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Relative Efficacy of Two Constructivist Instructional Models on Students' Interest in Genetics in Secondary Schools in Enugu State, Nigeria

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Abstract

This study looked at the effectiveness of two constructivist teaching strategies in increasing students' interest in genetics in Enugu Education Zone, Enugu State, Nigeria. This study used a quasi-experimental approach with non-equivalent control groups. The study was led by two research questions and two hypotheses. Purposive sampling was used to choose 160 students (79 males and 81 females) from a cohort of 1,986 SS III Biology students. The Genetics Interest Inventory (GII) was utilized as the data collecting tool, and a reliability of 0.88 was determined using Cronbach Alpha. The data were analyzed using mean, standard deviation, and Analysis of Covariance (ANCOVA). Among other things, the results demonstrated a substantial difference in students' interest in Genetics taught using the 5Es and PEDDA constructivist instructional paradigms. It was recommended, among others, that teachers should use the 5Es and PEDDA constructivist instructional methods in their classrooms to help students develop interest in genetics.

Keywords: Biology, 5Es constructivist instructional model, Interest, Gender, Genetics, PEDDA constructivist instructional model

Introduction

Biology plays an important part in the nation's educational growth. Biology is a branch of science that studies living creatures, including their structure, function, and distribution. According to Awodofu et al., (2020), Biology focuses on tackling environmental and health problems that affect our daily lives, making biology useful in a variety of courses such as medicine, pharmacy, nursing, and genetic engineering. A nation's scientific and technical development may be hampered if appropriate attention is not paid to Biology. As a result, Biology curriculum is developed to take into account students' sentiments and interests in order to motivate students to acquire scientific knowledge (Janelle, 2018). Biological knowledge when acquired, reforms the daily lives of the citizens by proffering solutions to their social problems, such as poverty and health. Experts in the field of Biology think that Genetics is one of the important topics required for effective learning of Biology (Oztas & Oztas, 2016). Genetics have been shown to have a strong impact on students' interest in Biology because it deals with the questions and answers on inheritance.

The knowledge of Genetics has made students gain insight into the world around them. According to Etobro and Banjoko (2017), Genetics involve heredity and variation which deals with the development of genes and its transmission from generation to generation. Genetics is taught in senior secondary schools to acquaint students about how traits are inherited from parents by their offspring and how variation among organisms come about. Whitley et al., (2020) opined that Genetics help students to gain experience in improving plant and animal species in many areas including health, ancestry and traits. It then means that students also learn accurate ways of explaining genetic defects that may be found in their families and communities for instance improving diagnosis and treatment of diseases such as cancer. Students' interest in Genetics needs to be fostered so that they may contribute effectively in a civilized society (Acarh & Acarh, 2020). Such expertise helps pique students' interest in the subject.

One of the important goals of teaching Genetics is to bring a change in the interest of students. It has been suggested that learning Genetics requires a fundamental change in the interest of students (Suhel & Rusyati, 2021). Odukwe (2021), defines interest as a student's willingness to participate in an academic endeavor. When the teacher is teaching heredity and variation in plants for instance, the students can arrange and decorate the classroom with different varieties of flowers as a sign of having the interest to learn. It is expected that the interest of students could enable the students to carry out experiments in order to promote creative practices in Genetics. Because someone who is interested in learning an activity is likely to be profoundly invested in it and encouraged to learn. This means that curiosity is the cornerstone of learning. If the student puts his effort and time into learning interesting activities connected with Genetics, it will certainly influence the student's attentiveness, engagement, commitment, and concentration (Vickova et al., 2019; Soe, 2018). A student has a positive interest in Genetics when he enjoys studying and also derives satisfaction from the knowledge of Genetics. Interest in Genetics ascertains the extent to which the student is eager to learn, the preparedness or the mastery of the subject matter which can enable the student to further his education to a higher level.

The study of Genetics should be interesting to students since the majority of the concepts in Genetics are familiar to the students in their daily lives and environment. Unfortunately, students perform poorly in the Genetics aspect of Biology (West African Examination Council (WAEC) chief examiners report, 2016-2020). The poor achievement which also leads to lack of interest may be because students face difficulties in learning Genetics (Maigoro, et al, 2017; Chatila & Husseiny, 2017). Factors identified that cause learning difficulties in Genetics include extensive genetic terminologies, the mathematical content of Mendelian task and the abstract nature of Genetics (Agboghoroma & Oyovwi, 2015). Due to the abstract nature of Genetics, teachers have not explored the best strategies that could enable them to deliver the content effectively to the students and this prevents meaningful learning. The problem of poor achievement in Genetics may probably not be solved without improving the interest of students in Genetics. Due to these predicaments, researchers have made several efforts to search for appropriate methods that will enhance students' interest in Genetics.

Studies carried out by researchers showed that constructivist instructional models could be used in teaching Biology in order to understand the complexities of the subject (Ihekwoaba et al., 2020; Abiasen & Reyes, 2020). In the constructivist instructional model, teachers do not transfer their knowledge to students but facilitate the students' ability to build their understanding by reflecting on their experiences (Kalu, 2018). As a result, emphasis is laid on constructivist instructional models particularly 5Es (Engagement, Exploration, Explanation, Elaboration, and Evaluation) and PEDDA (Prior conception, Exploration, Discussion, Dissatisfaction, and Application) constructivist models.

The 5Es constructivist model is the most commonly used constructivist instructional model. Samba et al., (2020) reported that 5Es constructivist instructional model gives the students the opportunity to obtain detailed information in Genetics and develop their skills by constructing knowledge. The teacher helps the students to create curiosity to investigate the scientific concept (Umahaba, 2018). There is active involvement of the students in exploration activities and the students construct their knowledge by linking the present knowledge to new ideas. It may be difficult to stimulate active engagement of students in the teaching and learning process in Genetics if the teachers' approaches are not suited for inspiring the students' interests (Ihejiamaizu et al., 2018; Cakir, 2017). In order to ensure a higher level of interest and participation of students in learning and understanding of Genetics, PEDDA constructivist model was explored for teaching and learning of Genetics.

PEDDA constructivist instructional model provides an outline for teachers who wish to combine the development of reasoning and the enhancement of interest of students in Genetics. Ekon and Nwosu (2016) stated that PEDDA constructivist instructional model provides the student opportunity to be strongly involved in testing his previous knowledge in line with the new knowledge and this enhances interest. There may be a failure in the acquisition of knowledge due to misconception that makes learning uninteresting for students. Teachers are encouraged to identify students' prior conceptions and make necessary corrections by incorporating interesting activities that can improve students' interests, personal knowledge and skills (Ekon & Edem, 2018). The interest of students in Genetics may be influenced by gender.

Gender is a discrimination that has led to the participation of few boys or girls in the learning of Genetics. Anaekwe et al., (2018) defined gender as the social and cultural characteristics associated with males and females. There has been clear evidence of the influence of gender on students' interest in Genetics (Nwagbo & Onah, 2018). Ezechi and Adukwu (2017) noted that males enjoy Genetics more than females while Falemu et al., (2017) found that females are more interested in Biology than males. Again, Parveen (2017) reported that no gender difference was found between males and females in Genetics. It is against this background that this study, therefore, investigated the relative efficacy of two constructivist instructional models on students' interest in Genetics with gender as a moderating variable.

Statement of Problem

The interest of students in Genetics is very substantial in students' achievement in Biology. Evidence from the literature has shown that the achievement of students in Biology has been poor due to a lack of interest in learning processes in recent times in the senior secondary certificate examination (WASSCE). This problem has made students begin to get bored and discouraged and this leads to failure in examinations. Empirical evidence attributed to this trend in lack of interest could be a result of the lack of use of innovative teaching methods in teaching Genetics.

It seems today that several efforts are being made by researchers to sustain the interest of students by using innovative instructional models such as the constructive instructional model in Genetics. As a result, constructivist instructional models have been advocated to enable the students to manifest positively in their interest in Genetics. This study advocates for the use of 5Es and PEDDA constructivist models to improve the situation of lack of interest in Genetics. Therefore, the problem of this study is to investigate the relative efficacy of these two constructivist models on students' interest in Genetics.

Purpose of the Study

This study aimed to investigate the relative efficacy of 5Es and PEDDA constructivist instructional models on students' interest in Genetics. This study specifically sought to determine the:

1. relative efficacy of 5Es and PEDDA constructivist instructional models on students' mean interest ratings in Genetics.
2. influence of gender on students' mean interest ratings in Genetics.

Research Questions

The following research questions were raised to guide this study:

1. What are the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models?
2. What is the influence of gender on students' mean interest ratings in Genetics?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

Ho_1: There is no significant difference in the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models.

Ho_2: There is no significant influence of gender on the mean interest ratings of students in Genetics.

Method

The non-equivalent control group design was the quasi-experimental research method used in this study. 1,986 SS III Biology students from 31 government-owned secondary schools in Enugu Education Zone, Enugu State, made up the study's population. 160 SS III Biology students from four coeducational schools in two local government areas in the Zone for the 2020-2021 academic year comprised the sample (79 males and 81 females). The sampling process involved many stages. Four co-

educational schools were purposefully chosen based on gender, whereas two of the three local government areas namely, Enugu North and Enugu East were chosen using simple random selection. Each of the two experimental groups received training on one of the models. In contrast to group B, which employed the PEDDA (Prior Conception, Exploration, Discussion, Dissatisfaction, and Application) constructivist instructional model, group A used the 5Es (Engagement, Exploration, Explanation, Elaboration, and Evaluation) constructivist instructional model.

Data were gathered using the Genetics Interest Inventory (GII), which has parts A and B. Students' demographic information, including gender and school name, is required in Section A. With 25 questions in Part B, students' interest in Genetics is evaluated using a four-point Likert-type choice scale which are made up of 13 positively and 12 adversely skewed items. The instrument was validated by three specialists from the Department of Science Education, University of Nigeria, Nsukka, two from the Biology unit and one from the Measurement and Evaluation unit. Cronbach alpha was employed to determine dependability, and a reliability index of 0.88 was achieved. The acquired data were analyzed using mean and standard deviation for the study questions and ANCOVA for the hypotheses.

Results

Research Question : What are the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models?

Table 1: Pre-test and post-test of the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models

Groups		Pre-test		Post-test		
	N	x	SD	X	SD	Mean gain
5Es	80	40.54	8.23	53.85	7.20	13.31
PEDDA	80	38.85	7.69	49.19	8.79	10.34

Note: N = Number of Respondents, X= Mean, SD = Standard deviation

Table 1 shows that students who were taught Genetics using the 5Es constructivist instructional model had a pre-test mean interest rating of (M = 40.54, SD = 8.23) and a post-test mean interest rating of (M = 53.85, SD = 7.20), whereas students who were taught using the PEDDA constructivist instructional model had a pre-test mean interest rating of (M = 38.85, SD = 7.69) and post-test mean interest rating of (M = 49 49.19, SD = 8.79). This implies that students who were taught using the 5Es constructivist teaching model were more interested in Genetics than students who were taught using the PEDDA constructivist instructional model. Both models are effective at raising students' interest in Genetics, but the 5Es constructivist instructional model outperformed the PEDDA constructivist instructional model in this regard, with pre-test and post-test mean differences of 13.31 and 10.34 for students taught Genetics using the 5Es and PEDDA

constructivist instructional models, respectively. More students benefit from the model, as seen by the reduced standard deviation (7.20) for 5Es compared to PEDDA (8.79).

Ho_1: There is no significant difference in the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models.

Table 2: Analysis of Covariance (ANCOVA) of the difference in the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Dec.
Corrected Model	4410.368[a]	4	1102.592	10.172	.000	.208	
Intercept	6218.043	1	6218.043	57.362	.000	.270	
InterestPretest	3239.053	1	3239.053	29.881	.000	.162	
Group	495.355	1	495.355	4.570	.034	.029	S
Gender	380.935	1	380.935	3.514	.063	.022	NS
Group *Gender	674.419	1	674.419	6.222	.061	.039	NS
Error	16801.876	155	108.399				
Total	506423.000	160					
Corrected Total	21212.244	159					

Note: S = Significant, NS = Not Significant and η^2_p = partial eta squared

According to the outcome in Table 2, an F-ratio of p = 0.034 was attained. The null hypothesis, which states that there is no significant difference in the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models, is rejected because the associated probability value of 0.034 is less than the threshold level of significance of 0.05. The conclusion made is that there is a substantial difference between the mean interest ratings of students who were taught Genetics using the PEDDA constructivist instructional model and the 5Es constructional instructional model.

Research Question 2: What is the influence of gender on students 'mean interest ratings in Genetics?

Table 3: Pre-test and post-test for the influence of gender on Students' mean interest ratings in Genetics

Gender		Pre-test		Post-test		
	N	X	SD	X	SD	Mean Difference
Male	79	37.65	8.49	50.13	7.32	12.48
Female	81	38.10	7.38	51.22	9.75	13.12

Note: N = Number of Respondents, X= Mean, SD = Standard deviation

According to the data in Table 3, male students' mean interest ratings were (M = 37.65, SD = 8.49) before the exam and (M = 50.13, SD = 7.32) after it. For the interest in

Genetics rating among male students, the mean difference was 12.48. While the average interest rating for female students was (M = 38.10, SD = 7.38) in the pretest and (M = 51.22, SD = 9.75) at the post-test, respectively. The average discrepancy found for the female students' estimations of their interest in Genetics was 13.12. In conclusion, the results indicate that, despite the fact that female students exhibit somewhat more interest in Genetics than their male counterparts, there is no statistically significant difference in the mean interest ratings of male and female students in Genetics.

Ho_2: There is no significant influence of gender on the mean interest ratings of students in Genetics.

Table 2 results show that gender has a p-value of 0.063. Because the associated probability value of 0.063 exceeds the 0.05 threshold of significance, null hypothesis two (Ho_2), which asserts that no significant difference existed in the male and female students' mean interest ratings in Genetics, is not rejected. The researchers concluded that there was no appreciable variance in the average interest ratings in Genetics among male and female students. This indicates that gender has little to no impact on students' interest in genetics.

Discussion

The 5Es constructivist instructional model is effective in enhancing students' interest in Genetics. The result agrees with the studies of Cakir, (2017) and Ihejiamaizu et al., (2018) which found that students with a high level of interest are more likely to choose Biology courses in tertiary institutions. This could be that teachers encourage hands-on activities of students so that conceptual knowledge and skills may be extended to other topics in Biology. When the 5Es constructivist instructional model is employed in the teaching and learning process, students' interest and career choices in Biology are enhanced.

The result also shows that PEDDA constructivist instructional model facilitates interest in Genetics. The finding of this study supports the findings of other researchers such as Ekon and Nwosu, (2016) and Ekon and Edem, (2018) who found that students exposed to the PEDDA constructivist instructional model had more interest in Biology than the control group. This could be that teachers sustain the interest of students by providing opportunities for them to interact with the teacher and themselves to reject the misconception and accept the new concept. This enables the students to reflect on their prior conceptions and associate them with new knowledge to improve their learning.

The finding of this study is in agreement with the findings of various researchers such as Nwagbo and Onah, (2017) and Ezechi and Adukwu, (2017) who reported that gender affects students' interest in Biology. The 5Es constructivist instructional model involves both males and females in activity-based teaching and learning which sustains students' interest. The finding of this study is also in agreement with that of Parven (2017) who found that students taught Genetics using the 5Es constructivist instructional model had greater interest than those taught with the conventional method. The high interest of

students recorded in the 5Es constructivist instructional model might be a result of the fact that teachers were able to attract the attention of the students by encouraging them to interact with the environment to make the acquisition of knowledge and skills easy for them.

The high interest of students taught using PEDDA constructivist instructional model could be that students' feelings were impressive as they were strongly involved in the interactive process. Students were comfortable with the explanation of the teacher and articulated their thoughts in the attractive and interesting activities of the teacher.

The 5Es and PEDDA constructivist instructional model were efficacious on students' mean interest ratings in Genetics. This supports other research findings that 5Es and PEDDA constructivist instructional model arouse students' interest by engaging them in activities that promote participatory learning.

Conclusion

Based on the finding of this study it is concluded that 5Es and PEDDA constructivist instructional model were efficacious in enhancing students' mean interest ratings in Genetics since both models aroused students' interest by engaging them in activities that promote participatory learning. It is also concluded that there was no significant difference between gender and the mean interest ratings of students taught Genetics using 5Es and PEDDA constructivist instructional models. This is because both male and female students' interest is sustained when they participate actively in constructing new knowledge.

Implications of the Study

It is evident from the findings of the study that most teachers of Biology from Enugu Education Zone are not employing 5Es and PEDDA instructional models for teaching. This implies that they are not encouraging active participation of students and this may have caused the seeming lack of interest in Genetics. Constructivist instructional models can only be effective when the teacher acts as a facilitator by encouraging the students to be active in class and interact with the students so that they become interested in learning Genetics. The findings of the study also revealed that gender was not a significant factor in determining the interest of students using the two instructional models. This implies that both models can be effectively used to enhance the interest of students in Genetics irrespective of gender.

Recommendations

In line with the findings drawn from the study, the following recommendation were made:

1. Teachers should adopt 5Es and PEDDA constructivist instructional models to engage the students in meaningful learning which leads to enhanced interest.
2. Curriculum should be reviewed to incorporate 5Es and PEDDA constructivist instructional models for effective teaching and learning of Genetics.

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