Journal of Modern Education Review, ISSN 2155-7993, USA
August 2023, Volume 13, No. 4, pp. 200–207
Doi: 10.15341/jmer(2155-7993)/04.13.2023/006

http://www.academicstar.us

The Influence of Learning Styles on Achievement in Activity-Based Biology Instruction

Victor Olu Akinola[1], Premobowei Dele Melekeowei[2]
(1. Department of Educational Technology, Lagos State University of Education, Oto/Ijanikin, Nigeria;
2. Department of Counselling Psychology Education, Lagos State University of Education, Oto/Ijanikin, Nigeria)

Abstract: This investigation monitored Achievement in activity-based biology instruction and the influence of learning styles in the Senior Secondary Schools in Lagos State, Nigeria. A quasi-experimental design was adopted. Two groups employed in the experiment were activity-based experimental group with intent class of 64 students and a control group with intact class of 72 students. A total of 136 students were exposed to treatment for six weeks using Instructional Package on Ecology (IPE), Learning Style Inventory VARK-B1 and Biology Activity-Based Achievement Test (BIAT). 2 by 4 factorial design and Analysis of Co-Variance were used to analyze the hypotheses on the data obtained while F-value and Multiple Classification Analysis (MCA) were applied to determine the source and magnitude of effects. There was significant main effect on treatment on biology (F2, 92) =15.40, p = .001 partial eta, Squared = .164. However, 89% (w2 = 0.887) of the total variance in Biology Achievement was accounted for by the two groups. No single learning style as moderator variable had significant influence in student achievements [F (3, 27) = 5.07, p = .006 partial eta, Squared = .36]. Only 20% (w2 = 0.20) of the total variance was accounted for by the four learning styles, Reading/Writing (M = 30.25, SD = 7.34), Aural (M = 24.38, SD = 5.15), Kinesthetic (M = 24.13, SD = 5.44) and Visual (M = 23.88, SD = 3.56). However, the learning styles altogether contributed significantly towards achievement in Activity-Based Biology Instruction. Multi-dimensional teaching that consciously accommodates various learning styles and from which learners intuitively selects their option of preferred learning is most suitable for each student.

Key words: learning styles, activity-based, achievement, biology instruction, multi-sensory approach

1. Introduction

Teaching methods varies from one instructor to the other, some instructors lecture while others demonstrate or guide learners to self-discovery, some other focus on principles while some focus on applications. A good number emphasis memorization while others emphasis understanding. Since various methods can be used to teach, different methods can be used to learn.

Learning styles show preferred ways by which different people take in new materials (Idpride, 2010), individuals favour some particular way of interacting with or processing information or stimuli and solving

Victor Olu Akinola, Ph.D., Department of Educational Technology, Lagos State University of Education. E-mail: victakim@yahoo.co.uk.
Premobowei Dele Melekeowei, Ph.D., Department of Counselling Psychology Education, Lagos State University of Education. E-mail: melekeoweidele@gmail.com.

problem. Fleming (2017) evolved four calibrators of learning styles and according to him visual learners have preference for seeing (they think in pictures, visual aids such as overhead slides, handouts, diagrams, etc.), while Aural or Auditory learners are best at listening (the concentrate on listening to lectures, sermon discussion, tapes, etc). Reading and writing preferences are in individuals who read details and classify or analyze them salient point for discussion, illustration and applications. Kinesthetic or tactile learners prefer learning through direct experience involving, moving, touching and doing active exploration through science projects, experiments, trips, etc. Apart from Fleming there are several other models of learning style including David Kolb's; Suddbury, De Myer Briggs MBTI; Disc Assessment, Dun, Dun; and Price VAK, Honey and Mumford, Siadatry and Taghiyarh model on conscience development and lot of others.

Fleming is preferred for this study due to its simple and direct features reflecting psychological, social and physiological dimensions of the educational process. Various proponents on referent to learning styles in education prefer that teachers obtain the learning style of their student and modify classroom instruction suitable for each learners. Empirical and pedagogical issues support the "mershing hypothesis" that if individuals are provided with their preferred modality (visual, auditory, read/write or kinesthetic they will experience enhanced learning outcomes (Pashler et al., 2008).

Dunlosky et al. (2013) however suggested that retirement of mershing hypothesis as well as its revolving learning style concept when ten (10) classroom strategies are supported by studies that do not require perceptual learning style. A fresh and innovative approach to biology education that appeals to learners and teachers alike is that which consider the study of biological science through various themes as an inquiry. Thematic approach in this manner contributes to students comprehension of fundamental life processes, understanding of interaction among organisms and the application of biological processes. From the foregoing appropriate strategies through process skill and activity-based manner are suitably considered.

Arbuthrott and Krating et al. (2015) also lament the fact that the endorsement of learning styles theory interferes with the development of evidence based practice in education and the wider community. Indeed several studies have doubted this approach (Knoll et al., 2017). This study takes into cognizance the controversy on the application of learning styles approach in teaching and content delivery in various disciplines and subject areas hence looked into the influence of learning styles on achievement in Activity-based biology instruction.

2. Methodology

The research grew out of the curiosity to ascertain importance of learning style in the teaching and learning of Biology. Another interest was to examine preferred way of accommodating learning style in the teaching of biology. This study is unique in the investigation of learning styles in biology most research on learning styles have often being on combined variables with result showing Alt and Covariate influence. Present research focus directly on various learning styles and Activity-based biology instruction.

The population of Senior Secondary School (SSS) students class two in Lagos State was used for the study; sample was selected from the population as two schools that were experimentally accessible chosen in different educational districts in Lagos. Sixty four (64) students were sampled for the purpose of identify differential learning styles. Eight (8) students for each learning style subgroup and thirty-two (32) students for each group using VARK-Bi learning style.

3. Research Instruments

Three research instruments were used:

1) VARK Learning Style Inventory in Biology (VARK-BI)
2) Biology Achievement Test (BIAS)
3) Instructional Package on Ecology (IPE) - Visual
4) Instructional Package on Ecology (IPE) - Aural
5) Instructional Package on Ecology - IPE - Read/write
6) Instructional Package - IPE - Kinesthetic

VARK-BI Instrument adopted from Flemings (2011-VARK Questionnaire) was used to elicit response from samples for grouping them into learning styles. Pre-test (BIAS) followed by Treatment using IPE and later Post-test administered.

Each of the instrument was validated, each group of eight students subgroup of thirty-two were exposed to Biology activity-based instructional package in Ecology with peculiar teaching strategies of each sub-group. IPE Visual, IPE-Aural, IPE-Read/write and IPE Kinesthetic. Thus same instructional content for each group and sub-group but different instructional mode for each subgroup. While treatment for the sub-groups in School 1 was under conventional teaching as control group, treatment for the sub-group in school 2 was Activity-based biology instruction as Experimental group unified Post-test was conducted after the treatment.

4. Presentation of Results

The result engaged the use of descriptive statistics to explain and compare pretest and post-test.

Issues addressed were:

- Learners awareness of their learning styles and overall learning styles concept
- Learners performance based on Activity-based instruction in Biology
- Learners performance in Biology based on learning styles.

4.1 Influence of Treatment on Achievement in Biology

4.1.1 Research Question 1

What is the impact of treatment on Biology in various groups?

One way between-groups analysis of covariance was conducted to look at the results of the two different groups on students' achievement in Biology. The student variables were the groups, Activity-based instruction and Control), and the dependent variable consisted of scores on Achievement Test in Biology administered after the treatment was completed.

Preliminary checks were conducted to ensure that there was no violation of the options of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pretest scores there was significant main effect of Activity Based instruction on Achievement in Biology [F (2,92) = 15.40, p = .001, partial eta squared =.164]. However, about 89% (w^2 = 0.887) of the total variance in Biology Achievement score was accounted for by the groups. There was a weak relationship between the pre-test and post-test scores on the Achievement Test in Biology, as indicated by a partial eta squared value of .121. The inspection results showed that there was a significant difference between Activity Based Instruction scores and Control Group scores (See Table 2).

Table 1 The Impact of Treatment on Biology in Various Groups

	Mean	Std. Deviation	N
Mean and SD of Post-test scores Activity Based Group	25.6563	5.01668	32
Control Group	26.6563	3.64213	32
Total	27.3646	4.87770	96

mean difference is significant at the .05 level
Adjustment for multiple comparisons. Bonferroni.
Field work (2022)

Table 2 One-Way ANCOVA (Dependent Variable. Post-Test)

	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	369.730[a]	3	123.243	5.998	.001	.164
Intercept	4132.175	1	4132.175	201.089	.000	.686
Pretest	73.396	1	73.396	3.572	.062	.037
Group	259.542	2	129.771	6.315	.003	.121
Error	1890.510	92	20.549			
Total	74147.000	96				
Corrected Total	2260.240	95				

R-squared = .164 (Adjusted R Squared = .136)
Field work (2022)

4.1.2 Research Question 2

What is the influence of Activity Based instruction on the various learning styles of Visual, Aural, Read-write and kinesthetic in Biology.

Table 3 N, Mean and SD

Learning Style	Mean	Std. Deviation	N
Visual	23.8750	3.56320	8
Aural	24.3750	5.15302	8
Reading/Writing	30.2500	7.34361	8
Kinesthetic	24.1250	5.43632	8
Total	**25.6563**	**5.91668**	**32**

Field work (2022)

Table 4 One-Way ANCOVA (Dependent Variable. Post Test Activity Based Instruction)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected model	595.775[a]	4	148.944	8.216	.000	.549
Intercept	245.718	1	245.718	13.555	.001	.334
Pretact	369.681	1	369.681	20.393	.000	.430
Leanstyle	275.692	3	91.897	5.069	.006	.360
Error	489.444	27	18.128			
Total	22149.000	32				
Corrected	1085.219	31				

a. R Squared = .549 (Adjusted R Squared = .482)
Fieldwork (2022)

Table 5 Multiple Comparisons (Dependent Variable. Post-Test of Activity Based Instruction)

(I) Learning Style	(J) Learning Style	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	User Bound
Visual	Aural	-.283	1.871	1.000	-5.611	5.045
	Reading/Writing	-8.008	1.984	.002	-13.657	-2.359
	Kinesthetic	-1.592	1.975	1.000	-7.214	4.029
Aural	Visual	.283	1.871	1.000	-5.045	5.611
	Reading/Writing	-7.725*	1.966	.003	-13.323	-2.127
	Kinesthetic	-1.310	1.945	1.000	-6.848	4.229
Reading/Writing	Visual	8.008	1.984	.002	2.359	13.657
	Aural	7.725*	1.966	.003	2.127	13.323
	Kinesthetic	-1.310	2.038	.024	.613	12.218
Kinesthetic	Visual	1.592	1.975	1.000	-4.029	7.214
	Aural	1.310	1.945	1.000	-4.229	6.848
	Reading/Writing	-6.416*	2.038	.024	-12.218	-6.13

Based on estimated marginal means
a. Adjustment for multiple comparisons. Bonferroni.
* The mean difference is significant at the .05 level.
* Fieldwork (2022)

A one-way between-groups analysis of covariance was conducted to look at the main effect of Activity Based Instruction on Biology achievement of students for the different learning styles. The moderator variable was the different learning styles (Visual, Aural, Reading/Writing and Kinesthetic), and the independent variable consisted of scores on Post Test Activity Based Instruction in Biology administered after the treatment was completed.

Participants' scores on the pre-test administration of the Activity-Based instruction in Biology were used as the covariate in this analysis. Preliminary checks was conducted to ensure that there was no violation of the assumptions of normality, clarity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pre-test scores, there was significant difference between the Visual, Aural, Reading/Writing and Kinesthetic on post-test scores of Activity Based Instruction in Biology [F (3,27) = 5.07, p = .006, partial eta squared =.36]. However, only 20% ($w^2 = 0.20$) of the total variance in Biology achievement score was accounted for by the four learning style groups. There was a moderate relationship between the pre-test and post-test scores on the Activity-Based Instruction in Biology, as indicated by a partial eta squared value of .43 An inspection of the interaction of the learning styles revealed that there was significant effect on respective learning styles. Reading/writing (M = 30.25, SD = 7.34, Aural (M = 24.38, SD = 5.15), Kinesthetic (M = 24.13, SD = 5.44) and Visual, (M = 23.88, SD = 3.56) (See Table 4).

From Table 6, the results indicated that 43.1% of the variance in the response was explained by the predictors (Treatment experimental group of Activity-Based Instruction).

Table 6 Model Summary of Dependent Variable: Post-Test of Activity-Based Instruction in Biology

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
	.656[a]	.431	-.329	4.10712	.431	.567	4	3	.70….

a) Predictor (Constant), Kinesthetic, Visual, Reading/Writing, Aural
b) Dependent Variable. Activity Based Instruction.

Table 8 showed that none of the Learning Styles contributed significantly towards the student achievement in Activity Based Instruction.

Table 7 Regression

Sum of Squares	Df	Mean Square	F	Sig.
38.270	4	9.567	.567	.707[a]
50.605	3	16.868		
88.875	7			

*Fieldwork (2022)

Table 8 Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	9.191	21.824		.421	.702
Visual	.413	.594	.328	.696	.536
Aural	.539	.520	.607	1.036	.376
Reading/writing	.061	.923	.036	.066	.951
Kinesthetic	.053	.431	.065	.123	.910

a) Dependent Variable. Activity Based Instruction
*Fieldwork (2022)

5. Discussion

There was significant different in Achievement in Activity Based Biology Instruction among the learning styles of Visual, Aural, Reading/Writing and Kinesthetic: *F,* 3,27 = *p = .006* partial eta square = .36. 20% of the total variance in biology achievement score was accounted for by the four learning styles group however none of the learning style contributed significantly towards the student achievement in Activity-based Instructions. This research investigated the influence of learning styles on Achievement in Activity-based biology Instruction, the extent to which activity-based treatment influence Achievement in Biology the proposal generated three research questions which were tested at 0.05 level of significance with statistical procedures.

Difference showed among Read-write (m = 30.25, SD = 7.34), Aural (m = 24.38 SD = 5.15), Kinesthetic M = 24.13, SD = 5.44) and Visual (m = 23.55, SD = 3.56). However, there was no significant difference between Visual, Aural, Reading/Writing and Kinesthetic on retention scores of activity-based instruction in Biology (F = 3,27 = .68, p = .001 partial eta squared = .43]. None of the learning styles (predictor variables) contribute significantly towards achievement and retention in Activity-based instruction.

Evidence from this research aligned with the position of Nguyen Thu Ha (2019) that evidence of learning styles was highly variable while Duntosky, Rawson, Marsh et al. (2013) showed the compartments in learning styles are not heuristic, while learner may prefer a style for learning the real world situation is an integrated phenomenology where interpretation and operation of what is learnt in practical life are not tied to bias of learning styles. In the real sense assessment items are synchronized and not differentiated into learning styles.

It is therefore not in doubt that learning preference are exhibited by learners but the question is whether structuring and delivery instruction through preferred learning style leads to greater attainment.

Instruction from this level should therefore address specific need of individual learner, development need of learner and leaning style by providing instruction that may not necessarily separate specific learning style but consider varieties of learning styles. The proximate goal in the education system is thus not what the teacher is required to teach but what learners learn and how they are able to learn.

From the overall results, assessing learning styles in Biology has proved to be a resourceful option for improving teaching strategies, learning resources and performance in theory, alternatives and real practicals

(Akinola, 2016). However multi-dimensional teaching that constantly accommodates various learning style from which learner's intuitively select their option of preferred learning modality is far more effective for each student. Rogowsky, Calholm, Tallal et al. (2020) proved that tested learning style had no significant advantage when taught using their preferred learning style. This position aligns with Lettaly and Harries (2016). It can be deduced that learning style is not isolated for learning, each learning style complement another, its utilization in learning is integrated as wholistic assimilation and interpretation of concept through a synchro-system.

6. Recommendation

This research recommends that teachers should not necessarily teach individual students based on their assigned or preferred learning style but taking cognizance that learning styles inevitably differ among students in a classroom. Teachers should make changes such that every learner irrespective of their style will benefit and that such changes include constant classroom redesigns, development of small group, technique variation in contact activity packages, team learning, brainstorming, peer group techniques involving "circle of knowledge", scaffolding, portfolio reflection and so on.

References

Akinola V. O. (2016). "Learning styles: Information and communication technology and achievement in biology", PhD thesis, Science and Technology Education, Lagos State University, Lagos, Nigeria.

Arbuthnott K. D. and Kratzig G. P. (2015). "Effective teaching: Sensory learning styles versus general memory processes", *Innovative Teach.*, No. 4, pp. 1–9, doi: 10.2466/061T.4.2.

Aslaksen and Love S. (2018). "The modality-specific learning style hypothesis: A mini review", *Front Psychol.*, Vol. 9, pp. 1–5, doi: 10.3389/fpsyg.2018.01538.

Barrable A. (2019). "The case for nature connectedness as a distinct goal of early childhood education", *International Journal of Early Childhood Environmental Education*, Vol. 6, No. 2.

Byun S., Rufini C., Mills J. E., Douglas A. C., Niang M. and Stepchenkova S. (2016). "Parenting approaches: Family functionality and internet addiction among Hong Kong adolescents", *Open Access BMC Pediatrics 16*, Article 130.

Coffield F., Moseley D. and Hall E. (2004). "Learning styles and pedagogy in post-16 learning: A systematic and critical review", London: Learning and Skills Research Centre.

Deligiannich and Howard-Jones (2015). "The neuroscience literacy of teachers in Greece", *Procedia-Scoial and Behavioural Sciences*, Vol. 174, pp. 3909–3915.

Dun R., Dunk and Price C. E. (2009). *Learning Style Inventory*, Lawrence, KS, USA Price System.

Dunlosky J., Rawson K., Marsh E. T., Nathan M. J. and Wyllingham D. T. (2013). "Improving students' learning with effective learning techniques: Promising directions from cognitive and educational psychology", *Psychological Science in the Public Interest*, Vol. 14, No. 1, pp. 4–58, doi: http://doi.org/10.11777152910061245326 6.

Flemming N. D. and Baume D. (2006). "Learning styles again: VARKing up the right tree", *Educational Development*, Vol. 7, pp. 4–7, available online at: http://www.johnsilvero.com/EDU16702/Fleming VARK learningstyles.pdf.

Flemming N. D. (2017). "The VARK modalities", available online at: http://vark-learn.com/introduction-to-vark/thevark-modalities.

Hargreaves D. (2005). "About learning: Report of the learning working group", available online at: http://www.denos.co.uk/catalogue/aboutlearning/Demos.

Heagreaves, Goswam & Wolf, available online at: http://doi.org/10.1016/j.sbspro2015.01.1133.

Honey P. and Mumford (2001). *The Learning Styles Helpers Guide*, Maiden head, Peter-Honcy Publications Ltd.

Idpride (2008). *Understanding Your Learning Styles*, Learning style book @Idpride.net.

Knoll A. R., Ofani H. and Skeel R. L. (2017). "Learning styles: Judgements of Learning and learning of verbal and visual information", *British Journal of Psychology*, Vol. 108, No. 3, pp. 544–563, doi: http://doi.Ng/10.1111/bjop.12214.

Kolb D. A. (1984). *Experimental Learning: Experience as the Source of Learning and Development*, Englewood Cliffs NT Prentice-Hall.

Macdonald G., Livingstone N. and Valentine J. C. (2017). "Families and Schools Together (FAST) for improving outcomes for children and their families", *Cochrane Database of Systematic Reviews* [CD012760], doi: https://doi.org/10.1002/14651858.CD012760Pub2.

Myers and Briggs (2023). *A Guide to the Development and use of the Myers-Briggs Type Indicators (MBTI)*, The Myers & Briggs Foundation, Gainesville, FL 32609.

Nguyen Thu Ha and Do Thi Tien Yen (2019). "Teacher's perception of students' learning styles and their English teaching at university of economics — Technology for industry, Vietiam", *International Journal of English Language Teaching*, Vol. 7, No. 6, pp. 32–47.

Papadatou-Pastou M., Touloumakos A. K. and Barrable A. (2021). "Learning styles neuromyth: When the same term means different things to different teachers", *European Journal of Psychology of Education*, Vol. 36, pp. 511–531.

Rogowsky B. A., Calholm B. M. and Tallal P. (2020). "Providing Instruction based on students learning style preferences does not improve learning", *Front Psychol.*, Vol. 11, p. 164, doi: 10.3389/fpsyg.2020.00164.

Rogowsky B., Calholm B. and Tallal P. (2020). "Matching learning styles to instructional method: Effect on comprehension", *Journal of Educational Psychology*, Vol. 10, No. 1, p. 64.

Rohrer and Pashler (2012). "Learning styles: Where's the evidence?", *Online Submission*, Vol. 46, No. 7, doi: http://doi.org/10.1111.j.1365-2923.2012.04273x.

Siadatc M. and Taghiyareh F. (2007). "PALS2: Pedagogically adaptive learning system based on learning styles", in: *Seventh IEEE International Conference on Adaptive Learning Technologies (ICALT 2007)*.

Stepchenkova (2016).

VARK Learn Limited (2021). Available online at: https://vark-learn.com.