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Students' Gender and Perceived Difficulty of Concepts in Secondary School Physics in Jos Metropolis, Nigeria

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Abstract: *This study employed survey research design to explore students' gender perceived difficulty of concepts in secondary school physics and their achievement in the concepts. The study which was carried out in Jos metropolis, Nigeria used a sample of 160 senior secondary school two (SS2) students (120 were male and 40 were female). Data were gathered using three 20 item instruments developed by the researchers: Physics Concepts Difficulty Questionnaire (PC-DIQ), Physics Concrete Concepts Achievement Test (PC-CAT) and Physics Abstracts Concepts Achievement Test (PA-CAT). PC-DIQ, PC-CAT and PA-CAT'S reliabilities were 0.72, 0.70 and 0.75 respectively. The t-test was employed to test the formulated hypotheses. Analyses indicated that while the level of perceived difficulty of concrete concepts in physics differ by gender, that for perceived difficulty of abstract concepts is insignificantly different. Furthermore, the academic achievement of both male and female students in difficult concrete concepts in physics was not significantly different (63.63% for male and 62.13% for female). A significant difference, however, existed in the academic achievement of both gender when they were subjected to test in difficult abstract concepts in Physics (50.25% for male and 35.13% for female). Based on the findings, recommendations were proffered. One of such is that female students' confidence and interest in physics should be boosted by providing them with remedial measures on numerical proficiency.*

Keywords: *Students' Gender, perceived difficulties, secondary school, physics, Jos metropolis, Nigeria*

I. Introduction

The Nigerian education system comprises of four states of education, namely early childhood (pre-primary) education, primary education, secondary education and tertiary education (Federal Republic of Nigeria FRN, 2004). The first three years of the secondary school education is the junior secondary school (JSS) education and the last three years is the senior secondary school (SSS) education.

In Nigeria, Physics being one of the core science subjects is offered by students at the SSS level for education. Young and Freedman (2008) view physics as an experimental science where observation of natural phenomena is done in order to attempt searching for physical theories and laws or principles. These theories, laws or principles aid scientists and technologists in their endeavor of improving livelihood. The study of physics cannot be undermined. Its study is very important given that physics is one of the most basic sciences. Young and Freedman (2008) proffered reasons on why physics is very important to the society. The study of physics being an adventure is one of those reasons. This is because students find physics challenging, sometimes frustrating, occasionally painful and often richly rewarding and satisfying.

Physics is a cross-cutting discipline that is applied in many sectors for economic development. Josiah (2011) opined that the understanding of physics concepts is a pre-requisite for developing modern instrumentation and techniques in the health sector. For instance, with the help of medical physics the appropriate equipment for the diagnosis of diseases are produced. Earlier on, Young and Freedman (2008) had the following view on the cross-cutting nature of physics; the chemists who studies molecule structure, the paleontologists who attempts to reconstruct how dinosaurs walked the climatologist who pries into how human activities affect the atmosphere and oceans, and the engineers who designs flat screen television and other technologies make use of physics concepts.Another important role physics plays in the technological development of any nation is in information technology. Josiah (2011) pointed out that the knowledge of physics is required in developing fixed line and optical-fibre network.

Haven highlighted the importance of physics in all spheres of the economy of a nation; the teaching of physics cannot afford to be relegated to the background. Eze as cited in Inyang (2008) asserted that the aim of teaching physics "is to provide a student with basis of understanding that physics... reveal a number of natural laws, which are known to be operating in all nature's phenomena." However, researches carried out in different parts of Nigeria have intriguing results. Josiah's (2004) study revealed that the poor performance of students in physics is not always linked to his or her negative attitude towards the subject. This implies that other factors, aside attitude, affect performance in physics. A similar study revealed that students generally like physics as a subject but some are forced to drop it due to the method of teaching (Eze as cited in Inyang, 2008). Reports of

studies have also shown that although students are interested in studying physics, most perceive it as difficult (Josiah, 2004; Orisaye as cited in Inyang, 2008).Physics can be categorized into two: experimental physics, which describes results of experiments in terms of concrete concepts; and theoretical physics, which uses both concrete and abstract concepts to explain a mathematical formulation of observed regularity of the physical world. Mujumdar and Singh (2015) are of the view that theoretical physics describes the experimentally observed regularity in an unambiguous, precise and logical manner. Concrete concepts are those that have defining attributes and examples that are observation. Such concepts are learned through sensory observation of examples and non-examples. Through such observations, attributes characterizing concepts are understood by the physics student. By using these attributes to categorize other entities as examples or non-examples of a concept, the student exhibits understanding of that concept. in contrast to concrete concepts, abstract concepts are those that do not have perceptible instances or have relevant or defining attributes that are not perceptible.

A possible reason why Nigerian students perform poorly in secondary school physics is the abstract nature of the subject. A study embarked upon by Obafemi and Onwioduokit (2013) revealed that both students and teachers attest to the difficulty of physics concepts. This difficulty may have arisen from the abstract nature of the subject. At present not much empirical data exists on the impact of gender on perceived difficult physics concepts and academic achievement in physics. Broadly speaking, physics teaching focuses primarily on transferring factual knowledge (know what). The "know how" and "know why" aspects pose great challenges. In this wise, physics education in Nigeria seems to fall short of attaining more challenging goals of fostering insight into and understanding of concepts in physics.

It is on the basis of the afore-mentioned that this work hinged on students' gender and perceived difficulty of concepts in secondary school physics in Jos Metropolis, Nigeria. In the context of this study, Jos metropolis refers to Jos Local Government Area of Plateau State, Nigeria.

Purpose of the study

The purpose of this study is to ascertain the impact of students' gender on perceived difficulty of concepts in secondary school Physics.

Specifically, it aimed at determining:

i) the difference between students' gender and perceived difficulty of concepts in physics.
ii) the difference between students' gender perceived difficulty of concepts in physics and their achievement in physics.

Research Questions

The following research questions were raised in the study:

i) What is the impact of students' gender on perceived difficulty of concepts in physics?
ii) To what extent does students' gender perceived difficulty of concepts in physics influence achievement in Physics?

Research Hypotheses

The following null hypotheses were formulated for testing:

1) There is no significant difference between the mean scores of perceived difficulty of concrete concepts in physics based on gender.
2) There is no significant difference in the mean scores of perceived difficulty of abstract concepts in physics based on gender.
3) There is no significant difference in the mean achievement scores of male students and their female counterparts in perceived difficult concrete concepts in physics.
4) There is no significant difference between the mean achievement scores of male and female students in perceived difficult abstract concepts in physics.

Method and Procedure

The study employed the survey research design to explore students' gender difficulty perception of concepts in secondary school, physics and their achievement in the concepts. In this study the independent variable is gender while perceived difficulties of concrete and abstract concepts in physics are the dependent variables. One identified extraneous variable in this study is achievement.The population of the study consisted of all senior secondary school two (SS2) students offering physics in secondary schools in Jos North Local Government of Plateau state, Nigeria. A sample of 160 SS2 students from two secondary schools was used for the study. Out of this number, 120 were male students while 40 were female.

Three instruments were used for the study. All were twenty-item achievement tests. Physics Concepts Difficulty Questionnaire (PC-DIQ) was designed to assess students' perceived difficulty in physics concepts. Physics Concrete Concepts Achievement Test (PC-CAT) and Physics Abstract Concepts Achievement Test (PA-CAT) were constructed to test whether gender has any effect on academic achievement in difficult concrete and abstract physics concepts, respectively. Both PC-CAT and PA-CAT were based on West African Examination Council's (WAEC) West African Senior School Certificate Examination (WASSCE) syllabus on

the concepts of heat energy (concrete concept) and electricity and electric circuits (abstract concepts). These concepts were chosen for the study so as to explore students' understanding of such concepts. Furthermore, heat energy has been perceived by students as a difficult concrete concept while electricity and electric circuits as difficult abstract concepts (Taber, de Trafford & Quail, 2006; Inyang, 2008; Okoronka & Wada, 2014). The content validities of the three instruments were established by experts in University of Jos, Nigeria. Cronbach's Coefficient Alpha Method was used to obtain the reliability of the instruments. PC-DIQ's reliability was 0.72%, PC-CAT's reliability was 0.70 and PA-CAT's was 0.75.

II. Results

The test for homogeneity of variances at 0.05 level of significance indicated that the separate variance formula for t-test was employed to test hypothesis ones. However, the pooled variance formula for t-test was used for testing hypotheses two, three and four. This was as a result of the test for homogeneity of variances which favoured the use of polled variance formula for t-test on hypotheses two, three and four.

Ho_1: There is no significant difference between the mean scores of perceived difficulty of concrete concepts in physics based on gender.

Table 1 shows the results of t-test on perceived difficulty of concrete concepts in physics based on gender.

Table 1: Summary of t-test on perceived difficulty of concrete concepts issues based on gender

Gender	N	$\overline{X}$	S	t-cal	t-table	df
Male	120	24.03	14.28			
				4.15	1.96	158
Female	40	15.90	9.28			

P<0.05

Table 1 show that the calculated t-value (4.15) was greater than the critical t-value (1.96) from tables, at 0.05 level of significance and 158 degrees of freedom. This means that there is a significant difference between the male mean score of perceived difficulty of concrete concepts in physics and that of their female counterparts.

Ho_2: There is no significant difference between the mean scores of perceived difficulty of abstract concepts in physics based on gender.

Table 2 shows the results of t-test on perceived difficulty of abstract concepts in physics based on gender.

Table 2: Summary of t-test on perceived difficulty of abstract concepts in physics based on gender

Gender	N	$\overline{X}$	S	t-cal	t-table	df
Male	120	20.25	13.12			
				1.61	1.96	158
Female	40	24.25	15.00			

P> 0.05

From table 2 the null hypothesis was upheld since the computed t-value (1.16) is less than the critical value (1.96) from tables. This implied that there is no significant difference between the male mean score of perceived difficulty of abstract concepts in physics and that of their female counterparts.

Ho_3: There is no significant difference between the mean achievement scores of male students and their female counterparts in perceived difficult concrete concepts in physics.

Table 3 shows the results of t-test on achievement of gender in perceived difficult concrete concepts in physics.

Gender	N	$\overline{X}$	S	t-cal	t-table	df
Male	120	63.63	15.86			
					1.96	158
Female	40	62.13	16.40			

P > 0.05

From table 3, the null hypothesis Ho_3 was upheld, since the calculated t-value is not greater than the critical t-value from tables. This indicates that the mean achievement scores of male and female students in perceived difficult concrete concepts is not significantly different. While the mean percentage score of the male students is 63.63%, that of female is 62.13%.

Ho_4: There is no significant difference between the mean achievement scores of male and female students in perceived difficult abstract concepts in physics.

Table 4 shows the results of t-test on achievement of gender in perceived difficult abstract concepts in physics.

Table 4: Summary of t-test on achievement of gender in perceived difficult abstract concepts in physics

Gender	N	$\overline{X}$	S	t-cal	t-table	df
Male	120	50.25	13.56			
				6.02	1.96	158
Female	40	35.13	14.30			

P<0.05

Table 4 shows that the calculated t-value was greater than the critical t-value from tables, at 0.05 significant level and 158 degrees of freedom. The implication is that the null hypothesis was rejected. This further signifies that the mean achievement scores of male and female students in perceived difficult abstract concepts in physics differ significantly.

III. Discussion

The result presented in table 1 indicated that the level of perceived difficulty of concrete concepts in physics differ in terms of gender. On the contrary, the finding in table 2 showed no significance difference in the level of perceived difficult abstract concepts in physics based on gender. Table 3 showed that the academic achievement of both male and female students in difficult concrete concepts in physics was not significantly different. The difference level was 1.50 while male students scored 63.63% (mean), the female students scored 62.13% (mean). This can be attributed to the nature of concrete concepts in physics. Even though some of the concrete concepts are perceived difficult, learning such concepts through sensory observation of examples and non-examples facilitates understanding of the concepts.

A significant difference was, however found to exist in the academic achievement of male and female students when subjected to test in difficult abstract concepts in physics. While the male students had a mean score of 50.25%, their female counterparts had 35.13%. The superiority of male students over their female counterparts in difficult abstract concepts can be attributed to their gain in numerical proficiency over the female students. Apata (2011) found out that male students were more proficient in theoretical and practical physics than the female students. The researcher attributed this difference to two reasons: lack of confidence in the female students who usually perceive physics as a difficult mathematically inclined subject and the lack of interest in sciences.

Abdul-Raheem (2012), however, attributed the difference in gender achievement in physics and other sciences to unfavorable home and school environment for the female student, and non-encouragement of the female student by the trio of parents, teachers and Nigerian government. Home environment has a negative effect of the female students because of stereotyping, where chores such as cooking and sweeping are apportioned to the female gender. A striking revelation is that although there was a significant difference, based on gender, in academic achievement the feat of students in difficult abstract concepts in physics was lower than their achievement in difficult concrete concepts in the subject. While male students had a mean score of 63.63% in the difficult concrete concepts test, their mean score was 50.25% in the difficult abstract concepts test. The female students had a mean score of 35.13% in the difficult abstract concepts test as against 62.13% in the difficult concrete concepts test. This revelation can be attributed to the nature of abstract concepts in physics which makes it unrealistic for students to comprehend concepts and their defining characteristics.

IV. Conclusion and Recommendations

In conclusion and based on the findings of this study, the following recommendations have been proffered:

1. A careful combination of practical work and student-centered methods of teaching physics is advocated. This will help demystify difficult concepts, in physics.
2. Female students' confidence and interest in physics as a subject should be boosted by providing them with remedial measures on numerical proficiency. This will enhance their performance in physics, especially in abstract concepts.
3. Stereotyping both at home and school should be discouraged. This will enable the female students to be able to measure up to the level of their male counterparts in physics.
4. Physics teachers should be given adequate in-service course in physics to properly understand the concepts so that students' learning of such concepts can be facilitated.

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