

# Effects of Convergent Learning and Divergent Learning Strategies on Students' Academic Performance in Biology in Ilorin, Nigeria

Adekunle T. Olutola<sup>1</sup>, Mayowa O. Ogunjimi<sup>2\*</sup>, Dorcas S. Daramola<sup>3</sup> & Adaramaja L. Sheu<sup>4</sup>

<sup>1</sup>Department of Educational Foundations, Faculty of Education, Federal University, Dutsin-Ma, Katsina State, Nigeria. Email:olutolatola@gmail.com

<sup>2</sup>Department of Adult and Primary Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria. Email:ogunjimimayowa@gmail.com

<sup>3</sup>Department of Social Sciences Education, Faculty of Education, University of Ilorin, Ilorin, Nigeria. Email:immaculatetabitha@yahoo.com.

<sup>4</sup>Department of Educational Psychology/G & C, Faculty of Education, Federal College of Education, Owerri, Imo State, Nigeria. Email:

adaramaja4real@yahoo.com

\*Corresponding author

## Abstract

*The study examined the effects of convergent learning and divergent learning strategies on students' academic performance in Biology in Ilorin, Nigeria. Three senior secondary schools in Ilorin metropolis were randomly chosen and intact science class of senior secondary school two in each of the chosen schools was selected for the study. Students' in the first and second schools were taught and assessed using convergent learning and divergent learning strategies respectively. In addition, students' in the third school were taught and assessed using conventional teaching method. The researchers' designed Biology Performance Test 1 (BPT 1) and Biology Performance Test 2 (BPT 2) with Cronbach's Alpha reliability coefficient of 0.85 (Pre-test) and 0.88 (Post-test) were used to obtain data for the study. The data collected were analysed using Analysis of Covariance (ANCOVA). Findings revealed that there is significant effect of convergent and divergent learning strategies on secondary school student's performance in biology. In addition, there is no significant effect of convergent and divergent learning strategies on secondary school students' performance in biology based on gender and there is no significant interactive effect of gender and learning strategies on secondary school students' performance in biology. It was recommended that Biology teachers should make use of both the convergent and divergent learning strategies during their lessons and Biology students should be encouraged to serve as a tutor to teach their colleagues', which is one of basis for divergent learning strategy.*

*Keywords: Biology, convergent learning, divergent learning, students performance*

## Introduction

Testing has been seen worldwide as a best way to determine the success or failure of the teaching and learning process in the school setting. Testing is a method of finding out whether a solution is working, as it should (Kelly, 2011). It takes place during development as the solution is being built. To some degree, tests as one of the assessment techniques determine when students study, what they study and how they study.

According to Abodunrin (1999), a test refers to formal situation(s) deliberately created by a tester to make the testee(s) respond to stimulus from which desired information could be elicited. A teacher uses test for the purpose of diagnosis when planning a particular unit of instruction. It enables the teacher to discover whether students have actually acquired knowledge and skills they are expected to have mastered. The importance of

tests in determining the performance of students in the school subjects such as Biology, Physics, Chemistry, Agricultural Science, and Economics and so on cannot be overemphasizes.

Biology deals with the study of living things both the plants and animals. Biology as one of the science subjects offered at senior secondary school level deals with the scientific study of living things, their relationship with one another and with the natural environment among other things (Achor, Ogbaha & Umoru, 2014). It is worthwhile to note that, despite the importance and popularity of Biology compared to other science subjects, students' performances in Biology in both internal and external examinations have remained poor over the years. WASSCE Chief Examiner's Reports Nov/Dec (2007) indicate that the performance of the students in paper 2 (Essay) was slightly poorer than that of the previous year with a mean score of 17 and a standard deviation of 8.77 compared to a mean of 18 and S.D of 8.94 for Nov/Dec 2006. WAEC (2012) report indicated that the trend of failure rate was decreasing in Physics, English and Mathematics, while an increase in failure rate was recorded for Biology and Chemistry. The highest failure rate of 28.66% was recorded for Biology followed by Mathematics (24.39), Chemistry (22.52), English (21.89) and the least failure rate was in Physics (13.08).

Ajagun (2000) observed that the performance of students in senior secondary sciences including Biology in Nigeria has remained an issue of concern to all stakeholders. Many factors contributed to students' poor performance in Biology such as students' attitude to biology. (Nzelum, 2010) reveal that some of the reasons of lack of students' attitude to biology are due to the abstractness of certain aspects of biology, lack of understanding on the students' part of certain biological concepts and terminologies. Nwike and Catherine (2013) pointed out that lack of effective use of appropriate instructional aid is one major problem that causes poor students' attitude to biology. The main causes of students' poor performance in Biology and how to find solution to it has been the focus of researchers nowadays.

This calls for alternative teaching methods such as (convergent learning and divergent learning strategies) that can help to improve students' performance in Biology. Teachers' teaching methods, skills and knowledge are the most important variables in the classroom that can enhance students' performance in Biology. The use of conventional teaching method does not always enhance the understanding of Biology because it does not actually involve the students in the learning process. Adegoke (2011) noted that students' individual capabilities, intelligence and creative thinking can only be achieved through student centered instructional methods.

Convergent teaching tends to focus on the teacher transmitting the information that they know to the students (Bar-Yam, Rhoades, Sweeney, & Bar-Yam, 2002). Convergent teaching focuses on the teacher and is teacher centered. Those students are typically assessed by a formal written test where the only right answer is the one that the teacher gave them. In contrast, divergent teaching focuses on the student and is very student-centered (Bar-Yam, et al.,2002). The convergent approach is highly structured and teacher-centered; the students are passive recipients of knowledge transmitted to them and learning achievements are measured by standardized tests.

Divergent learning is classified as being student-centered and flexible, where the students are completely involved in their own learning (Tomar & Sharma, 2005). The students decide how to complete the assignments given by the teacher and what approach to take with them. Divergent thinking involves taking a topic and breaking it down into its individual parts (Zent, 2001). A divergent project may include a portfolio, a commercial to advertise a product, or other special projects that promote more than one answer to the problem that is given (Tomar & Sharma, 2005). The divergent approach is flexible, student-centered, where the students are active participants in the learning process and learning achievements are assessed by a variety of evaluation tools such as self-evaluation in parallel to teacher evaluation; documentation portfolios; and special projects (Bar-Yam, Rhoades, Sweeney & Bar-Yam, 2002).

In a classroom where only convergent teaching is happening, some students may attain the knowledge given by the teacher while others may fall by the wayside or given some of remediation with limited results (Bar-Yam, et al., 2002). Tomar and Sharma (2005) noted that both a convergent approach and a divergent approach are needed in the classroom setting. The convergent teaching gives students the background knowledge in order to complete the divergent project or activity.

Rintelman (2007) found that middle school technology education students performed better on the convergent laboratory activity than the divergent laboratory with the topic of mechanisms. Spence (2004) found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment. Olutola, Daramola and Bamidele (2016) in their study discovered that there is significant effect of practical methods on secondary school students' performance in Biology. Therefore, practical method is an important factor in predicting student performance in Biology in secondary school. In addition, the researchers found that there is no significant effect of practical methods on secondary school students' performance in Biology on the basis of gender.

Since traditional teaching method mostly used by teachers in Nigerian schools has not given students enough opportunities to construct their own learning and one of the causes of students' poor performance in Biology is ineffective teaching. The study is therefore, interested in finding out the effects of convergent and divergent learning strategies on students' academic performance in Biology in Ilorin, Nigeria. The study was designed to investigate whether convergent learning and divergent learning strategies will affect students' academic performance in Biology.

### **Research Hypotheses**

The following null hypotheses were formulated to guide the study.

1. There is no statistically significant effect of convergent and divergent learning strategies on secondary school students' performance in Biology
2. There is no statistically significant effect of convergent and divergent learning strategies learning strategies on secondary school students' performance in Biology based on gender
3. There is no statistically significant interactive effect of gender and learning strategies on secondary school students' performance in Biology

### **Methodology**

The pretest–posttest quasi -experimental research design with two experimental group and one control group was adopted for the study. Three senior secondary schools in Ilorin metropolis were selected for this study. The science arm of senior secondary two (SS2) in each of the sampled schools participated in the study. The sample for the study consisted of 90 senior secondary school two (SS2) students made up of 47 males and 43 females drawn from three randomly selected coeducational secondary schools in Ilorin metropolis. These students were assigned into two experimental group and one control group. All members (intact class) of these sampled classes participated in the study. The hypotheses in the study were tested using a 3 X 2 factorial model. The factors included treatment at 2 strategies (convergent and divergent) and gender occurring at 2 levels (male and female).

Biology instructional modules were developed for SS2 students by the researcher based on the SSCE syllabus. The students were taught two topics, namely animal nutrition and adaptation for survival. These two topics were broken into 12 teaching lessons. Each topic was taught within six periods of 45 minutes. The experiment lasted for six weeks. Treatment was assigned to two experimental group (convergent learning strategy and divergent learning strategy) and placebo was administered to the control group (traditional method). Both the experimental and control groups took pretest and posttest. Two multiple choice tests in Biology developed by the researchers were used for data collection. These comprised a pretest Biology Performance Test 1 (BPT 1) made up of 25 items and posttest Biology Performance Test 2 (BPT 2) made up of 30 items with Cronbach's alpha reliability coefficient of 0.85 (Pre-test) and 0.88 (Post-test). This shows that the instruments were reliable.

The instruments were validated by ensuring that all multiple choice items were developed from the topics chosen from Senior School Certificate Examination syllabus and scheme of work contents used by the schools for teaching their students. The content validity of the tests was established by the three Biology teachers from the sampled schools. The data collected were analysed using Analysis of Covariance (ANCOVA).

**Results**

The pretest and posttest data collected from the two experimental groups and control were analyzed using Analysis of Covariance and the result of the analysis is presented in table 1:

*Hypothesis 1: There is no statistically significant effect of convergent learning and divergent learning strategies on secondary school student’s performance in biology*

**Table 1: Summary of ANCOVA on the effect of learning strategies on students’ performance in Biology**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Corrected Model	1138.87	3	379.62	225.29	0.00	
Intercept	1041.65	1	1041.65	618.16	0.00	
Pretest(Covariate)	6.78	1	6.78	4.03	0.06	
Learning Strategies	1136.33	2	568.16	337.17	0.00	<b>S</b>
Error	144.92	86	1.69			
Total	17471.00	90				
Corrected Total	1283.79	89				

Table 1 reveals that the calculated F-value of 337.17 with an F(p) value of 0.00. Since the F(p) value of 0.00 is less than 0.05, the null hypothesis one was rejected. Therefore, there is a statistically significant effect of convergent and divergent learning strategies on secondary school student’s performance in biology. Thus, it was concluded that convergent and divergent learning strategies significantly affect secondary school students’ performance in biology.

*Hypothesis 2: There is no statistically significant effect of convergent learning and divergent learning strategies on secondary school students’ performance in Biology based on gender*

**Table 2: Summary of ANCOVA on the effect of learning strategies based on gender**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Corrected Model	11.34	2	5.67	0.39	0.00	
Intercept	1345.28	1	1345.28	91.98	0.00	
Pretest (Covariate)	2.61	1	2.61	0.18	0.67	
Gender	8.79	1	8.79	0.61	0.44	<b>NS</b>
Error	1272.45	86	14.63			
Total	17471.00	90				
Corrected Total	1283.79	89				

Table 2 reveals that the F-value (0.61) of the posttest score of male and female subjects in the three groups is not significant at 0.05 alpha level (p = 0.44). Thus, the null hypothesis which state that there is no statistically significant effect of convergent and divergent learning strategies on secondary school student’s performance in biology based on gender is accepted. This means that convergent learning and divergent learning strategies does not have statistically significant effect on secondary school student’s performance in biology based on gender.

*Hypothesis 3: There is no statistically significant interactive effect of gender and learning strategies on secondary school students' performance in biology*

**Table 3: Summary of ANCOVA on the interactive effect of gender and learning strategies on secondary school students' performance in biology**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remark
Corrected Model	1140.12	6	190.02	109.78	0.00	
Intercept	977.91	1	977.91	564.97	0.00	
Pretest (Covariate)	7.48	1	7.48	4.32	0.06	
Learning Strategies	1079.09	2	539.55	311.71	0.00	
Gender	0.28	1	0.28	0.16	0.69	
GROUP*Gender	0.94	2	0.47	0.27	0.76	NS
Error	143.67	83	1.73			
Total	17471.00	90				
Corrected Total	1283.79	89				

Table 3 reveals that the F-value (0.27) of the intercept between the subject's gender and the learning strategies is not significant at 0.05 alpha level ( $p = 0.76$ ). Hence, the null hypothesis, which states that there is no statistically significant interactive effect of gender and learning strategies on secondary school student's performance in biology, is accepted. Interactive effect of gender and learning strategies does not statistically significant influence on secondary school student's performance in biology.

### **Discussion of Findings**

The findings of this study revealed that there is significant effect of convergent and divergent learning strategies on secondary school student's performance in biology. Therefore, convergent and divergent learning strategies are important factors in predicting students' performance in Biology in secondary schools. The finding of this study is not in agreement with the findings of Jo-Ann (2003) which studied the relation between creativity and convergent and divergent methods of teaching spelling. He found that there is no significant difference in achievement between children taught by a convergent method and children taught by a divergent method. Moreover, Tomar and Sharma (2005) noted that both a convergent approach and a divergent approach are needed. The convergent teaching gives students the background knowledge in order to complete the divergent project or activity. Moreover, the study discovered that there is no significant effect of convergent and divergent learning strategies on secondary school student's performance in biology based on gender. This study is supported by the findings of Spence (2004) which found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment.

In addition, it was found in this study that there is no significant interactive effect of gender and learning strategies on secondary school students' performance in biology. This means that students' performance in Biology cannot be attributed to the interaction of gender and treatment conditions. The result is supported by the findings of Iloputaife (2001) and Ibe (2004) who found no significant interaction effect between instructional methods on gender performance. This result also supported by the findings of Jo-Ann (2003) who found no significant interaction between teaching methods (divergent and convergent teaching method) and creativity.

### **Conclusion**

The results of this study revealed that, both the convergent and divergent learning strategies have significant roles to play in the students' performance in Biology because there is significant effect of convergent and divergent learning strategies on secondary school student's performance in biology. Bar-Yam, et al., (2002) noted that both convergent and divergent approaches need to be used since there are some students that may perform very well in a convergent setting but not well in a divergent setting, and vice-versa. In addition, the

result of this study revealed that there is no significant effect of convergent and divergent learning strategies on secondary school student's performance in biology based on gender and there is no significant interactive effect of gender and learning strategies on secondary school students' performance in biology.

## Recommendations

The following recommendations were made based on the findings of this study:

1. Biology teachers should make use of both the convergent and divergent learning strategies during their lessons,
2. Government should train Biology on the use of convergent and divergent learning strategies to improve students' performance in both the internal and external Biology examinations;
3. Government should employ qualified Biology teachers with teaching skills to teach Biology in our schools in order to enhance students' performance in Biology and
4. Biology students should be encouraged to serve as tutor to teach their colleagues', which is one of the basis for divergent learning strategy.

## References

- Abodunrin, I.O (1999). *Evaluating teaching/learning effectiveness (a basic course in educational test, measurement and evaluation)*. Oro: Cardinal Information Technology.
- Achor, E. E., Ogbeba, J. A. & Umoru, O. W. (2014). In search of interactive teaching strategy that could yield high achievement in biology: An examination of computer based instruction in some secondary schools in Nigeria. *Research Journal in Organizational Psychology and Educational Studies*, 3(1), 1-6.
- Adegoke, B.A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in Physics. *European Journal of Educational Studies*, 3(3), 537-541.
- Ajagun, G.A. (2000). A study of the performance of students in the senior secondary school certificate examination in selected schools in Kano State. *Kano Journal of Education* 6(1): 10-21.
- Bar-Yam, M., Rhoades, K., Sweeney, L. B., & Bar-Yam, Y. (2002). Changes in the teaching and learning process in a complex education system. Retrieved November 27, 2016 from: [www.necsi.edu/research/management/education/teachandlearn.html](http://www.necsi.edu/research/management/education/teachandlearn.html)
- Ibe, E. (2004). *Effects of guided inquiry, demonstration and conventional methods of teaching science on acquisition of science process skills among senior secondary school students*. An Unpublished M.Ed. Thesis, Department of Science Education, University of Nigeria, Nsukka
- Iloputaife, E.C. (2001). *Effects of analogy and conceptual change instructional model on physics achievement among secondary school students*. Unpublished Ph.D Thesis, University of Nigeria, Nsukka.
- Jo-Ann, C. (2003). Information literacy and teacher education [online]. Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education. (ERIC Document Reproduction Service No. ED 424231) [cited 13 March 2003]. Retrieved November 29, 2016 from: <http://www.ericfacility.net/ericdigests/ed424231.html>.
- Kelly, M. (2011). Testing and evaluation. Retrieved November 29, 2016 from: <http://vceit.com/p/PSM-testing.htm>
- Nwike, C. M. & Catherine, O. (2013). Effects of use of instructional materials on students' cognitive achievement in agricultural science. *Journal of Educational and Social Research*. 3(5), 103-107.
- Nzelum, V. N. (2010). Mechanism of transmission of information along a Neuron: *A practical approach to a reflex Action. A paper presented at STAN Biology panel workshop, model Girls Secondary School, Rumeme, Port-Harcourt, River State.*
- Olutola A. T., Daramola, D.S. & Bamidele, E.O. (2016). Comparative effects of practical and alternative to practical methods on students' academic performance in biology. *International Journal of Educational Benchmark (IJEB)*, 3(1), Pp. 67-80.
- Rintelman, I. (2007). An analysis of convergent and divergent instruction on the ability of eighth grade students to understand mechanisms. Retrieved October 4, 2009 from: <http://www.uwstout.edu/lib/thesis/2007/2007rintelmanj.pdf>
- Spence, D.J. (2004). Engagement with mathematics courseware in traditional and online learning environments: relationship to motivation, achievement, gender and gender orientation. Unpublished Ph.D Dissertation, Emory University. Retrieved March 17, 2007, from [http://www.des.emory.edu/mfp/Spence Dissertation 2004.pdf](http://www.des.emory.edu/mfp/Spence%20Dissertation%202004.pdf).
- Tomar, M. & Sharma, S. K. (2005). *Learning and teaching: Learning process*. India: Isha Book University of Nigeria, Nsukka.
- WAEC (2001 – 2007). The West African Senior School Certificate Examination. *The Chief Examiners' reports for Nigeria*.

*Effects of convergent learning and divergent learning strategies*

- WAEC.(2012). *Year 2012 21<sup>st</sup> WAEC state committee meeting agenda papers for Taraba State*. West African Examination Council.
- Zent, E. S. (2001). Strategies of convergent thinking. Retrieved November 29, 2016 from: <http://faculty.washington.edulezent/imct.htm>