



# **JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION (JSTE)**

**A PUBLICATION OF THE  
DEPARTMENT OF SCIENCE,  
TECHNOLOGY & MATHEMATICS  
EDUCATION (STME),  
NASARAWA STATE UNIVERSITY, KEFFI**



**VOLUME  
9**

*ISSN: 2651-5539*

## EFFECT OF SENSORY SIMULATION TEACHING STRATEGY ON STUDENTS' ACHIEVEMENT IN GENETICS IN ABUJA, NIGERIA

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**Citation:** Aghabalu, R. A. & Akhideno, P. (2025). Effect of sensory simulation teaching strategy on students' achievement in genetics in Abuja, Nigeria. *Journal of Science, Technology, and Education (JSTE)*; [www.nsukjste.com/](http://www.nsukjste.com/) 9(45), 647-659.

### Abstract

This study determined the effect of sensory simulation teaching strategy on achievement among secondary school Biology students in genetics in Abuja. Quasi-experimental pretest, posttest experimental and control groups research design was adopted for the study. A sample of 174 SS II students comprising 82 males and 92 females in two intact classes from two secondary schools in Abuja were used for the study. One class was randomly assigned as the experimental group while the other class as the control group. The treatment lasted for four weeks, during which the experimental group was taught using Sensory Simulation Teaching Strategy. The control group was taught using conventional teaching method. The instrument used in the study was Genetics Achievement Test (GAT). The instrument was face validated by experts, pilot tested and the reliability index of the instrument was obtained for GAT and was found to be 0.89. The value was considered high enough for the study. Two research questions and two null hypotheses were formulated for this study. Means and standard deviations were used to answer the

research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that Sensory Simulation Teaching Strategy has facilitative effect on achievement of biology students in genetics. Gender had no significant effect on achievement among biology students in genetics. Students taught using Sensory Simulation Teaching Strategy achieved higher than those taught using conventional teaching method. Recommendations were made which included Biology teachers should be encouraged to teach genetics using Sensory Simulation Teaching Strategy; by making resources and time available by curriculum planners and school administrators, this will further enhance students' achievement in genetics. Seminars, conferences should be organized for biology teachers on the use of Sensory Simulation Teaching Strategy by professional bodies like STAN.

**Keyword:** Sensory simulation teaching strategy, student achievement, genetics instruction, quasi-experimental design, and biology education.

## Introduction

Science and technology have been improving rapidly today. This progress of scientific technology developments can also be seen on the field of education and makes it necessary to rebuild teaching and learning environments.

The academic contents and learning paths of students are customized by the adaptive educational system, which emphasized on the need of the hour in present educational environment (Richa Bajaj, Vidushi Sharma 2018). This system results to a reduced occasion of disorientation and cognition over road problem, as a result, learning efficiency is achieved. Evidently, the present educational system lacks adaptability. They provide same resources for all users irrespective of their personal differences. Students have different learning styles, figuring this out is a very important step in enhancing e-learning and traditional education and making them adaptive. The various learning model should be explored in determining the learning style of the students.

Adaptation in learning has been proved using different Artificial Intelligent (AI) method (Richa Bajaj, Vidushi Sharma, 2018). A large crowd of interconnected neurons known as neural networks work together to process Information. Studies have shown the use of artificial neural network in sampling of global personalized learning process

(ICCIDS 2018). This neural network is used to classify students in certain instances. This has been used to determine learning styles of the students. According to Vidushi Sharma, (2018), there are apparently, eight learning styles which generate sixteen combinations. The four dimensions includes; active/reflective, sensing/intuitive, visual/verbal and sequential/global (Richa Bajaj, Vidushi Sharma, 2018). Active learners learn best by being actively involved in the process of learning, applying the required skills, taking risks, exploring materials, initiating ideas and drawing conclusions. In contrast, reflective learners have the skill of thinking about the learning content. The sensing learners apply their sensory cells experience to learn facts and concrete materials involved.

Intuitive learners enjoy learning of abstract materials such as theories and principles with the imbedded meanings. Visual learners are skilled in the use of their sight and memories. They remember very well what they have seen in form of pictures, diagrams and flow-charts, videos. Verbal learners prefer textual materials, written or spoken. Sequential learners learn in little progressive steps, they are said to have a sequential learning progress. In contrast, global learners learn by understanding the large picture. They use a global holistic thought process (Richa Bajaj, Vidushi Sharma, 2018). Individuals having

Read/ Write learning style prefer information in form of words, text style of input and output, reading and writing manuals, report, essay and assignments. The person with Kinesthetic learning style applies experience and practice; it may be simulated or real. This learning style involves demonstration, simulation, video, movies and case studies. (Richa Bajaj, Vidushi Sharma, 2018)

Students generally view genetics as a difficult subject (Hsiao-Ching she, Yi Zen, 2019). The reason could be mainly because it exposes them to many new concepts and processes at the macro and molecular levels of organization of life. Robinson (2020) in Hsiao-Ching she, Yi Zen, (2019) argued that students aged 14–16 lacked primary knowledge and understanding of the structure in genetic and in basic biological concepts (such as cell, chromosome, and gene) and their relationship to each other. Students have high level of misconception about the process of mitosis and meiosis. They lack proper understanding on the functions and processes of mitosis and meiosis; they are not familiar with stages in mitosis and meiosis and thus are not usually able to arrange them in their sequence. They mix up the functions and procedures of mitosis and meiosis, failing to name the various phases appearing in mitosis and meiosis or being unable to arrange them

properly they usually assume mitosis to be meiosis.

The vestibular system is the sensory system specifically involved in the development of the middle and inner ear and recognized mostly for its critical role with balance, equilibrium and motor development. When we move our heads, the fluid in these organs moves and shifts, constantly providing us with information about the position of our heads and bodies in space, known as spatial awareness (Braley, 2014). However, this system, which is the base to the other two, holds another important responsibility as it combines with the other senses (namely the eyes and ears) in filtering through environmental stimuli and providing responses. Movements such as jumping, swinging, rolling, crawling, and climbing are responsible for developing the vestibular system, thus aiding in the more appropriate analysis and response of sensory information. On the other hand, when a student has a well-developed sensory system, information from the eyes, ears, balance, and movement organize more efficiently and filter in the brain quicker, allowing the brain to provide appropriate responses to environmental stimuli. To accomplish this, much research suggests activities that promote brain integration be performed frequently until movements are fluid and coordinated and the eyes are converging efficiently. Likewise, a growing

body of mainstream scientific research clearly points to the critical role that sensory/motor neural development through the vestibular system (balance/inner ear system) plays in the learning process (MIM, 2012).

Simulation exercises can quickly enrich visual perceptual problems in offspring with vestibular dysfunction. In fact, children respond more quickly than adults because of their greater neural plasticity – the ability to move quickly compensate for and adapt to vestibular deficits (Cronin, 2014). With an individualized approach, exercises addressing eye-movement control, balance, and body movement functions could have an immediate and dramatic positive effect on the academic achievement and classroom behavior of students. According to Cronin (2014), teachers and occupational and physical therapists are excellent professionals to integrate the vestibular training into activities for learning, movements, and behavior. Simulations are tools that facilitate learning through representation and practice in a repeatable, focused environment. It helps students to identify and understand factors which control the system and or predict the future behavior of a system. Umoke and Nwafor (2014) and Ezeudu and Ezinwanne (2013) observed that the use of simulations to teach science gives positive results over time and permits the learner to manipulate variables

or parameters and then observe the consequences of their actions.

It is the first system to develop in uterus and to have an organized response to sensory output, it is the most protected area of the brain, and has a very close relationship to gravity, safety, survival, arousal, and attention (Greutman, 2016). When a child has an underdeveloped vestibular system, the brain is not getting the correct information from the eyes, ears, and the sense of gravity or movement of the body. This in turn makes the brain and body feel unsafe. When not feeling safe, arousal level, attention, and survival mode responses kick in (Gruetman, 2016). Reynolds (2020) opined that sensory integration is distinctly effective in improving a child with learning disabilities development. Although sensory integration has been a popular and highly supported subject with babies in the womb, infants, and special populations, some professionals considered sensory integration approaches to be “demonstratively ineffective” models of intervention. This is particularly true for elementary students who do not fall in a special population. BRAIN GYM, a program consisting of 26 activities recalling the movements naturally done during the first years of life when learning to coordinate the eyes, ears, hands, and whole body, is committed to the principle that moving with intention leads to optimal learning. To date, there are over twenty

years of research studies on the effect of this program in different diversified settings. Learning Minds is a comprehensive approach to understanding how sensory integration and motor control drives learning and performance in children.

### **Statement of the Problem**

The primary purpose of teaching is for students' learning. It is expected that students who are taught will go in for public examination like Senior Secondary School Certificate Education (SSSCE) and perform credibly well. It is unfortunate that the reverse is the case with the teaching of genetics. The importance of genetic in biology as a subject has positive impact on human life and national development. The subject therefore requires to be taught by competent teachers who can guide students towards attaining the desired educational goal. But there is a serious decline in students' achievement in the subject. The reports attributed the cause of the students' poor achievement to the lack of knowledge of the subject matter, non-commitment and poor method on the part of teachers. Poor method of teaching could be as a result of persistent use of strategies of teaching in the school.

Teaching strategy appears to have rendered the student's passive and encouraged rote memorization of the curriculum contents. Lack of success in academic achievement can result to inappropriate behaviour and

frustration on the part of students. It could be observed that rote learning does not foster transfer of knowledge which occurs as a result of retention of information learned. As such, it could be noted that teaching strategy is not so effective and as a result, affects the performance of students in public examinations. The foregoing therefore underscores the need to explore other teaching methods that would enhance students' Achievement on the subject matter, and possibly motivate students to commit themselves in learning genetics. In addition, teachers being the implementers of any educational policy on school curriculum require to be highly committed in guiding the students towards achieving the desired educational objectives. It has been argued that constructive-oriented methods foster teachers' commitment and students' active participation in teaching-learning process. Also, it has been argued that students can learn effectively by the use of Sensory Simulation Teaching Strategy. On this basis, it becomes worthwhile to explore how teachers' use of Sensory Simulation Teaching Strategy on Achievement Among Senior Secondary School Student's in Genetics in Abuja.

### **Objectives of the Study**

The main purpose of this study was to find out the Effect of Sensory Simulation

Teaching Strategy on Achievement of Students in Genetics in Abuja, Nigeria.

Specifically, the study sought to:

- i. determine the Genetics Achievement of students using Sensory Simulation Teaching Strategy (SSTS) and those taught using Conventional Teaching Method, (CTM).
- ii. determine the Genetics Achievement mean scores (GAMS) of students taught genetics using Sensory Simulation Teaching Strategy (SSTS) based on gender.

### Research Questions

The study was guided by the following research questions:

- i. what are the mean achievement scores of students taught genetics using Sensory Simulation Teaching Strategy (SSS) and those taught using Conventional Teaching Method?
- ii. what are the mean achievement scores of students taught genetics using Sensory Simulation Teaching Strategy based on gender.

### Statement of Null Hypotheses

The study was guided by the following null hypotheses.

**H<sub>01</sub>:** There is no significant difference in the Genetics Mean Achievement Scores of students taught using Sensory Simulation Teaching

Strategy and those taught using conventional teaching method.

**H<sub>02</sub>:** There is no significant difference in the Genetics Mean Achievement Scores of students taught using Sensory Simulation Teaching Strategy based on gender.

### Methodology

This study used quasi-experimental researcher design involving non randomized pre-test, post-test, control group. The groups were non-equivalent in the two intact SS II biology classes in two different schools. The two schools were randomly selected and assigned as experimental group and control group. However, to establish the groups entry behaviour, a pre-test was given to the two groups. After the pre-test, treatment was given to the two groups. The treatment exercise lasted for four weeks and subsequently post-test was administered after the treatment. The intervention employed was the Sensory Simulation Teaching Strategy (SSTS). The population for this study was 2,245 SS two Biology students comprising 1,257 males and 988 females drawn from public senior secondary

schools in Abuja metropolis. The sample used for this study was 174 SS two biology students comprising 82 males and 92 females. The study used multistage sampling technique to choose the sample because stratification was applied on more than one variable at a time in several stages of the study. The instrument for data collection was Genetic Achievement Test (GAT) the GAT was used to measure biology student achievement in Genetic the GAT was given to two science education experts specifically in biology and one measurement and evaluation expert for validation. The reliability of GAT was determined by pilot testing with a public senior secondary school that is part of the target population of the area under study but not part of the sampled schools in FCT, Abuja. The data collected

were analysed using Kuder Richardson ( $KR_{21}$ ) to obtain a reliability coefficient of 0.89. Biology student in the experimental groups were taught using sensory simulation teaching strategy while the Biology student in the control group were taught using conventional teaching method. Both groups were taught for four weeks. At the end of four weeks, GAT was administered as post-test to Biology student in the two groups. The data collected were analysed using descriptive statistics of mean and standard deviation and inferential statistics of Analysis of Covariance (ANCOVA). The mean and standard deviation were used to answer the research questions while the ANCOVA was used to test the hypothesis at 0.05 level of significance.

## **Results**

**Research Question 1:** What are the mean achievement scores of students taught using Sensory Simulation Teaching Strategy (SSTS) and those taught using conventional teaching method.

**Table 1: Mean and Standard Deviation of Mean Achievement Scores of Students Taught Sensory Simulation Teaching Strategy and Conventional Teaching Method.**

Variable (Group)	Pretest			Posttest	
	N	$\bar{X}$	SD	$\bar{X}$	SD
Experimental (SSTS)	80	21.80	8.92	61.86	7.96
Control (CTM)	94	20.80	7.94	52.37	7.11
Total	174				

Results in Table 1 show that the group taught genetics using Sensory Simulation Teaching Strategy had a pretest achievement mean score of 21.80 with a standard deviation of 8.92 and a posttest mean score of 61.86 with a standard deviation of 7.96. The difference between the pretest and posttest achievement mean score was 40.06. The group taught genetics using conventional teaching method had a pretest achievement mean score of 20.80 with a standard deviation of 7.94 and a posttest mean of

52.37 with a standard deviation of 7.11. The difference between the pretest and posttest mean was 31.57. However, for each of the groups, the posttest achievement means were greater than the pretest means with the group taught using Sensory Simulation Teaching Strategy having a higher mean gain. This is an indication that Sensory Simulation Teaching Strategy more efficacious on students' achievement in genetics than the conventional teaching method.

**Research Question 2:** What are the mean achievement scores of students taught genetics using Sensory Simulation Teaching Strategy based on gender.

**Table 2: Mean and Standard Deviation of Pretest and Posttest Achievement Scores of Male and Female Students in Genetics.**

Variable	N	Pretest		Posttest	
		$\bar{X}$	SD	$\bar{X}$	SD
Male	36	38.90	8.65	57.66	8.74
Female	44	38.88	8.67	57.41	8.69
Total	80				

In Table 2 shows that the male group taught genetics had a pretest achievement mean

score of 38.90 with a standard deviation of 8.35 and a posttest mean score of 57.66 with

a standard deviation of 8.74. The difference between the pretest and posttest achievement mean score for the male group was 18.76. The female group taught genetics had a pretest achievement mean score of 38.88 with a standard deviation of 8.67 and a posttest mean score of 57.41 with a standard deviation of 9.09. The difference between the

pretest and posttest mean for the female group was 15.53. However, for each of the groups, the posttest achievement mean scores are equal to the pretest means with the male group having a higher mean gain. This is an indication that gender does not influence students achievement in genetics

**Hypothesis 1:** There is no significant difference in the mean achievement scores of students taught genetics using Sensory Simulation Teaching Strategy based on gender.

**Table 3: Analysis of Covariance (ANCOVA) of the Difference in the Mean Achievement Scores of Students Taught Genetics Using Sensory Simulation Teaching Strategy Based on Gender**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	11568.540	4	2892.135	52.924	0.000
Intercept	57707.476	1	57707.476	1056.006	0.000
Pretest achievement	18.898	1	18.898	.346	0.557
<b>Method</b>	<b>9265.793</b>	<b>1</b>	<b>9265.793</b>	<b>169.557</b>	<b>0.000</b>
Error	24864.354	169	54.647		
Total	1537021.000	174			
Corrected Total	36432.893	173			

In Table 3 shows the significant difference in the mean achievement scores of students taught genetics using Sensory Simulation Teaching Strategy and conventional teaching and method. Result shows that with respect to the groups taught genetics using Sensory Simulation Teaching Strategy and those taught using conventional teaching method,

an F-ratio of 169.55 was obtained with associated probability value of 0.00. Since the associated probability value of 0.00 was less than 0.05 set as level of significance, the null hypothesis (H01) which stated that there is no significant difference in the achievement mean scores of students taught genetics using Sensory Simulation

Teaching Strategy and that of those taught using conventional teaching method is rejected. This, inference drawn is that there was a significant difference in the achievement mean scores of students taught genetics using Sensory Simulation Teaching Strategy and that of those taught using conventional teaching method with those taught using Sensory Simulation Teaching Strategy having a higher mean

gain. This shows that Sensory Simulation Teaching Strategy has more effect on students' achievement in genetics than the conventional teaching method. These taught using Sensory Simulation Teaching Strategy had a higher mean gain. This shows that Sensory Simulation Teaching Strategy had more effect on students' achievement in genetics than the conventional teaching method.

### Hypothesis Two

There is no significant difference in the mean achievement scores of biology students taught genetics using Stimulus Variation Teaching Strategy based on Gender

**Table 4: Result of One-Way ANCOVA of Mean Achievement Scores of Biology Students Taught Genetics Using Sensory Simulation Teaching Strategy Based on Gender**

Score	Type II sum of square	df	Mean square	F	Sig (P value)	df at 0.05
Corrected model	10.236	2	5.517	0.428	0.702	
Intercept	3557.5	1	3557.5	243.245	0.000	
Pre-test	8.193	1	8.193	0.512	0.576	
Gender	3.280	1	3.280	0.352	0.670	Accepted

Table 4 shows the summary of the One-Way ANCOVA result on male and female biology students' achievement test. The results indicates that  $P=0.670>0.05$ . The null hypothesis was accepted showing there is no significant difference in the achievement mean scores of biology students taught genetics using Sensory Simulation Teaching Strategy Based on gender.

### Discussion of Findings

The findings with respect to research question 1 indicate that Biology students taught genetics in the experimental using sensory simulation teaching strategy achieved significantly in their mean

achievement scores as against the biology students taught genetics using conventional teaching method. This finding agrees with Achanya, Uzoechi, & Musa, (2020) and Katcha (2017) who opined that innovative teaching strategy such as sensory simulation

teaching strategy improves students' achievement than the conventional teaching method. Yunusi (2016) also reported that innovative teaching strategy like sensory simulation teaching strategy is effective in improving students' conceptual scientific skills. The finding also shows that there was no significant difference in the mean achievement scores of students taught genetics using sensory simulation strategy based on gender. This finding is in agreement with the finding of Katcha (2017) who reported that there was significant difference in the mean achievement scores of male and female students taught genetics using sensory simulation teaching strategy. The reason for this inclusive statement might be that male and female students indicated equal higher level of commitment which may have necessarily enhanced their perceptions using sensory simulation teaching strategy.

### Conclusion

The study determines the effect of "Sensory simulation teaching strategy on achievement

among secondary school biology students in genetics" in Abuja, Nigeria. The findings of this study revealed that sensory simulation strategy is efficacious in enhancing students' achievement in genetics using conventional teaching method. The educational implication of this is that the overdependence of biology teachers on conventional teaching method in teaching genetics might probably be responsible for the persistent students' poor achievement in genetics.

### Recommendations

The following recommendations were made in this study:

- i. Education policy makers, curriculum planner should stipulate that genetics should taught using sensory simulation teaching strategy.
- ii. Seminars and workshops should be encouraged to guide biology teachers on how to use sensory simulation teaching strategy to teach genetics in secondary schools.

### References

- Achanya, M. A., Uzoechi, B. C. & Musa, D. C., (2020). Effect of graphic Advance Organizer on Senior Secondary School Students' Achievement and Retention Algebraic Processes in Abuja, Nigeria. *Journal of Science, Technology and Education (JSTE)* 4. No. 8 [www.nsjkste.com/ISSN:2651-5339](http://www.nsjkste.com/ISSN:2651-5339)
- Aniaku, O. L. (2012). Effects of guided and sensory simulation teaching methods

- on secondary school students' interest and achievement In Biology in Enugu State. Unpublished Master's Degree Dissertation. Retrieved from [www.unn.edu.ng](http://www.unn.edu.ng)
- Baram-Tsabari, A, Sethi, R. J., Bry, L. & Yarden Anat (2010). Identifying students' interests in biology using a decade of self-generated questions. *Eurasia Journal of Mathematics,*

- Science & Technology Education*, 2010, 6(1), 63-75. Retrieved from [www.iserjournals.org](http://www.iserjournals.org)
- Braley, M., (2020). Open Education Leadership Program.
- Cawood, R., Roche, J., Sharma, D., Jones, L., Kirkhope, J., Ong, A., . . . Ta, D. (2018). *Can the universities of today lead learning for tomorrow? The University of the Future*. Ernst & Young Australia. Retrieved from <https://cdn.ey.com/echannel/au/en/industries/government---public-sector/ey-university-of-the-future2030/EY-university-of-the-future-2030.pdf>
- Cimer, A. (2012). What makes biology learning difficult and effective: Students' views. *Educational Research and Review*. 7(3), 61-71, 19 January, 2012. Retrieved from [www.academicjournals.org/ERR/content/uploads/2018/03/MIT\\_NEET\\_GlobalStateEngineeringEducation2018.pdf](http://www.academicjournals.org/ERR/content/uploads/2018/03/MIT_NEET_GlobalStateEngineeringEducation2018.pdf)
- Cromin, D. A. (2022). Working memory control predicts shorter fixation duration in science viewing: *Journal of Psychological Research*. 18 sing ming lane, ₦ 06-15 mid views city, singapore 573960.
- Cronin, E. (2017). *Robot-proof: higher education in the age of artificial intelligence*. Cambridge: MIT Press.
- Delpech R (2002) Why are school students bored with science? *Journal of Biological Education* 36(4) 156-157.
- Ebenezer J V & Zoller U (1993) Grade 10 students' perceptions of and attitudes toward science teaching and school science. *Journal of Research in Science Teaching*. 30(2) 175-186.
- Eziwane, (2013). Impact of computer simulation on students' achievement, Group interaction and Attitude in Direct Current Circuits. ResearchGate
- Federal Ministry of Education (2009). senior secondary school curriculum biology. Corrected Version.
- Festus, C. & Ekpete, O. A. (2012). Improving students' performance and attitude towards chemistry through problem-based-solving Techniques (PBST). *International Journal of Academic Research in Progressive Education and Development January 2012*, Vol. 1, No. 1 ISSN: 2226-6348. Retrieved from [www.hrmars.com](http://www.hrmars.com).
- Foer, F. (2017). *World Without Mind*. New York: Random House.
- Francis L J and Greer J E (1999) Attitudes toward science among secondary school pupils in Northern Ireland: relationship with sex, age and religion. *Research in Science and Technological Education*. 17(1) 67-74.
- Friedman, T. L. (2016). *Thank you for being late: An optimist's guide to thriving in the age of accelerations*. New York: Farrar, Straus and Giroux.
- Graham, R. (2018). *The global state of the art in engineering education*. Technical Report, Massachusetts Institute of Technology, Cambridge. Retrieved from <http://neet.mit.edu/wp->
- Grasso, D., & Burkins, M. (2010). *Holistic engineering education: Beyond technology*. Springer Science & Business Media.
- Gruetman, R. (2016). Self-translation in trans-cultural mode: the theory of trans-culture applied to self-translation. University of British Colombia.

- Gruetzmacher, H. (2014). Effect of sensory simulation teaching strategy on achievement among secondary school biology student in genetics. *Research gate*
- Hidi S & Harackiewicz J. M. (2000) Motivating the academically unmotivated: a critical issue for the 21st century. *Review of Educational Research*. 70(2) 151-179.
- Kabutu,c.o Oloyede, E.o, of Bandele, A..D (2015). Effect of sensory simulation teaching on student' Achievement in Biology. *Journal of Education and practice (JEP)*. Osun state, Nigeria.
- Katcha, M. A. (2017). Innovative and students' centered method of teaching and learning science subjects. *Journal of Science Education (JSE)* (2), 3-20.
- Lebata, M. C. & Mudau, A. V. (2014). exploring factors affecting performance in biology 5090 at selected high schools in Lesotho. *Mediterranean Journal of Social Sciences*, MCSER Publishing, Rome Italy. ISSN 2039-2117 (online). Retrieved from [www.mcser.org](http://www.mcser.org)
- Li, Y. (2011). On the cultivation of students' interests in biology teaching. *international education studies*. 2; May 2011. Retrieved from [www.files.eric.ed.gov](http://www.files.eric.ed.gov)
- Mimi, A. D. A (2012). Effect of sensory simulation teaching strategy on achievement among secondary school Biology students in Genetics in Abuja, FCT, Nigeria. *International Journal of Research and Innovation in Social Science (13 RISS)*.
- Rich B. & Vidushi S. (2018). Smart education with artificial base intelligence base determination of learning styles. *International Conference on Computational Intelligence and Data Science (ICCDIS)*. Procedia Computer Science 132, 834-842. Available online at [www.sciencedirect.com](http://www.sciencedirect.com)
- Robinson, D., (2020). A mixed methods evaluation of the feasibility, acceptability, and impact ECHO for community health workers (CHWSs). SPRINGER NATURE Link. Pilot and Feasibility Studies.
- Umoke and Nwafor, C. E. & Oka, O. O. (2016). Effects of Computer Assisted Instruction On Junior Secondary School Students' Achievement In Basic Science. *International Journal of Scientific & Engineering Research*, 10, October-2016 ISSN 2229-5518. Retrieved from [www.ijser.org](http://www.ijser.org)
- Umoke, I.A., of Nwonfor, c.c (2014). Comparative analysis of the effectiveness of lecture and discussion method on students' achievement in Biology. *Journal of Education and Practice*. (19) pages (11STE), Ney York, united states
- WAEC Chief Examiner's Report (2011, 2013, 2014, 2015, 2016, 2017, 2018 & 2019).
- Yunusi, M. M; Nordin, N.; Salehi, H.; Embi, M. A. & Salehi, Z. (2016). The use of information and communication technology (ICT) in teaching ESL writing Skills English Language Teaching, 6, 1-8 <http://dx.doi.org/10.5539/elt.v6n7p>.