

Research Article

Plastic relief sculpture: Improving Nigerian students' performance in practical biology

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ABSTRACT

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Among the factors identified to be responsible for the poor performance of senior high school students in biology is inappropriate instructional media. This study investigated the effects of plastic relief sculpture on senior high school students' performance in biology practical activity in Ogbomoso, South Local Government Area of Oyo State, Nigeria. Moreover, it also observed gender as the moderating effect in this study. The population of this quasi-experimental study was the all senior high school biology students in Oyo State. Two intact classes of 120 biology students were randomly sampled for the study. Two instruments were used in this study i.e. Students' Biology Practical Test and Biology Practical Lesson Notes. The findings of this study revealed that there was significant difference existed between the performance of students in the experimental and control group ($F(8, 51) = 1.89, p < 0.05$). Meanwhile, female students performed insignificantly different compared with male students ($t(118) = 7.16, p = 0.12$). Therefore, the study concluded that plastic relief sculpture is effective in improving students' performance in biology. Thus, it is recommended that teachers should adopt plastic relief sculpture as the innovative instructional resource in teaching biology.



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INTRODUCTION

Biology is one of science subject contained in the Senior High School (SHS) curriculum which involves the basic study of life. It is explained as the study of living things in terms of plants and animals (Michael, 2012) and their constant interaction with non-living things. Furthermore, biology has several branches like Zoology which elaborates about animal and Botany which focused on plant study. In Nigeria education system, the branches of biology are commonly taught in higher education either university, polytechnic, or colleges. Thus, biology is an urgent prerequisite for many specialized sciences and technology courses. Yet, there was no considerable improvement of students' science performance, particularly Biology (The West African Examination Council, 2013). In addition, there has been the data found in the West African Examinations Council (WAEC) and the

National Examinations Council (NECO) which stated that there was the significant difference of students' performance between those who lived in rural and urban area (Olutola, 2016) likewise between the school students and private school students (Udofia & Udoh, 2017).

Several previous studies were conducted to highlight the problems (Çimer, 2012; Etobro & Fabinu, 2017) and proposed the alternative solutions for problems of biology learning process (Hossain et al., 2015), including teaching method (Estai & Bunt, 2016; Joseph & Singh, 2019) and media (Hennessy, Kirkpatrick, Smith, & Border, 2016; Hoyek, Collet, Rienzo, Almeida, & Guillot, 2014). The use of lecture method and memorization only has led to the persistent poor performance in Biology. Thus, Andrew (2013) proposed practical activities to make learning becomes more real and easy understood for students compared to those which are presented in theoretical manners. Several advantages of implementing biology hands-on activity have been reported as well. It is proven to improve biology students' achievement (Vidija, 2015) as it involves all sense organs which, in turn, improves cognitive, affective and psychomotor skills of students. In addition, it supports the function and effectiveness of teaching.

To go further, practical learning activity requires learning media to achieve the expected learning outcomes determined (Dumitrascu, Crivii, & Opincaru, 2016). The resources can be in many forms such as equipment (Olayinka, 2016), visual (Yamada-rice, 2011) or audio-visual materials, and the other crucial substance which stands as the assistants for instructor in teaching and learning situation (Olumorin, Yusuf, Ajidagba, & Jekayinfa, 2010). The existence of learning media enable teachers to deliver certain material which is impossible to be transferred through merely lecture method (Pillai & Vengadasamy, 2010). The use of visual instructional media helps the students to concentrate and pay attention during teaching and learning process as well as motivates them to do more to learning.

It is clear that instructional media are the wheel on which the teaching and learning is built. It makes learning to be more effective (Makokha & Wanyonyi, 2015), positive and real, as well as improve students' achievement (Olayinka, 2016). The unavailability of instructional resources used in Nigerian high schools resulted to the low level of students' performance in national examinations. Hence, it is important to understand that the existence of instructional resources, especially learning media, which can be utilized by students in schools is the key point in learning activity to achieve meaningful and interesting lesson learn.

In biological learning, there are various media developed the both types factory made and improvised media. For instance, dental and anatomical sculptures which used in dentistry courses (Peck & Skandalakis, 2004) and medical courses (Buchaim et al., 2014). These media have been proven to be effective in increasing students' interest as well as develop students' cognitive skill. However, as the use of various sculpture media in several majors in Nigeria, but the study which focused on the effect of this media on biology students is limited. Yet students in different area majors have different conditions.

The study focused on effect of learning media is essential to conduct as its big contribution in providing various basic references for teachers in choosing the most proper media they need to achieve the expected learning outcomes they determined. In accordance with this issue, the information provided by this study will be useful for some related parties to issue suitable policies for education field based on the conditions in their area. Therefore, this research aimed at investigating the effect of plastic relief sculpture on students' biology performance in Nigerian Senior High School. In addition to the effect of media, it also addressed the moderating variable which remained inconclusive i.e. gender.

METHOD

The research design was a 2x2 pre-test, post-test quasi experimental, non-equivalent and non-randomized control group design. This design was adopted because it allows intact classes to be used without disrupting the school programs. An experimental group and a control group was used in this study. Students in experimental group were exposed to plastics relief sculptures, while those who were in the control group were not exposed to the plastic relief sculptures. The dependent variable was the performance of students in biology practical activity and the independent variable was the treatment (i.e. plastic relief sculptures). The moderating variable was students' gender (male and female). The population for the study were all biology students of senior high school (SHS) in Ogbomoso South Local Government Area of Oyo State. Two intact classes of 120 biology students and their biology teachers were randomly sampled for the study. There were two instruments for the study. The first instrument was Students' Biology Practical Test (SBPT) for the students who joint biology anatomical structures (Digestive System, Respiratory System, Circulatory system, Skeletal System and Excretory System of Human). The second instrument was Biology Practical Lesson Notes (BPLN) developed by the researchers for the teachers. By using Cronbach alpha, the reliability index measured for the instrument was 0.75. Meanwhile, the items analysis was also carried out on 50 items from 55 items.

The SBPT which contained of 50 items was already validated by West Africa Examinations council (WAEC). Every ten items represented the five anatomical structures mentioned. Furthermore, five lesson plans were prepared, one for each of the five anatomical structures. During the learning activity, plastic relief sculpture of the system was the instructional resource presented by the teacher. The students were instructed to use all senses to comprehend the study of the anatomy of the systems. The teacher who taught the experimental group was trained by the researcher. Moreover, the researcher ensured the prevention of interaction effect among the students in experimental group and control group. This was done by employed the students who stayed in boarding house and those who were commuter students as the sample groups. Moreover, the all ethical issues were properly addressed.

The treatment group were treated for five weeks, yet the control group were taught without plastic relief sculpture. The SBPT was given to the two groups of students in the sixth week. The standardized marking scheme by WAEC was used on the items of the SBPT for both groups. Meanwhile, the mean value was gained by analyzing the raw data. Furthermore, the Analysis of Covariance (ANCOVA) and independent samples t-test were used to analyze the data.

RESULTS AND DISCUSSION

Anatomy material has been known as the branch of biology in which the students are traditionally rely on their memorization about the names and functions of anatomical structures. Thus, through practical activity, teachers expect the students gaining the ability in performing higher-order learning.

The results of this study showed that there was a significant difference of students' performance who were taught using plastic sculptures in their practical activity and those who were not taught using the media. The analysis results showed this fact are served in [Table 1](#).

Table 1. The ANCOVA analysis results of the students' biology performance who were taught using plastic relief sculpture

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|-----------------|-------------------------|----|-------------|--------|------|
| Corrected Model | 2147.933 ^a | 9 | 238.659 | 2.299 | .030 |
| Intercept | 9878.629 | 1 | 9878.629 | 95.151 | .000 |
| Pre test | 1037.208 | 1 | 1037.208 | 9.990 | .003 |
| Post test | 1566.159 | 8 | 195.770 | 1.886 | .003 |
| Error | 5294.821 | 51 | 103.820 | | |
| Total | 261928.000 | 61 | | | |
| Corrected Total | 7442.754 | 60 | | | |

[Table 1](#) showed the significant effect of plastic relief sculpture use on students achievement ($F(8, 51) = 1.89, p < 0.05$). This means that there was significant difference in the performance of students exposed with plastic relief sculptures and those who were not exposed with the media. This findings interestingly in line with the previous study which revealed that by employing sculpture media approach, students' achievements were improved ([Noland et al., 2016](#)), even though the reasons of the fact revealed were still unclear ([Waters, Meter, Perrotti, Drogo, & Cyr, 2005](#)).

The findings can be interpreted that the media employed in this study was proper to engage the students' focus and interest so that they did thinking process seriously to achieve their learning goal. [Ghousseini and Sleep \(2011\)](#) argued that there are five aspects which must be found in hands-on activity which makes it study-able i.e. engaging the content, providing insight into student thinking, orienting to the instructional context, providing lenses for viewing, and developing a disposition of inquiry. [Olumori et al. \(2010\)](#) also reported that innovative instructional strategies and the use of appropriate instructional resources contributed positively to students' learning. In the same direction, the study of [Makokha and Wanyonyi \(2015\)](#) confirmed the effectiveness of instructional resources in promoting students' learning.

Introducing new interesting media to students is vital matter in learning issue. This will address students' willing to gain the knowledge happily as their curiosity are triggered. Meaningful engagement through hands-on activity learning according to students gives stronger stimulation rather than just observing an experiment conducted by teachers or making notes based on teachers' explanation ([Reddy, 2017](#)).

Anatomy plastic sculpture experience was more effective than the other conventional learning method. The students who learnt using plastic sculpture were paid their focus on the precise form of the structure which they were learning. They must encompass the general shape and position of the structure in the text or model, mold the structures and placed them in the right positions. In the other words, they also sensed the exact form of the structure. Students' continues self-reflections through several resources is crucial to underpinning crucial concepts ([Thwin, 2017](#)). [Waters et al. \(2005\)](#) claimed that encompassing human anatomy using was proven to

strongly engaged students focus in learning process. This means that the students in experimental class involved their all senses (Vidija, 2015) to construct their understanding about the anatomical structures learnt. This experience led them to have stronger memories about the materials learnt. Yet, the students who have no similar experience only could imagine abstract structures. They only relied on their memories about teachers' explanation without any confirmation whether the materials and concepts comprehension they gained were correct or not.

There are several variables possibly take the responsibility in students' understanding in learning anatomy. This study observed the gender effect as moderate variable which may determine students' gain in their practical learning activities using plastic relief sculpture. Table 2 depicts the analysis results of the effect of gender on students' performances in biology practical learning as they were exposed with plastics relief sculptures.

Table 2. The t-test results of biology students' performance exposed with plastics relief sculptures

| Variables | N | Mean | Std. Deviation | DF | T | Sig. (2-tailed) |
|-----------|----|---------|----------------|-----|-------|-----------------|
| Male | 59 | 65.0847 | 10.98791 | 118 | 7.161 | .117 |
| Female | 61 | 67.9344 | 8.70224 | | | |

The t-test analysis results imply that gender factor did not pay significant effect to the biology students' achievement as they were taught using plastic relief instructional sculpture ($t(118) = 7.16, p = 0.12$). This can be caused of the surrounding conditions which do not interfere gender issues such as school and society cultures which do not emphasize the matter of gender issue. This may also due to the equal attention given by teacher in guiding the students without considering the gender. Kumari and Saraladevi (2014) stated that students could face obstacles in earning incase their teachers do not provide an adequate support for them during their learning processes. This finding is supported by Yamtinah, Masykuri, and Syahidul Shidiq (2017) who also found that male and female students have no different attitude toward science process skill, even though there were slight differences in the smaller level of activities done.

The both male and female students exposed to plastic relief sculpture performed well with the improvement observed in the comparison between students' pre-test and post-test scores. The finding of this study tallied with the study of Akintola and Ahmed (2018) which proofed that there were no significant difference existed between male and female students' performances in biology.

Contrarily, several previous studies showed the different results. Kumari and Saraladevi (2014) concluded that gender gave significant effect on students' learning styles as well as their attitudes towards science, Reddy (2017) findings showed the difference preferences between girls and boys in learning, while van der Vleuten, Jaspers, Maas, and van der Lippe (2016) reported that gender determined students ideology which means that taking significant role in driving the students' learning interest. This conditions demand the further observation which highlight the more various variable which possibly affect students' performance, particularly in Biology.

CONCLUSION

The findings of this study revealed that students taught using plastic relief sculpture performed better in biology subject, particularly in anatomy material, than those who were not taught using the media. Moreover, the both male and female performed better in biology as they were taught using plastic relief sculpture. Therefore, it was recommended that teachers should adopt the use of plastic relief sculpture in teaching biology and other science related subjects.

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