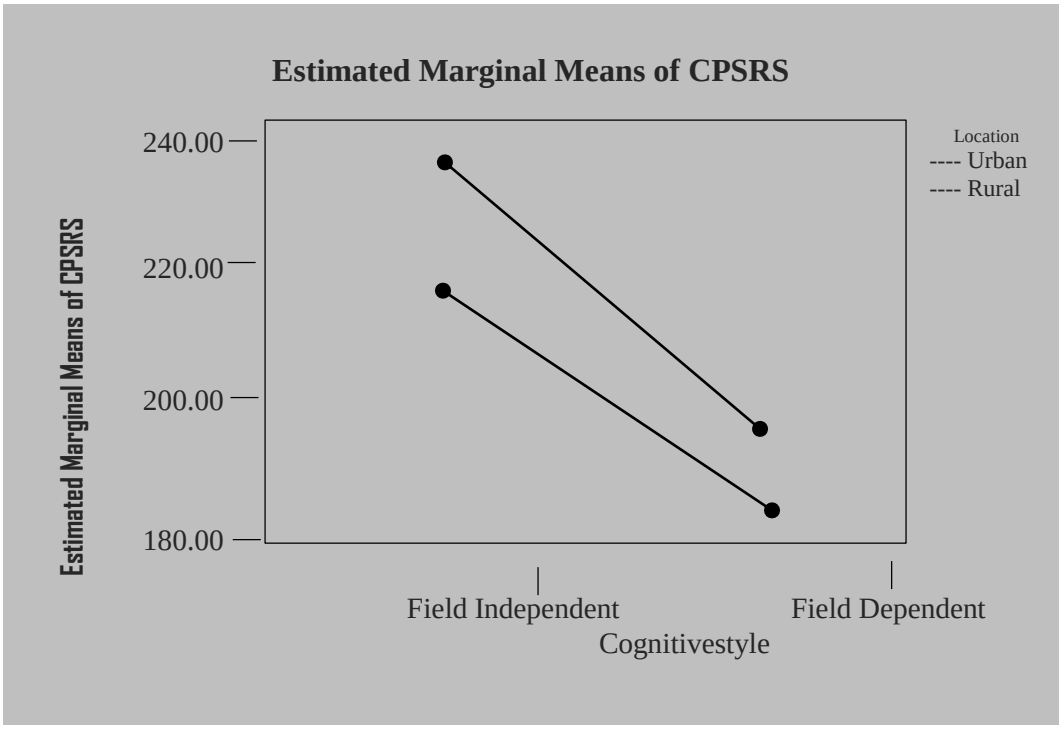


Figure I Graph of interaction of cognitive style and school location on students mean scores in Biology practical skills.

Further analysis to show whether there is significant interaction of the influence of cognitive style and school location on means scores of students in Biology practical skills is shown in figure I. The profile plots shows that, there is interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills but the interaction is not significant. This is because the two lines of the graph are not parallel to each other as drawn and they did not also intersect.

Discussion

The result of Analysis of Variance (ANOVA) used in testing hypothesis one as shown in Table 2; yielded an F-ratio of 167.83 and associated probability value of .00. The result of this study indicates $P < .05$ and cognitive styles have significant influence on students' mean scores in Biology practical skills. Hence, the null

hypothesis one (Hoi) of the study, which states that cognitive styles do not have significant influence on students' mean scores in Biology practical skills was rejected. The finding of this study was in line with the findings of (Blacksburg, 2006; Bassey and Udidia, 2011; Alegra, 2012 and Okoye, 2014) as they concluded that cognitive styles significantly influences students' learning regardless of the subject area that is involved and also have significant influence on students acquisition of practical skills. The finding of this study has also confirmed and supported the statement that field dependence and field independence constitute an important aspect of individual differences among students regarding the way they acquire practical skills or process information. This is due to the higher performance of field independent students over the field dependent students in Biology practical skills.

Table 4 showed that, an F-ratio of 33.74 and associated $P < .05$ was obtained. The result of this study indicates that school location has significant influence on mean scores of students in Biology practical skills. Hence, null hypothesis two **(H_{02})** of this study which states that school location does not have significant influence on mean scores of students in Biology practical skills was rejected. The finding of this study is in agreement with that of **Agboghoroma (2009), Adigun and Yusuf (2010) and Akpochafo (2001)** who reported that school location has significant influence on students' performance and achievement in school subjects. Although, some other studies states that school location do not have significant influence on students' acquisition of science practical skills (Omajuwa 2011 and Jack, 2013). Above all, this study has confirmed that school location significantly influenced students' acquisition of Biology practical skills.

Table 5 showed that, an F-ratio of 2.76 was obtained with associated $P > .05$. The result of this study shows that, there is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills. Hence, the null hypothesis three (H_{03}) of this study which states that there is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills was accepted. A further analysis by the use of profile graph plots showed that, there is interaction of the influence of cognitive style and school location on means scores of students in Biology practical skills but the interaction is not significant because the two line

graphs are not parallel and did not intersect with each other. The finding of **Okereke** (2011) states that, there is significant interaction influence of cognitive style and school location on mean scores of students in science practical skills did not agree with the present finding. The result of this study has confirmed that, there is no significant interaction of the influence of cognitive style and school location on mean scores of students in Biology practical skills.

Conclusion and Recommendations

This study has shown that cognitive styles have significant influence on students' acquisition of practical skills in Biology. It is therefore, necessary that Biology teachers should discover the cognitive styles of their students and organize their lesson in such a way that students of different cognitive styles will benefit optimally. For instance, as it was revealed that field independent students did better than field dependent students in Biology practical skills. It becomes pertinent for the field dependent students to be given instructional treatment to enable them match with their field independent counterparts in acquisition of Biology practiced skills.

This study has also shown that the rural school students did better than their urban school counterparts. The study justified this chain by revealing that the laboratories of the rural schools were well equipped and spacious enough to permit the few students of rural schools work effectively irrespective of their cognitive styles. This is because their laboratories were financed by multinational companies and the state government while that of urban schools with large population are only financed by government and Parents Teachers Association (PTA). Hence, it is important that school laboratories should be well equipped and spacious enough to enable the students participate effectively in their practical activities irrespective of their cognitive styles and school locations.

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