

**EFFECTS OF TACTILE MODEL ON SENIOR SECONDARY ONE STUDENTS WITH VISUAL IMPAIRMENT ACHIEVEMENT IN BIOLOGY IN PLATEAU STATE, NIGERIA**

**Sani Danladi,  
Dr. Friday John  
Prof. Felicia O. Agbo  
Department of Science and Technology Education,  
University of Jos, Plateau State, Nigeria.**

<sup>1</sup>[sanidanladi2016@gmail.com](mailto:sanidanladi2016@gmail.com), <sup>2</sup>[john@unijos@unijos.edu.ng](mailto:john@unijos@unijos.edu.ng), <sup>3</sup>[dronyemowo@gmail.com](mailto:dronyemowo@gmail.com)  
08087145197                      08035922512                      08034040671

**Abstract**

*The purpose of this study was to determine the learning effects of tactile models on students with Visual Impairment' achievement in Biology. This study intends to assist Biology teachers to implement tactile models effectively in the classrooms so as to get a satisfactory learning outcome from students in senior secondary schools. The study was conducted in Plateau State Senior Secondary one students with Visual Impairment, the study used an integrated approach from several relevant psycho-educational theories with a framework of subsequent reflections that derived effective results. The models were locally designed and used as instructional models from an integrated view point. The models were examined for their validity and reliability as well as their capacity for assessing students' academic achievements in Biology. They were involved in teaching and learning process at Senior Secondary Schools, data were collected and analysed and the results revealed that the students' perception and learning with tactile models have a positive and significant effect on students' academic achievement. Also, they were found to be useful tools for conducting formative evaluation of teaching and learning process since they allow perception from students to be captured and compared across deference dimensions. The study adopted quasi experimental research design using pre-test, post-test control groups without randomization. The study was conducted on two groups of students in senior secondary schools in Plateau State, namely Experimental and Controlled groups, the two groups were pre-tested and after administering the intervention the two groups were post-tested. The sample used comprises of 10 male and female students with Visual Impairment. Hypotheses were formulated and questionnaires were administered at the beginning of the lesson and the students' intention to learn was measured. Pre-test and post-test were done on the students to assess their achievement in Biology. The study shows that the students with Visual Impairments that experience the tactile models intervention did well in Biology.*

**Keywords: Biology, Tactile Model, Visual Impairment, Achievement, Experimental and Control groups.**

**INTRODUCTION**

Education is an empowering process that guides an individual to develop his vision, passion and orientation towards wisdom for timely action. It is a process of giving instruction and knowledge in an educational system such as Schools, Colleges, Polytechnics, and Universities. Education helps one to develop critical skills, logical thinking, mental agility, decision making and problem-solving ability.

Education gives people facing problems ability to make rational and informed decisions, depending on how educated they are. Education is the transmission of values, accumulated knowledge and norms from one generation to another. Which social scientists called socialisation. Education maximizes the creative potentials and skills of an individual's for self-fulfillment Adolphus (2020)

Biology is a systematic study of structures, characteristics of physical and natural things through observation, experimentation and testing of theories. Biology can also be defined as the

pursuit and application of knowledge and understanding of the natural world by following a systematic methodology based on evidences. Biology increases students understanding as well as promoting their knowledge of technology. It uses observation and experimentation to explain natural phenomena and provides medicine to cure human diseases alleviates pains and helps to provide good water for human consumption.

Biology with other science subjects provides man with knowledge of food processing and how to convert sunlight to solar energy for better life UNESCO (2021)

Biology education shared scientific knowledge, methods and discoveries with individuals who are not considered traditionally as members of a scientific community; such individuals could be local farmers, illiterate market women and people with visual impairment, this made science accessible to all. Milkman and Jonah (2014) said that teaching science education to students is simply teaching them how to think, learn and solve problems. Science education holds the key to progress and development of any nation in the world. It plays a major role in people economic growth, wealth creation and transformation of societies; hence students with visual impairment need science education for personal progress and development. Science education and technology may be defined as the application of scientific knowledge on human practical activity and manipulation of human environment for the benefit of all humanity. Science education is geared towards inculcation of right values, knowledge and skills in the young minds of students to enable them fit into the society and responsibly contribute to the development of their communities. Adolphus (2020) defined Science Education and Technology as a field of study that investigates the process of analyzing, designing, developing, implementing and evaluating instructional materials. Through studying Science education and technology nations will see their technological needs. Huberty (2021) Anaeto, Asiabaka, Ani, Nnadi, Asiabaka and Ugwoke (2016) in their work, observed that the gap between the rich and the poor nations may largely be attributed to the differences in their technological applications. They believed that any nation that does not implement Science education and technology will have minimal development and that nation may be rated by the international community as underdeveloped nation. This may be the case with Nigeria as a nation. Presence of Science education and technology has brought the world, the presence technologies like computers, internets, electricity, cars, planes and machines. It is science and technological inventions that has transformed the world. Biology has discovered that microbes have being the cause of environmental diseases like malaria, polio, meningitis, ulcer, cancer and water borne diseases (Vedantu 2023) Biology education has also discovered how to convert microbe negative effects to positive effects. Scientists are now using the microbe organisms combined with enzymes to produced important foods such as cheese, yoghurt, bread, yeast and beer, UNESCO (2021). Apart from manufacturing of these desired products, microbes also aid in warranting the quality and safety of the products MohammadHassan, Masoomah and Mehdi (2023). Biology together with other subjects such as Chemistry and Physics have made possible the production of cars, aircrafts, ships, boats and aeroplanes, this has improved movement of people and goods from one location to another. Biology education has also help in the discovery of products like fuel, kerosene, gas, iron ore for production of iron and rubber used for making tires, shoes and seats. In the area of healthcare Biology education has contributed in producing medicine for medical doctors, nurses, Pharmacies and other medical related personnel thereby meeting societal needs. The knowledge of biology education has also brought about beauty products like shampoo, lotions, cosmetics, perfumes and soap. Biology education has also provided vaccines for different diseases. It has improved human nutrition and by applying the knowledge of animals and plants breeding.

This research study is majorly on students with Visual Impairment offering Biology, Visual impairment is a term used to describe all kinds of vision loss, whether it's someone who cannot see completely or someone who has very low vision, because study has shown that some people are totally blind, while others are partially blind. Science education is 80 percent learned through visual channel, so Lack of a good vision has negatively affected how a learner performs in Biology.

Available studies have looked at the achievement of learners with Visual Impairment in Biology, the findings indicated that learners with Visual Impairment generally performed poorly in the sciences Wanja (2021) however, the author opined that learners with visual impairment could perform well; if improvement could be made in the way their teaching are made by their teachers. Students with Visual Impairment need knowledge of Biology to enhance their thinking and problems solving ability. This study is designed to encourage and assists these categories of students to acquire knowledge of Biology through tactile models touch experience. Tactile models may be defined as tools designed for teaching and help students with Visual Impairment to interpret shapes, sizes, volumes and to recognize any form of represented elements through fingering. Tactile models are physical representations of objects that help students with Visual Impairment to investigate phenomenon in a controlled manner. For instance, the model of a human skeleton is not an actual human bones or an actual skeletal system. They are only use as representative of the bones. The tactile models give students with Visual Impairment opportunity to touch, feel and imagine the assumed objects. All the tactile models for this study were locally designed and provided by the researcher. However, the tactile models were used to teach experimental group only, the differences in achievement of the two groups attest to the effectiveness of the tactile models intervention. The tactile models were developed to help students reasoning ability; they were produced in different forms and sizes. The purposes of making larger models smaller are to make the large objects like aeroplanes and cars smaller for students to have a better view of them during learning. The reason for making smaller models like bacteria cells larger is to increase the size of the tiny objects to help students feel their structures during teaching and learning. Effective teaching and learning with tactile models is only through the sense of touching and feeling, especially for people with poor sight. In this study, students with Visual Impairment offering biology used tactile models to feel and identify organisms through imagination.

Research study has shown that tactile models form conceptual image in the mental mind of students with Visual Impairment Vishnu, Brian (2023). The human sense of touch is very active and informative. The sense of touch may be defined as the function of receptors in human skin that receive and give messages related to pressure, vibration, texture, temperature and pain, the sense of touch allows students to receive information about their internal and external environment, Sense of touch has the ability to perceive an object or other stimulus that comes into contact with the surface of the skin. Research has shown that effective perception increase students 'achievement, or their ability to perform a particular activity successfully.

### **STATEMENT OF THE PROBLEM**

According to the World Health Organization, persons with total blindness together with visual impairment (VI) comprise of around 2.2 billion of the world's total population. Mohamed, Salah and Farghal (2023) The problem here, is that this huge population have no or very little chance of learning Biology, because Biology has to do with vision at least to see the living and non things which are macro and micro in nature, however people with (VI) need to know about microbes and macro organisms because they affect their lives, knowing about them will able them know how to protect their body from the effects of micro- organisms. People with Visual Impairment have serious problem of accessibility to the knowledge of Biology due to their poor vision. They faced this problem because Biology syllabus has no provision for people with poor sight, the practical teaching aids and the diagrams in Biology textbooks can be viewed by sighted students. Therefore, students with visual impairment have no accessibility to the knowledge of Biology compared to their sighted peers. It is clear that students with visual impairment have unique challenge regard to Biology content which they cannot see or feel the writing or diagrams by fingering, due to this problem they hardly cope with the abstract nature of Biology contents. A study has revealed that students with visual impairment have significantly lower achievement in Sciences (Biology inclusive) compared to their sighted peers Kizilaslan (2019). This low achievement might be as a result of the VI students'

inability to see practical specimens and carry out other vital practical exercises that involves critical observation.

In an effort to substantiate the claims, an interview was granted to the researcher by the head-teacher of the school of the Blind at Gindiri, Plateau state, Nigeria who herself was Visually Impaired, on why persons with Visual Impairment are not commonly found studying sciences, the interviewee revealed that the main reason students with Visual Impairment do not study sciences, is because of their inability to write formulas, observe Biology specimens, conduct physics and Chemistry practical which involve measurement and titration in the West African School Certificate Examination (WASSCE) and also in the Senior Secondary School Certificate Examination (SSCE).

Another reason was lack of patience on the side of Science teachers, compared to Art teachers, considering the slow learning pace of students with visual impairment.

There is therefore the need to find viable ways to enhance students with visual impairments' achievement in Biology. The researcher felt tactile learning models are the best alternative because they involve teaching students with practical materials that allow students to touch and feel with their fingers. This could improve their attitude towards learning Biology which may translate into better achievement. The Researcher considered the study of this topic namely, 'Effects of Tactile Model on Senior Secondary one Student with Visual Impairment' Attitude and Achievement in Biology in Plateau State, Nigeria as an effort to fill the gap for students with VI who are interested in offering Biology.

### **OBJECTIVES OF THE STUDY**

This study is aim at investigating the effects of tactile models on the achievements of students with visual impairments offering Biology in senior secondary one in Plateau State. The specific objectives of this study were to:

1. Determine the effect of tactile model on achievements of SS1 students with Visual Impairment in Biology in the experimental and control groups.
2. Determine the effect of tactile model on achievements of the male and female students with Visual Impairment taught Biology using tactile models.

### **RESEARCH QUESTIONS**

The following research questions guided the study:

1. What is the achievement mean scores of students with Visual Impairment in the control and experimental groups after treatment with tactile model?
2. What is the achievement mean score of male and female students with Visual Impairment offering Biology?

### **HYPOTHESES**

The following null hypotheses were tested at 0.05 level of significant

1. There is no significant difference between the pre-test and post-test achievement mean scores of students with Visual Impairment in the experimental and control groups.
2. There is no significant difference between the pre-test and post-test achievement mean scores of male and female students with Visual Impairment offering Biology taught using tactile models and those taught not using tactile models

### **METHODOLOGY**

This study adopted Quasi-experimental Research design, which deals specifically with pre-test, post-test and non-equivalent control groups. The population of the study comprised of 10 students with Visual Impairment offering Biology in Secondary School in Plateau state that was purposively selected to include only students with visual impairment.

The 10 student used for the study were all from Nakam Memorial Secondary School Panyam, Plateau State; the entire population was used as sample because the population is small and manageable for the study.

The instrument used for data collection was Biology Achievement Test (BAT). BAT was a five points Likert scale with response type of Strongly agree (SA) =5 Agree (A)=4 Undecided (3), Disagree (D) =2, Strongly disagree (SD)=1 respectively for positive statements with 1,2,3,4 and 5 respectively for negative statements. Each respondent's score was determined by summing up the marks of all items on the instrument. The highest score obtainable was 250marks, while the lowest score possible was 50marks.

The validity of the instrument was ascertained by three experts. one expert from Science and Technology Education Department, one, from the Department of Educational Foundations and Department of Special Education and Rehabilitation Science of the University of Jos. The Biology Achievement Test (BAT) was adopted and was validated by experts before it was used to collect the data.

The reliability of the BAT used Cronbach's Alpha, yielded a reliability coefficient of 0.899.

Descriptive statistic of mean and standard deviation were used to answer the two research questions, while the ANCOVA was used to test the two hypotheses at 0.05 level of significant.

## RESULTS

### Research Question One

What are the pre-test and post-test, achievements mean scores of students with Visual Impairment in Biology in the experimental and control groups?

**Table 5**

**Pre-test and post-test Achievement mean Scores of Students with Visual Impairments in the experimental and control groups**

Group	Pre-test			Post-test		Mean Gain	$\bar{x}$ Gain difference
	N	Mean	SD	Mean	SD		
Experimental	10	39.40	6.041	77.80	10.261	38.4	32
Control	10	36.80	6.877	43.20	4.022	6.4	

Table 5 reveals the result of the pre-test and post-test achievement mean score of students with Visual Impairments in the experimental and control groups. In the experimental group the post-test achievement mean score was 77.80 and standard deviation of 10.261, higher than the pre-test mean score of 39.40 and standard deviation of 6.04 with a mean gain of 38.4, indicating that there was improvement in the achievement of students with Visual Impairment after intervention. Also, for the control group the mean score was 36.80 and a standard deviation of 6.877 in the pre-test. The post-test mean score of students rouse to 43.20 and a standard deviation of 4.022. The result showed that students in the experimental group had a higher achievement mean score (77.80) after intervention using tactile models than those in the control group (43.20) exposed to conventional method with a mean gain difference of 32 and post-test mean difference of 34.6. This means that at the pre-test the students with Visual Impairment in both groups had a poor achievement, but after the intervention the experimental group performed better than the control group. This implies that tactile models improved students' with visual impairment achievement more than conventional method.

**Hypothesis three**

There is no significant difference between the pre-test and post-test achievement mean scores of students with Visual Impairment in the experimental and control groups.

**Table 9**  
**ANCOVA Result on Post-test Achievement Mean Scores of Students with Visual Impairments in the Experimental and Control Groups**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	6015.323 <sup>a</sup>	2	3007.662	48.069	.000
Intercept	1420.025	1	1420.025	22.695	.000
Covariate	29.523	1	29.523	.472	.501
Group	5559.877	1	5559.877	88.860	.000
Error	1063.677	17	62.569		
Total	80284.000	20			
Corrected Total	7079.000	19			

a. R Squared = .850 (Adjusted R Squared = .832)

Table 9 shows that  $F(1,17) = 88.860$ ,  $p < 0.05$ , since the p-value of 0.000 is less than 0.05 level of significance, the null hypothesis was rejected, indicating that there was a significant effect of tactile models on students with Visual Impairments achievement in Biology . The result further reveals an adjusted R squared value of .832 which means that 83.2 percent of the variation in the dependent variable which is achievement is explained by variation in the treatment of tactile models, while the remaining 16.8% is due to other factors not included in this study. This implies that tactile models can help improve students with visual impairment achievement in Biology more than conventional method

**Table 3**  
**Post-test Achievement mean Scores of Male and Female Visually Impaired students in Biology in the experimental group**

Group	N	Post-test Mean	SD	$\bar{x}$ - difference
Male	4	81.00	6.831	5.33
Female	6	75.67	12.160	

Table 3 presents the result of the pre-test and post-test achievement mean score of visually impaired students. For the male students in the experimental group, the post-test achievement mean score for male was 81.00 and standard deviation of 6.831, higher than mean score of female students which is 75.67 and a standard deviation of 12.160. The findings showed that the male with visual impairments had a higher achievement mean score in Biology (81.00) after treatment using tactile models than the female students with visual impairments (75.67) with a mean difference of 5.33. This means that after intervention the male performed better than the females. This implies that male students performed better than female students with visual impairments, when taught Biology using tactile models.

**Hypothesis two**

There is no significance difference between the post-test achievement mean scores of male and female students with visual impairments taught Biology using tactile models

**Table 10**  
**ANCOVA Result on Achievement of Male and Female Students with Visual Impairments in the Experimental Group**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	130.694 <sup>a</sup>	2	65.347	.560	.595
Intercept	765.436	1	765.436	6.559	.037
Covariate	62.427	1	62.427	.535	.488
Gender	84.775	1	84.775	.726	.422
Error	816.906	7	116.701		
Total	61476.000	10			
Corrected Total	947.600	9			

a)R Squared = .138 (Adjusted R Squared = .108)

Analysis of Covariance (ANCOVA) was conducted to determine if there is a significant difference between the achievement of male and female students with visual impairments taught Biology using tactile models.

Table 10 shows that the main effect of gender yielded  $F(1,7) = .726$ ,  $p > 0.05$ , since the p-value of 0.422 is greater than 0.05 level of significance, the null hypothesis was retained, indicating that there was no significant **difference between the achievement mean scores of male and female students with Visual impairment exposed to** tactile models. It implies tactile models can help change students achievement in Biology with no gender difference.

### CONCLUSION

The study concluded that tactile learning model had significant effects on students with visual impairments' achievements in Biology and can help improved students with visual impairment achievements in Biology. The study also concluded that tactile learning model improved male and female students' achievements in Biology in the same manner.

### RECOMMENDATION

The following recommendations were made:

1. Government, school principals and other stakeholders in education should provide tactile learning materials in the schools that have students with visual impairment, so that such special students can effectively learn Biology and other science subjects conveniently.
2. Teachers of students with visual impairment should be trained on the proper used of tactile model learning materials, so that they can properly guide the students to learn effectively.
3. Braille machine with formulae be invented for all Science subjects such as Chemistry, Physics and Biology.
4. Government should also build more special schools for people with visual impairment.

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