

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

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**Abstract**

*The purpose of this study was to determine the effects of tactile models on students with Visual Impairments' learning attitude towards Biology. This study intends to assist Biology teachers to use tactile models effectively in the classrooms to get a satisfactory learning outcome from students' with Visual Impairment 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 tactile 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' attitude towards 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 the students' attitude. Also, they were found to be useful tools for conducting formative evaluation of the teaching and learning process, because they allow students' attitude to be captured and compared across different dimensions. The study adopted quasi experimental research design using pre-test, post-test control groups without randomization. The research study was conducted on two groups of students in senior secondary one (VI) students in Plateau State. (Experimental and control controlled groups) the two groups were pre-tested and after administering the intervention, the two groups were post-tested. Purposive sampling technique was used to select the two arms of the intact classes. The sample used comprises of 10 male and female students with Visual Impairments, hypotheses were formulated and questionnaires were administered at the beginning of the lesson and the students' attitude towards Biology was measured. Pre-test and post-test were done on the students at the end of the lesson to assess their attitude towards Biology. The study shows that after the students with Visual Impairments in the experimental group passed through the tactile models intervention, their attitude towards Biology improved and they also performed well in Biology.*

**Keywords: Education, Science education, Biology, Tactile Model, Visual Impairment, Attitude.**

**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 like decision-making, mental agility, problem-solving ability and logical thinking. Education is the transmission of values and accumulated knowledge of a society from generation to generation, which social scientists term as socialisation. Education maximizes the creative potentials and skills of individuals for self-fulfillment and general development of any society Adolphus T. (2020)

Science education is a systematic study of the structure and characteristics of the physical and natural world through observation, experimentation and testing of theories. There are three main branches of Science namely, physical science, earth science and life science. Science increases students understanding as well as promoting knowledge of technology. Science uses observation and experimentation to explain natural phenomena. Science monitors human health, provides medicine to cure human diseases, alleviates pains and helps to provide good water for human consumption. UNESCO (2021)

Aina (2013) stated that teaching science education to students is simply teaching them how to think, learn and solve problems; hence students with Visual Impairment need Science education. Science education inculcates right values, knowledge and skills in the populace of any nation to enable them fit into the society and responsibly contribute to the development of their communities, Adolphus (2020). Huberty (2021) Anaeto, Asiabaka, Ani, Nnadi, and Ugwoke (2016) in their study, observed that the gap between the rich and the poor nations may largely be attributed to the differences in their Science education and technological applications. Biology is defined as the study of life. The word "Biology" is derived from the Greek words "bios" (meaning life) and "logos" (meaning "study") in general Biology is the study of structure, function, growth, origin, evolution and distribution of living organisms. Biology has contributed in improving agricultural knowledge through the study of animals and plants. This study focuses only on students with Visual Impairment offering Biology. By definition Visual impairment is a term that experts used to describe two kinds of vision loss, someone who cannot see well or someone who has partial vision or low vision. A study has shown that some people are totally blind, while others have partial blindness, so this study is making effort to assist this category of students who have partial blindness, 80 percent of Biology education is learned through visual channel, so poor vision can negatively affect how a learner performs in Biology. Available study had shown that the achievement of learners with visual impairment in science subjects is generally poor in examinations, Wanja (2021). However, Wanja (2021) Opined that learners with visual impairment could perform better; if there is some improvement in the methods they are taught and in the way their examinations are conducted by examiners. Based on this, Students with Visual Impairments needs instructional materials like tactile models to learn Biology, this will enhance their thinking and problems solving ability. Lack of knowledge of Biology can negatively affect how a person behaves health wise. This research study is design to assist students with Visual Impairments to acquire knowledge of Biology through tactile touch experience. Tactile models refer to objects or teaching materials that is used for learning by touching and feeling. All the tactile models used for the study during the experimental class were locally designed and used by the researcher. However, the tactile models were used in the teaching of experimental group, they were not applied in the teaching of the control group; this attest to the effectiveness of the tactile models. 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 actual bones. The tactile models give students opportunity to touch and imagine the assumed objects. Models were developed to help reasoning ability of students within a simplified framework. Type of models includes; musculoskeletal models like human stomach, kidney, heart, ear, teeth and cells. Tombaugh and Tombaugh (2014) reported in their research study that tactile models were used to transmit information about organisms observed under a microscope by enlarging them. The tactile model could be something large which is made smaller or something smaller made larger. Some tactile models are moveable, like machines, some are completely static like doll baby. While some have parts that can be moved manually or may be powered to move. The purpose of models on a smaller scale is to make a large object to be viewed for the purposes of learning, eg. Toy-car and toy-plane. The purposes of making tactile models on a larger scale is to increase the size of tiny objects to help students feel by touching the structure or the things that are normally too small to touch during teaching and learning, for examples Amoeba models, virus models and bacterial cell models. For effective teaching with tactile modelling,

the researcher made students with Visual Impairment offering Biology to use their sense of touching and feeling to identify the tactile models representatives of organisms using their imagination.

Research has shown that tactile models formed conceptual image in the mental mind of students with Visual Impairment during the touching and feeling processed Birgit, (2012). The sense of touch can be defined as the function of receptors in human skin that receive and give messages related to pressure, vibration, texture, temperature and pain, Sense of touch allows people to receive information about their internal and external environment, it has the ability to perceive an object or other stimulus that comes into contact with the surface of the skin. Effective perception improved students' attitude and achievement in performing a particular activity. In learning attitude matter, attitude may be defined as the way a person views something or tends to behave towards a situation. The attitude of a person is determined by psychological factors like ideas, values, beliefs and perception. In psychology, attitude is look upon as a psychological construct, a mental state of mind or an emotional entity that one inheres to or that characterizes a person. The interplay of attitude, behaviour and students ability have crucial roles in students' achievement. A result of the study carried out on student attitudes and academic performance by Marilyn & Sandra (2014) shows that students perform better on those skills that they value and this may be influenced by underlying motivation and attitude towards mastering a skill. This is in contrast to students' performance in a skill not related to their interest, so using confidence as a performance measure may misrepresent the quality of learning being assessed. Students' attitude towards their academic subject plays a vital role in reaching their goals. Students' successes depend on their attitude towards learning. David, Emmanuel and Yanney (2020) reported in their research study that students' interest and academic growth is one important attitude to understanding a subject. Danyaya (2021) head teachers of the School of the Blind Ginddiri, in an interviewed with the researcher stated that many students with Visual Impairments feared sciences because of formulas, that this has affect their attitude towards the Sciences, based on this idea, the researcher made the students with Visual Impairments during the study, to understand that, Biology is not all about formulae, many parts of Biology have no formula. That Biology is mostly about diagrams and explanation of their parts and functions.

Hassanein. (2015) in his study revealed the negative attitudes of teachers' towards those with disabilities, especially students with Visual Impairments, that this negative attitudes of teachers' serves as a barrier to learning Biology. Generally, it is observed that the attitudes of the sighted toward the non-sighted discouraged them from effective learning, (Whitburn (2014) and McDonnal 2016). According to Brian (2021) good attitudes of the sighted have a crucial role in encouraging the persons with visual impairments to succeed in whatever thing they are willing to do or want to achieve. Iliyasa and Yahya (2015) in their study found out that attitude of students towards Biology is significant in educational research, because it play a vital role in their achievements in Biology. The differences in attitude and academic achievements between male and female students with Visual Impairments in Biology were considered in this study.

Table 3 presents the result on the pre-test and post-test attitude score of students with visual impairments in the experimental and control groups. In the experimental group the post-test attitude mean score was 68 and standard deviation of 5.033, higher than the pre-test mean score of 37.50 and standard deviation of 8.317 with a mean gain of 30.5, indicating that there was improvement in the attitude of students with visual impairments after treatment. Also, for the control group the mean score was 38 and a standard deviation of 4.853 in the prê-test. The post-test mean score of students with visual impairments rouse to 47 and a standard deviation of 6.45. The findings show that students in the experimental group had a higher attitude mean score (68) after treatment using tactile models than those in the control group (47) that were not given treatment with a mean gain difference of 21.5 and post-test mean difference of 21. This means that at the pre-test the students with Visual Impairments in both groups had a negative attitude because they were not exposed to any treatment but after the intervention the experimental group had a more positive

attitude to Biology than the control group. This implies that tactile models do change students with Visual Impairments' attitude positively.

### **STATEMENT OF THE PROBLEM**

According to the World Health Organization, persons with total blindness together with visual impairment (BVI) comprise of around 2.2 billion of the world's total population. Mohamed, Salah and Farghal(2023) The major problem here, is that this huge population have no or very little chance of learning Sciences, because the sciences deal with leaving and non things which are both macro and micro in nature, people with (VI) need to know about the microbes organisms that affect their body and how to protect their body from those micro- organisms, the (VI) people have minimum or no knowledge of the sciences due to their poor vision. They faced this problem because Biology syllabus was actually prepared by the sighted, for the sighted only, not bearing in mind the non-sighted in the society. In fact all the practical teaching aids in Sciences, including the diagrams in Biology textbooks were prepared with sighted students in mind. Biology syllabus clearly has no provisions for students with Visual Impairments.

Therefore, students with visually impairments have no accessibility to Biology knowledge compared to the sighted. Note that, students with visual impairment have unique needs and challenges regard to Biology content which they cannot see or feel the writing or the diagrams by fingering, due to this problem they cannot cope with the abstract nature of the Biology concepts. Researchers have revealed that students with visual impairments have significantly lower achievement in Sciences compare to their sighted peers Kizilaslan (2019), Kumar, S. (2001) however, through their researched work show that low vision cannot be a complete barrier to the study of Sciences. Though, past researches have shown a range of diverse obstacles that have hindered persons with Visually Impairment good performance in the sciences at schools, but further researched have indicated that the western worlds have equipped their schools with modern instructional aides that help students with Visually Impairment compare to the developing nations, that well-equipped schools for students with Visual Impairment now have better learning environment, good methodology for learning sciences alongside their sighted peers in the western worlds (Theekshana & Bandara. (2022). 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 a gap or find a solution to the problem of students with VI who are interested in Biology, in the developing world, Africa in particular.

In this effort an interview was granted to the researcher by a woman with Visual Impairment, Danyaya (2021) who was the head-teacher of the school of the Blind at Gindiri, Plateau state, Nigeria, on why persons with Visual Impairment are not commonly found studying sciences, the interviewee revealed that the main reason was that students with visual impairment cannot study sciences, due to their inability to write formulas in the West African School Certificate Examination (WASSCE) and also in the Senior Secondary School Certificate Examination (SSCE). And for the lack of patience on the side of Science teachers, compared to Art teachers considering the slow learning pace of students with visual impairment.

### **Aim and Objectives of the Study**

This study is aim at investigating the effects of tactile models on the attitude 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 attitude of SS1 students with Visual Impairment in Biology in the experimental and control groups.
2. Find out the effect of tactile model on attitude 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 attitude mean scores of students with Visual Impairment in the control and experimental groups after treatment with tactile model?
2. What is the attitude mean score of male and female students with Visual Impairment studying 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 attitude 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 attitude mean scores of male and female students with Visual Impairment studying 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 all the 10 students with Visual Impairment offering Biology in a secondary school in Plateau state that was purposively selected to include only students with visual impairment. The 10 students were used for the study 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 two arms of the (VI) students were use as intact classes. 4 males and 6 females as shown in tables 3 & 4 at the indexes. Table 3 presents the result on the pre-test and post-test attitude score of students with visual impairments in the experimental and control groups. In the experimental group the post-test attitude mean score was 68 and standard deviation of 5.033, higher than the pre-test mean score of 37.50 and standard deviation of 8.317 with a mean gain of 30.5, indicating that there was improvement in the attitude of students with visual impairments after treatment. Also, for the control group the mean score was 38 and a standard deviation of 4.853 in the prê-test. The post-test mean score of students with visual impairments rouse to 47 and a standard deviation of 6.45. The findings show that students in the experimental group had a higher attitude mean score (68) after treatment using tactile models than those in the control group (47) that were not given treatment with a mean gain difference of 21.5 and post-test mean difference of 21. This means that at the pre-test the students with Visual Impairments in both groups had a negative attitude because they were not exposed to any treatment but after the intervention the experimental group had a more positive attitude to Biology than the control group. This implies that tactile models do change students with Visual Impairments' attitude positively.

Table 4 shows the result on the pre-test and post-test attitude mean score of students with Visually Impaired in the experimental group in Biology. The post-test attitude mean score for male wwas 68.75 and standard deviation of 4.787, higher than the mean score of females which is 67.50 and standard deviation of 5.577 with a mean difference of 1.25, indicating that there was a change in the attitude of visually impaired students in Biology after treatment in favour of males. This implies that male had a more positive attitude towards Biology when taught using tactile models.

The descriptive statistics of mean and standard deviation were used to answer the research questions, while ANCOVA was used to test the null hypotheses at the 0.05 level of significance.

## RESULTS

### Construct Validity

Construct validity was established for the BAQ using factor analysis; the result revealed that the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.899 for the BAQ, indicating suitability of the instrument for factor analysis. The Bartlett's test of sphericity was also significant at  $p = 0.000$ , since the  $p$ -value is less than 0.05 level of significance ( $p < .05$ ), it means that the data was suitable for factor analysis. In determining factor to be retained, the Kaiser criteria of Eigen value greater than 1 and the screen plot test was used in retaining factors to avoid over or under extraction of factors. In extracting factors, the Principal Component method was used, 15 items were factorized, 2 components were extracted with Eigen value greater than 1 for the BAQ, accounting for 87.85% variance in students' responses to the items. Again, the orthogonal varimax rotation was used to rotate the factors and 15 items loaded on 2 factors. Twelve items loaded on factor one and only 6 items (2, 6, 7, 8, 11 & 12) were pure, 9 items loaded on factor two and 3 items (1, 19 & 14) were pure. All the 6 impure items (3, 4, 5, 9, 13 & 15)) having absolute values below 0.4 will be revisited before the main study.

### Reliability

Cronbach Alpha reliability and Kuder-Richards were used to measure the internal consistency of instruments and reliability coefficients obtained were .974 and .884 for the BAQ and BAT respectively, which is above the recommended value of 0.77 and above (Mohamad, Sulaiman, Sern&Salleh, 2015), hence, the instruments were regarded as reliable.

### Research Questions

#### Research Question One

What are the pre-test and post-test, attitude mean scores of students with visual impairments towards Biology in the experimental and control groups?

**Table 3**

**Pre-test and post-test Attitude Mean Scores of Visually Impaired Students in the Experimental and Control Groups**

Group	N	Pre-test		Post-test		Mean Gain	$\bar{x}$ Gain difference
		Mean	SD	Mean	SD		
Experimental	10	37.50	8.317	68.00	5.033	30.5	21.5
Control	10	38.00	4.853	47.00	6.446	9	

Table 3 presents the result on the pre-test and post-test attitude score of students with visual impairments in the experimental and control groups. In the experimental group the post-test attitude mean score was 68 and standard deviation of 5.033, higher than the pre-test mean score of 37.50 and standard deviation of 8.317 with a mean gain of 30.5, indicating that there was improvement in the attitude of students with visual impairments after treatment. Also, for the control group the mean score was 38 and a standard deviation of 4.853 in the pre-test. The post-test mean score of students with visual impairments rose to 47 and a standard deviation of 6.45. The findings show that students in the experimental group had a higher attitude mean score (68) after treatment using tactile models than those in the control group (47) that were not given treatment with a mean gain difference of 21.5 and post-test mean difference of 21. This means that at the pre-test the students with Visual Impairments in both groups had a negative attitude because they were not exposed to any treatment but after the intervention the experimental group had a more positive attitude to Biology than the control group. This implies that tactile models do change students with Visual Impairments' attitude positively.

#### Research Question Two

- i. What is the attitude mean score of male and female students with Visual Impairment studying Biology?

**Table 4**  
**Post-test Attitude Mean Scores of Male and Female Students with Visual Impairments in Biology in the Experimental Group**

Group	N	Post-test Mean	SD	$\bar{x}$ - difference
Male	4	68.75	4.787	1.25
Female	6	67.50	5.577	

Table 4 shows the result on the pre-test and post-test attitude mean score of students with Visually Impaired in the experimental group in Biology. The post-test attitude mean score for male was 68.75 and standard deviation of 4.787, higher than the mean score of females which is 67.50 and standard deviation of 5.577 with a mean difference of 1.25, indicating that there was a change in the attitude of visually impaired students in Biology after treatment in favour of males. This implies that male had a more positive attitude towards Biology when taught using tactile models.

### Research Question Three

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

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