

Assessing the Effectiveness of Audiovisual, Kinesthetic and Lecture Instructional Methods in the Teaching and Learning of Ecological Concepts

Y. Ameyaw¹, F. K. Nkansah², M. A. Owusu³

¹P. O. Box 25, Department of Biology Education, Faculty of Science Education, University of Education, Winneba, C/R, Ghana, W/Africa

²Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi, A/R, Ghana, W/Africa

³Adu Gyamfi Senior High School, Jamasi, A/R, Ghana, W/Africa

Abstract: *This article investigated the effects of audiovisual and kinesthetic instructional methods on students' performance in ecology among Adu Gyamfi Senior High School Biology students, Ashanti Region. Quasi experimental design was adopted for the study. A sample of 100 students was purposively selected for the study. Ecology achievement test was constructed and used to collect data for the study and reliability coefficient of the instrument was calculated to be 0.81 using Kuder-Richardson formula 20 (KR-20). Data obtained from the study were subjected to both descriptive and inferential analysis such as mean, standard deviation, box plot, mean plot, eta squared effect size, one-way ANOVA, two-way ANOVA and Post-Hoc Tukey HSD test with the support of SPSS version 20. It was established that both kinesthetic ($p > .001$) and audiovisual ($p > .001$) instructional methods were superior to conventional lecture method in the teaching and learning of Ecology. However, the paired comparison of kinesthetic instructional method and audiovisual instructional method showed a mean difference of 1.29, which indicates no statistical significant difference between these two methods ($p = .641 > .05$), hence there was no superiority of one on the other. One of the reasons to this result might be because the students in the kinesthetic and audiovisual instructional groups were taught according to their learning styles. Finally, the study revealed that gender had no significant effect on students' performance in teaching and learning of ecological concepts. Again, there was no interaction effect of the teaching methods and gender on the students' academic performance in the concept of ecology. Based on this, it was concluded that SHS Biology students learn ecological concepts better, when instructional method matches students' learning styles. It is therefore recommended that students' learning styles should be considered when teaching ecological concepts, and teachers should be trained and re-trained on the use of audiovisual and kinesthetic learning styles in teaching ecological concepts.*

Keywords: Academic Performance, Ecology, Audiovisual Teaching Method, Kinesthetic Teaching Method, Lecture Teaching Method

1. Introduction

For decades, researchers and teachers made concerted efforts to improve the teaching and learning of biology and teachers are expected to teach the same curriculum to all students irrespective of their differences (Asabere-Ameyaw, Dei, & Kalawole, 2012). But it is not an easy task for teachers to meet the needs of all students in their classrooms. Teachers and researchers are aware of learner individual differences for decades but little was done to address the situation. Instead, cooperative learning or flexible groupings were used with uniform instruction. Therefore the need to conduct research to address students' instructional preferences cannot be over emphasized. The challenge is how to diagnose why individual students are able or unable to learn, and searching for appropriate framework that support them to learn. It has been suggested that one of the ways to encourage learners active involvement in their education is to give them tools to help them become better learners regardless of the setting in which they are learning. Teachers can address learner needs by using a variety of teaching methods so that learners are exposed to multiple ways of learning thereby ultimately giving them opportunities to excel (Graf, Liu, & Kinshuk, 2010). To that effect this study suggests that an effective means to reach all learners is through modality based instruction such as visual, audio and kinesthetic teaching and learning style. Visual, Audio, Kinesthetic learning theory suggest that learners use three modalities to receive and acquire new information and

experiences (Abbas, 2012). However one or two of these receiving modalities is normally dominant. Since the theory of visual, audio and kinesthetic learning was based on individual difference and this study suggests that it could be the preferred frame work, because it was meant to accommodate the diverse population that teachers come across in their respective classrooms. One central theme of audiovisual and kinesthetic learning model is that individuals can learn and individuals have their own unique ways of mastering new and challenging information. In simple analogy, schools that teach in different ways would increase students' success. Audiovisual and kinesthetic learning theory opined that uniform instruction such as lecture does not have general effects on all learners but works for a portion of the population in the classroom (Cuevas, 2015). In spite of the efficacy of modality based instruction in the teaching and learning of biological concepts in other geographical context, it still remains unclear in Ghanaian context, the extent to which the use of audiovisual and/or kinesthetic teaching methods effect biology students' academic performance in ecology concept. This study therefore seeks to fill this gap. Therefore this study sought to investigate the effects of audiovisual and kinesthetic teaching methods on students' performance in ecology in Adu Gyamfi Senior High School, Ashanti Region. The present study also explored the possibility of an interaction effect of the teaching methods (audiovisual and kinesthetic) and gender. Some studies indicated that the effectiveness of a teaching method on student's performance

Volume 8 Issue 8, August 2019

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

significantly depends on the student gender (Usman, 2000) while other studies did not find any significant interaction effect of teaching method and gender on student performance. The present study, therefore as part of its objectives determined whether there is interaction effect of the audiovisual and kinesthetic teaching methods and gender. In other words, the study looked at sensitivity of gender on the effectiveness of the audiovisual and kinesthetic teaching methods, therefore established whether audiovisual and kinesthetic teaching methods are gender stereotype or not.

The study was guided by the following null hypotheses at 0.05 level of significance:

HO₁: There is no significant difference in the mean performance scores of students taught ecology concepts using kinesthetic, audiovisual and lecture methods

HO₂: There is no significant interaction effect of the teaching methods (kinesthetic, audiovisual and lecture methods) and gender on students' academic performance in ecology concept

2. Methodology

Sample and Sampling Technique

A sample size of 100 was selected from an accessible population of 330 biology students from the selected school (Adu Gyamfi SHS) through simple random sampling and this ensured that all students in the study population had an equal opportunity to be selected as a respondent. This sample size represented over thirty percent (30%) of the target population. They were then classified into three study groups through Fleming learning style indicator and the detail is shown in Table 1.

Table 1: Classification of Participants in Groups

Groups	Males	Females	Total
Audiovisual	15	20	35
Kinesthetic	13	22	35
Lecture Method	10	20	30
Total			100

Source: Field Study, 2018

Instrument for Data Collection

The research instrument consisted of 30 items a teacher-made objectives test, true or false and essay tests for a maximum of 50 marks. The reliability of the test items was obtained by administering the test items to an intact class of a non-participating school. The reliability coefficient of the instrument was calculated to be 0.81 using Kuder-Richardson formula 20 (KR-20). The instrument was considered to be reliable enough for data collection in this study because it was within the acceptable benchmark of reliable instruments (Leedy & Ormrod, 2005).

Research Design

The study employed a quasi-experimental research design which has to do with pre-test, post-test non-equivalent control group.

Data Collection Procedure

The researcher sought clearance from management of the selected school to conduct the study. The selected students

were classified into three study groups (Experiment groups 1 and 2 and control group). Fleming learning style indicator was used in classifying the participants into their respective instructional groups (audiovisual group, kinesthetic group, and lecture Method group). The groups were first tested using the Ecology pre-test instrument to know their knowledge entry level of the concept prior to the study. The two experimental groups (Audiovisual and Kinesthetic groups) were exposed to ecology concept using their designated teaching strategies aligned with their learning style, while control group was exposed to the concept by lecture method for a period of three weeks. This is followed by post-test administration right after the three weeks interventional period and this test was to measure the impact of the interventional methods on students' performance in the concepts.

Data Analysis

Scores obtained from the students in the pre-test and post-test form the data base for the study. After gathering the needed data, appropriate statistical tools were used to interpret the findings of the study. Descriptive statistics such as mean and standard deviation were used. Inferential statistics such as *eta* squared effect size, one-way ANOVA and two-way ANOVA were used to test the hypotheses of the study. Post-Hoc Tukey HSD test was also utilized to identify the significant differences among the categorical variables. Mean plot and box plot were used to show pictorial illustration of the results. The two-way ANOVA test was conducted to determine if there was an interaction effect of teaching method and gender on student performance in ecology. All the analyses were done with the help of statistical package for social sciences (SPSS) version 20 at .05 level of significance.

3. Results

To determine whether the students in the three instructional groups are equivalent in terms of knowledge in the concepts of ecology, their pre-test scores were analysed using both descriptive and inferential statistics (ANOVA). The outcome of the analysis is shown in Tables 2 and 3.

Table 2: Descriptive Statistics of Homogeneity of the Study Groups in the Concept of Ecology Prior to Treatment

Groups	N	Mean	Std. Deviation
Control Group	30	21.32	5.14
Experimental Group 1	35	20.87	4.95
Experimental Group 1	35	21.11	5.31
Total	100	21.10	5.13

Table 2 reveals the mean performance scores of students in experimental groups 1 and 2 in the concept of ecology prior to intervention as 20.87 and 21.11 respectively each with standard deviation of 4.95 and 5.31 while that of control group students had a mean performance score of 21.32 with a standard deviation of 5.14. Furthermore, there was no statistically significant difference in the mean scores among the three groups using their pre-test scores and result as shown in Table 3.

Table 3: Analysis of Homogeneity of Groups Performance in Ecology Concept Prior to Treatment

	Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Between Groups (Selected Groups)	924.47	2	462.24	.037	.650	.005
Within Groups	1676.91	97	17.29			
Total	2601.38	99				

Table 3 indicates no statistically significant difference in pre-ECPT scores between the study groups at $p < .05$ level [$F_{(2,97)} = .037, p = .650$]. Thus, prior to the study the three study groups (control group, experimental group 1 and experimental group 2) were at the same level in terms of their knowledge on concept of ecology and therefore appropriate for the study.

Research Null Hypothesis 1

There is no significant difference in the mean performance scores of students taught ecology concepts using kinesthetic, audiovisual and lecture methods.

Table 4 presents the descriptive statistics of the students' posttest scores among the three teaching groups.

Table 4: Descriptive Statistics of Students Performance in Ecology after Treatment

Teaching Methods/Groups	N	Mean	SD	SE	Min.	Max.
Lecture Method Group	30	26.33	5.14	.93	16	37
Kinesthetic Method Group	35	35.00	6.60	6.60	24	46
Audiovisual Method Group	35	36.29	5.71	5.71	25	47
Total	100	32.85	7.25	.73	16	47

From Table 4, students from audiovisual method group had the highest mean score of 36.29 followed by kinesthetic method group with a mean score of 35.00 and lecture method group with the lowest mean score of 26.33. To determine whether these mean scores among the three instructional groups are statistically different, the post-test scores were further subjected to analysis of variance (ANOVA) at a significant at level of .05. The result is shown in Table 5.

Table 5: Two-Way Analysis of Variance (2-Way ANOVA) Dependent Variable: Academic Performance

	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared
Corrected Model	1850.00 ^a	5	370.00	10.37	.000	.36
Intercept	99989.79	1	99989.79	2803.38	.000	.97
Teaching Method	1744.29	2	872.15	24.45	.000	.34
Gender	.256	1	.256	.007	.933	.00
Teaching Method*Gender	.824	2	.412	.012	.989	.00
Error	3352.75	94	35.67			
Total	113115.00	100				

a. R Squared = .356 (Adjusted R Squared = .321)

The ecology concept performance mean scores (post-test mean score) of students differed significantly among the three teaching methods [$F(2, 94) = 24.45, p < .001$] at 0.05 level of significance with large effect size ($\eta_p^2 = .34$). To detect which of the three teaching methods tests mean scores differed significantly from one another, multiple comparison analysis of the groups was carried out through the Tukey

HSD post hoc test analysis. In light of the number of comparisons that were made, the Tukey post hoc approach was applied because of its power to control for alpha inflation. The result of the multiple comparisons of the groups is summarized in Table 6.

Table 6: Multiple Comparison Analysis of the Students Performance Mean Score

Teaching methods (J)	Teaching methods (H)	Mean Diff. (J - H)	SE	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Lecture Method	Kinesthetic Method	-8.67*	1.486	.000	-12.21	-5.13
	Audiovisual Method	-9.95*	1.486	.000	-13.49	-6.41
Kinesthetic Method	Lecture Method	8.67*	1.486	.000	5.13	12.21
	Audiovisual Method	-1.29	1.428	.641	-4.69	2.11
Audiovisual Method	Lecture Method	9.95*	1.486	.000	.641	13.49
	Kinesthetic Method	1.29	1.428	.641	-2.11	4.69

Dependent Variable: Post-test Scores

* The mean difference is significant at the .05 level

The Tukey HSD test in Table 6 indicates a statistically significant mean score difference ($p = > .001$) between lecture method and kinesthetic method with a mean difference of 8.67, in favour of kinesthetic method. This implies that students who were taught with kinesthetic method performed better than those students taught with lecture method and that kinesthetic teaching method was superior to lecture teaching method. Also, audiovisual method was superior to lecture method with a mean difference of 9.95 ($p = > .001$). Therefore, students taught with audiovisual method performed higher than those students taught with lecture method. However, the paired comparison of kinesthetic method and audiovisual method showed a mean difference of 1.29 which indicates no statistical significant difference between these two methods ($p = .641 > .05$), hence there was no superiority of one on the other. Hence, the null hypothesis was rejected. Pictorially, the mean scores of the three teaching method groups are presented in Figure 1.

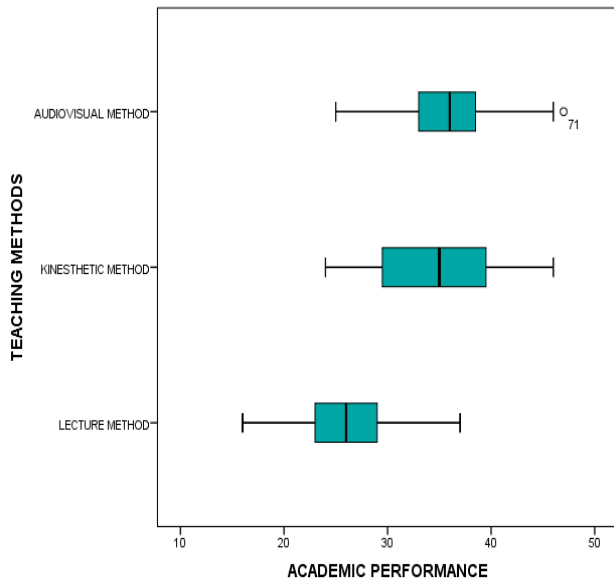


Figure 1: Box Plot Analysis of Students' Performance in after Treatment

In Figure 1, students in both kinesthetic and audiovisual instructional groups equally did well in the ecology concept as their minimum mean scores (kinesthetic = 24 and audiovisual = 25), maximum mean scores (kinesthetic = 47 and audiovisual = 48) and median scores (kinesthetic = 35 and audiovisual = 36) were almost on the level. However, these groups tremendously outperformed their counterparts

in the conventional lecture instructional group who recorded a minimum mean scores of 16, maximum mean scores of 38 and median score of 26. This means that when kinesthetic and audiovisual instructional methods are effectively used in the teaching and learning of ecology, it could improve students' academic performance more than that of conventional lecture method.

Research Null Hypothesis 2

There is no significant interaction effect of the teaching methods (kinesthetic, audiovisual and lecture methods) and gender on students' academic performance in ecology concept.

Again, the result in Table 5 reveals that there was no interaction effect of the teaching methods and gender on the students' academic performance in the concept of ecology. That is, the interaction effect of the teaching methods and gender is not significant as evidenced in the p-value > .05 [$F(2, 94) = .012, p = .989$]. This means that the effectiveness of the teaching methods does not depend on gender or gender has no influence on the effectiveness of the teaching methods. This implies that kinesthetic and audiovisual teaching methods are not sensitive to gender and therefore gender friendly. The mean plot illustration shown in Figure 2 gives a visual inspection of the interaction effect among the teaching methods and gender.

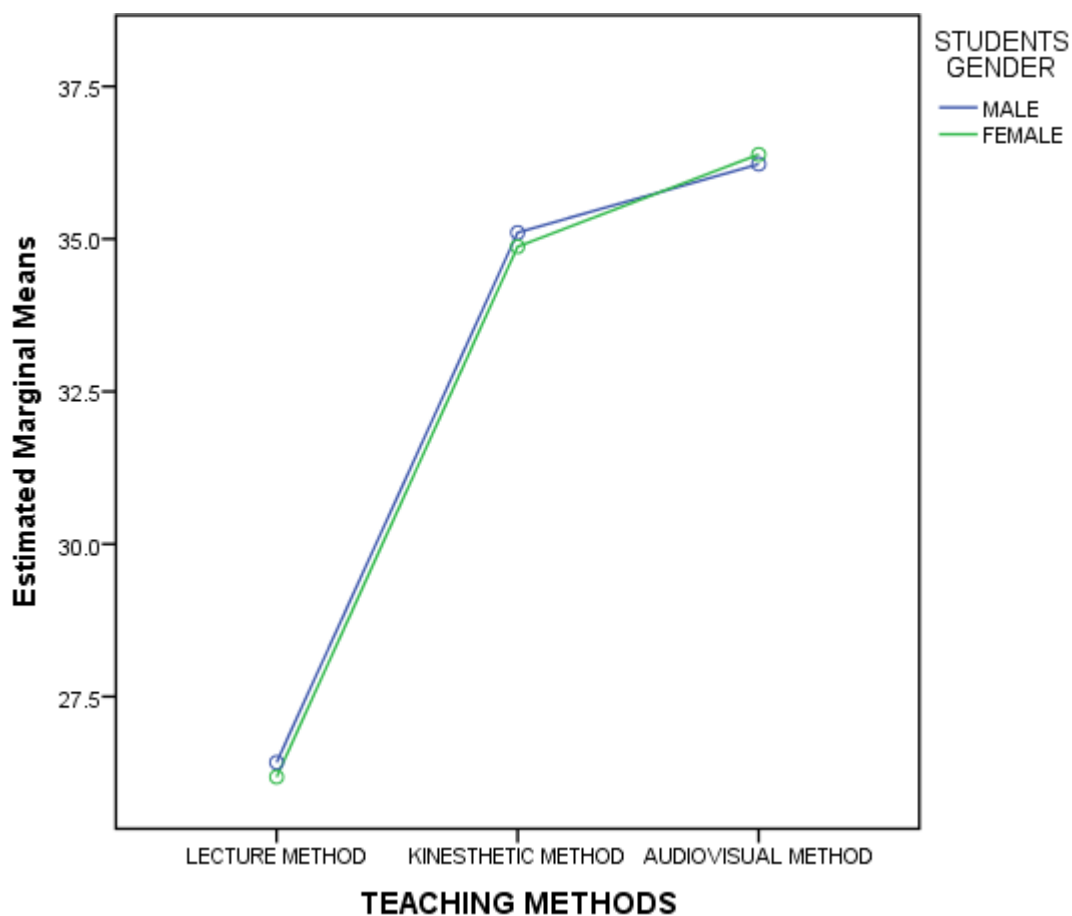


Figure 2: Mean Plot Showing Interaction Effect of Teaching Methods and Gender

It could be deduced from the plot in Figure 2 that male and female students among all the three teaching methods almost have the same mean scores and that there is no significant estimated marginal mean between the males and females in each of the three methods, and this proves that the methods are not sensitive to gender as required by a good instructional method.

4. Discussion

Kinesthetic teaching method was superior to lecture teaching method. This may be so due to the fact that Biology as a science subject requires learners who have zeal for practical activities and that kinesthetic group was taught according to their learning style. Also Kinesthetic teaching approach provided learners with firsthand knowledge on the concept, improved thinking abilities, stimulate a congenial classroom environment, increase in analytical skills and encourage participation in the learning process. This finding is in conformity with the findings of Amanda and Coppola (2006), Sanni and Emeke (2017) and Magulod (2019), whose study findings placed kinesthetic teaching method ahead of lecture teaching method. An audiovisual teaching method was superior to lecture teaching method. It may be possible that the audiovisual group was taught according to their learning style. Again, the audiovisual aid provided more effective understanding of lessons, incites interest in lessons, enriched the teaching and learning process, provided easy way to teach difficult concepts, provided a comprehensive and diversity in teaching methods, provided more meaning and understanding. This is in line with the findings of Thomas and Israel (2014), Liu, (2010) and Ameyaw and Kyere (2019) who concluded that the application of multimedia teaching techniques such as audiovisual approach in science education presents several advantages over the traditional lecture method. The paired comparison of kinesthetic method and audiovisual method showed a mean difference of 1.29 which indicates no statistical significant difference between the two methods. It could be inferred from this finding that both Kinesthetic and Audiovisual teaching methods have equal tendency of enhancing senior high students' achievement in ecology concept. The reason might be because students in the two groups were taught according to their learning styles. This finding contradicts the finding of Rajshree (2013), who discovered the existence of positive high correlation between kinesthetic learning style and academic achievement compare to visual and auditory learning styles. Finally, the study revealed that gender had no significant effect on students' performance in Ecology and that there was no interaction effect of the teaching methods and gender on the students' academic performance in the concept of ecology. This finding contracts the study of Usman (2000), who indicated that the effectiveness of an instructional strategy on student's performance significantly depends on the student gender.

5. Conclusions

Based on the findings it is concluded that Kinesthetic and Audiovisual teaching methods are better instructional methods than the conventional lecture method for teaching ecology concept in Senior High Schools. It is also concluded

that SHS Biology students learn ecological concepts better, when instructional method matches students' learning styles. Learners accomplish understanding through the interaction which occurs during the instructional sessions. That is, learners were allowed to view the processes, interact and relate with what is actually happening and this indeed highlighted the significance of Kinesthetic and Audiovisual teaching methods. The findings of this study have confirmed the prevalent ineffectiveness of conventional lecture teaching method as earlier reported in literature as being one of the causes of students' poor academic performance. This was clearly seen in the control group where students taught with the conventional lecture method obtained the lowest average mean score of 26.33. Finally, the study revealed that gender had no significant effect on students' performance in Ecology and that there is no significant interaction effect of teaching methods and gender on students' academic performance in Ecology. It could also be concluded from this finding that teaching ecology with kinesthetic or audiovisual can address the problems of male/female students' performance disparities in ecology and biology in general as they have proved to be gender friendly.

6. Recommendations

It is therefore recommended that in order to solve the persistent problem of underperformance in ecology as well as a disparity between males' and females' achievements in the concept, teachers should adopt teaching methods such as kinesthetic and audiovisual methods which aid learners to view the processes, interact and relate with what they are learning so as to help in the knowledge transfer and stimulate students to relate classroom knowledge to real life situation. It is also recommended that students' learning styles should be considered when teaching ecological concepts and teachers should be trained and re-trained to master the theories and practice of Kinesthetic and Audiovisual teaching methods in classroom situations in order to greatly improve the present poor students' performance in ecology.

7. Acknowledgements

Appreciation goes to Science Teachers and Students of Adu-Gyamfi Senior High School, Jamasi in the Asante Region of Ghana.

References

- [1] Abbas, P. G. (2012). Visual, Auditory, Kinesthetic Learning Styles and Their Impacts on English Language Teaching. *Journal of Studies in Education*, 2(1), 104-113.
- [2] Amanda, R. & Coppola, A. (2006). Effects of Implementing Kinesthetic Activities in the Classroom. Master Thesis. Retrieved from <https://pdfs.semanticscholar.org>
- [3] Ameyaw, Y. & Kyere, I. (2019). Comparative Effects of Three Teaching Methods on Students' Performance in Human Blood Circulatory System Concepts and Their Retention Rates. *International Journal of Innovative Science, Engineering & Technology*, 6(6), 182-200.

- [4] Asabere-Ameyaw, A., Dei, G. J. S., & Kalawole, R. (2012). Conclusion: Revisioning science and indigenous education in Africa: Meeting future challenges. *Contemporary Issues in African Sciences and Science Education*, 217–222.
- [5] Cuevas, J. (2015). Is learning styles-based instruction effective? A comprehensive analysis of recent research on learning styles. *Theory and Research in Education*, 13(3) 308–333.
- [6] Graf, S., Liu, T. C., & Kinshuk. C. (2010). Analysis of learners' navigational behavior and their learning styles in an online course. *Journal of Computer Assisted Learning*, 26(2), 116- 131.
- [7] Leedy, P. D., & Ormrod, J. E. (2005). *Practical research: Planning and design*. New Jersey: Pearson, Merrill Prentice Hall.
- [8] Liu, S. H. (2010). Factors related to pedagogical beliefs of teachers and technology integration. *Computers & Education*, 56, (2011), 1012–1022.
- [9] Magulod, G.C., Jr. (2019). Learning styles, study habits and academic performance of Filipino university students in applied science courses: Implications for instruction. *Journal of Technology and Science Education*, 9(2), 184-198. <https://doi.org/10.3926/jotse.504>
- [10] Rajshree S. V. (2013). Learning Style and Academic Achievement of Secondary School Students. *Voice of Research*, 1(4), 1-4.
- [11] Sanni, K. T., & Emeke, E. A. (2017). Direct And Indirect Effect Of Personality Type and Learning Style Preferences on Students' Achievement In Senior Secondary School Biology in Osun State, Nigeria. *European Journal of Education Studies*, 3 (11), 825-839.
- [12] Thomas, O. O., & Israel, O. O. (2014). Effectiveness of animation and multimedia teaching on students' performance in science subjects. *British Journal of Education, Society and Behavioral Science*, 4(2), 1-15.
- [13] Usman, I. A. (2000). *The Relationship between students' performance in practical activities and their academic achievement in integrated science using NISTEP mode of teaching*. Unpublished Doctorate of Philosophy Dissertation, Ahmadu Bello University, Zaria.