

Identification of Difficult Concepts in Senior Secondary School Two (SS2) Physics Curriculum in Rivers State, Nigeria

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ABSTRACT--- *The purpose of this study is to identify physics concepts which Senior Secondary Two (SS2) students, as well as their teachers in Rivers State of Nigeria, find difficult. All the sixteen (16) concepts of SS2 Physics curriculum were used. The Physics Concepts Checklist for Students (PCCS) and Physics Concepts Checklist for Teacher (PCCT) were used to gather the responses of students and teachers on the level of difficulty of the concepts. 600 students and 24 teachers were randomly selected for the study. The results show that 50% of the concepts in SS2 physics curriculum were considered difficult by the students while 44% of the concepts were considered difficult by the teachers. There is a relationship between the response of the students and teachers as seven of the concepts which were considered difficult or very difficulty by the students were also considere-d difficult or very difficult by the teachers. There is however a disparity in the responses of students and teachers on the level of difficulty of five concepts. SS2 physics curriculum is very important in senior secondary physics as it contains about 42% of the senior secondary school physics concepts. Lack of understanding of 50% of the concepts in SS2 physics curriculum by the students may lead to poor performance of thes students in the West African Secondary School Examination (WASSCE). It is thus recommended that more attention be paid to the teaching and learning of these difficult concepts, so as to reduce the level of difficulty of these concepts and improve the performance of students in physics.*

Keywords--- Identification, Physics concepts, Difficult concepts, Physics curriculum.

1. INTRODUCTION

‘Difficult’ concepts are concepts that are difficult to teach and difficult to learn [1]. Accordingly, lack of proper understanding of concepts in physics, among other factors, have been reported to account for students’ low performance in the subject. In the same vein, 2008 West African Senior Secondary Certificate Examination Chief examiner’s report showed that lack of understanding of the fundamental concepts of physics contributed to the abysmal performance of students in physics examinations. In the same way, [2] stated that most physics concepts are perceived difficult as students and teachers are unable to construct understanding of the concepts.

Inspite of the crucial role physics plays in the technological advancement of the nation, research has shown that students find it difficult to understanding physics concepts. In the study of Senior Secondary School Physics curriculum, [3] found that out of the 124 concepts in the curriculum, 68 physics concepts (54.84%) were averagely difficult while 28 physics concepts (22.58%) were very difficult for students to understand. These sum up to 96 difficult physics concepts (77.42%) out of 124 physics concepts in Senior Secondary physics curriculum. These difficult concepts include Waves, Light waves, Sound waves, Pressure, Electricity, Magnetism and Nuclear physics. If only 28 concepts (22.58%) were considered easy by the students, little wonder then, the recurring poor performance of students in physics.

Comparing also the students’ responses with the teachers’ responses, some concepts which were considered difficult by the students were also considered difficult for the teachers to teach. The topics include polarization of transverse waves, thermal conductivity, magnetism and radioactivity. [3] lamented that if a concept is difficult for a teacher, then the presentation to the students must be poor and the student will find it difficult to understand.

[4] discovered that all the seventeen (17) primary school science topics indicated by primary school science teachers to be difficult to teach are all physical science topics, and eleven (11) out of these physical science topics are physics concepts. The topics includes mirror and images (light waves), sound: sources and uses, force, heat and temperature, magnetism and magnets, cells and batteries, simple machines and pressure.

The difficulty of students in understanding physics concepts is a global one. [5] found that within the providence of British Columbia, for 11th grade level students, the most difficult physics concepts were vectors in three dimension, projectile motion and diffraction of light. For the 12th grade level students however, the most difficult concepts were centre-of-mass reference frame and simple harmonic motion. [6] found that students lack deep understanding of many fundamental concepts in engineering (which are physics concepts) such as charges, voltage, current, force, friction, moments, stress and strain. In the same vein, [7] posited that fundamental concepts such as force, voltage and current may be difficult for students to learn because students view those processes as if they were substances.

[5] found that difficulties of students about physics concepts were related to textbooks. [8] submitted that students' difficulties in physics stem from the way physics concepts are taught and the nature of physics problems which are sometimes very vague. In the same vein, [1] found that the difficulty in the understanding of physics concepts by students centers around teaching and textbooks. This view was supported with the following points:

- a. Many facts in physics tend to be stated in their general forms without much recourse to their applications and relevance to the immediate society of the students.
- b. Many concepts in physics are vaguely explained in languages not easily comprehended by the students.
- c. Some textbooks and formal notes from teachers tend to treat some topics rather superficially and in some cases with misplaced emphasis.
- d. The acute shortage of physics teacher in schools and the inadequately equipped laboratories result in low teacher effectiveness in class.
- e. The style of examination questions tends to encourage students to restrict themselves to the lower cognitive level of educational objective.

[9] thus suggested that if teachers of physics adopt appropriate teaching strategies and conduct research or make use of research findings on the area of learning difficulties of the students in physics, they will be appropriately guided to carefully select methods of teaching to enhance the understanding of physics concepts and thus be able to remove the difficulties of the students.

Studies were found on the identification of difficult concepts in secondary school physics as a whole, engineering and primary school science, but hardly was any work found addressing SS2 physics concepts specifically. If students are able to have good understanding of SS2 physics concepts, it will go a long way in boosting their performance in WASSCE physics. This is because SS2 physics curriculum contains about 42% of the total number of concepts in Senior Secondary School physics curriculum. This study therefore focused on identifying difficult SS2 physics concepts.

1.1 Problem of the study

An analysis of students performed in WASSCE physics between 1999 and 2009 in Nigeria shows that an average of 42.36% of the students who sat for the examination obtained credits and above. Could this persistent poor performance of students in physics be due to the difficult nature of physics concepts? To what extent are the concepts in SS2 physics curriculum difficult? Which of the concepts are considered most difficult by students and teachers? These questions will guide this study.

1.2 Purpose of the Study

The purpose of this study is to identify the concepts which are considered difficult in SS2 physics curriculum by the students and the teachers.

The specific objectives are to

1. determine the level of difficulty of the concepts in SS2 physics curriculum.
2. identify the concepts which are considered most difficult by the students and the teachers.

1.3 Research Questions

The following research questions will guide this study.

1. To what extent are the concepts in SS2 physics curriculum difficult?
2. Which of the concepts are considered most difficult by students and teachers?

1.4 Significance of the study

A focus on difficult concepts in SS2 physics curriculum is significant because SS2 physics curriculum contains a large chunk (about 42%) of the concepts in Senior Secondary School physics curriculum when compared with the concepts in SS1 and SS3 physics concepts.

It is thus hoped that the finding of this study will bring to lime light the concepts which are considered difficult by students and teachers in SS2 physics curriculum. This awareness will make students pay more attention to those concepts. The teacher will be aware of those concepts in other to adopt appropriate teaching methods, learning materials and experiences that will reduce the level of difficulty of those concepts. The textbook writers will be sensitized to use relevant examples and appropriate language that will help to boost the understanding of students in those difficult

concepts. The curriculum planner will also be sensitized to include learning materials and experiences as they plan physics curriculum so as to reduce the level of difficulty of those concepts.

2. RESEARCH METHOD

The research design was a survey one. The study was carried out in ten Local Governments Areas of Rivers State in the South-South Region of Nigeria. All the SS2 Physics students in all the Secondary Schools in Rivers state, Nigeria which is an estimated population of 2500 and 105 physics teachers constituted the population for the study. The sample for the study was made up of 600 SS2 physics students and 24 physics teachers who were randomly selected from 10 Local Government Area of Rivers State.

Two instruments were used in this study. They are the Physics Concepts Checklist for Students (PCCS) and the Physics Concepts Checklist for Teachers (PCCT). Physics Concepts Checklist for Students (PCCS) was constructed by the researcher. It contained all the sixteen (16) Senior Secondary School 2 (SS2) physics concepts. It was intended to measure the level of difficulty of physics concepts as perceived by physics students. Physics Concepts Checklist for Teachers (PCCT) was constructed by the researcher. It contained all the sixteen (16) Senior Secondary School 2 (SS2) physics concepts. It was intended to measure the level of difficulty of physics concepts as perceived by physics teachers. The Checklist was constructed with 4-point Likert Scale with the following key:

- VE- Very Easy
- E- Easy
- D- Difficult
- V- Very Difficult

Using Cronbach alpha measure of reliability, the Physics Concepts Checklist for Students (PCCS) and the Physics Concepts Checklist for Teachers (PCCT) have coefficients of reliability of 0.72 and 0.74 respectively. The instruments were validated by experts in the area of Physics Education both in Secondary and Post Secondary levels. Their comments and corrections were incorporated into the final form of the instruments. The Physics Concepts Checklist for Students (PCCS) was administered to the physics students and the Physics Concepts Checklist for Teachers (PCCT) was administered to their physics teachers. On the Checklists, the students and their Physics teachers indicated the level of difficulty of the Physics concepts.

3. ANALYSIS OF DATA

The students' and teachers' responses were analyzed using the mean, standard deviation and the difficulty index. The levels of difficulty of the Physics concepts were also determined.

3.1 Analysis of Students' Responses

Considering students' responses, with respect to mean values, the difficulty of the concepts was done as follows:

$$\begin{aligned} 1.71 &\leq \bar{X} \leq 2.15 && \text{-VE} \\ 2.15 &\leq X \leq 2.30 && \text{-E} \\ 2.30 &\leq X \leq 2.35 && \text{-D} \\ 2.35 &\leq X \leq 2.72 && \text{-VD} \end{aligned}$$

Considering students' responses, with respect to difficulty index, the difficulty of the concepts was done as follows:

$$\begin{aligned} 0.09 &\leq di \leq 0.33 && \text{-VE} \\ 0.33 &\leq di \leq 0.39 && \text{-E} \\ 0.39 &\leq di \leq 0.44 && \text{-D} \\ 0.44 &\leq di \leq 0.56 && \text{-VD} \end{aligned}$$

3.2 Analysis of Teachers' Responses

Considering teachers' responses, with respect to mean values, the difficulty of the concepts was done as follows:

$$\begin{aligned} 1.70 &\leq \bar{X} \leq 2.00 && \text{-VE} \\ 2.00 &\leq X \leq 2.25 && \text{-E} \\ 2.25 &\leq X \leq 2.50 && \text{-D} \\ 2.50 &\leq X \leq 2.75 && \text{-VD} \end{aligned}$$

Considering teachers' responses, with respect to difficulty index, the difficulty of the concepts was done as follows:

$$\begin{aligned} 0.08 &\leq di \leq 0.25 && \text{-VE} \\ 0.25 &\leq di \leq 0.38 && \text{-E} \\ 0.38 &\leq di \leq 0.50 && \text{-D} \end{aligned}$$

$$0.50 \leq d_i \leq 0.63 \text{ -VD}$$

4. RESULTS AND INTERPRETATION

The result of analysis of data per item is as shown on Tables1 and Table 2.

Table 1: Mean, Standard Deviation, and Difficulty Index of Students' Reponses on the Level of Diffifficulty of SS II Physics Concepts

| S/N | TOPICS | MEAN \bar{X} | SD | DIFFICULTY INDEX d_i | LEVEL OF DIFFICULTY |
|-----|------------------------------------|-------------------|------|------------------------------|------------------------|
| 1 | Vectors | 2.13 | 0.86 | 0.32 | VE |
| 2 | Motion | 1.71 | 0.69 | 0.09 | VE |
| 3 | Equilibrium of forces | 2.30 | 0.86 | 0.39 | D |
| 4 | Simple harmonic motion | 2.30 | 1.01 | 0.40 | D |
| 5 | Projectile Motion | 2.31 | 0.93 | 0.44 | D |
| 6 | Linear momentum | 2.16 | 0.89 | 0.34 | E |
| 7 | Newton's laws of motion | 1.97 | 0.76 | 0.22 | VE |
| 8 | Machines | 2.15 | 0.95 | 0.33 | E |
| 9 | Temperature and its measurement | 2.20 | 0.95 | 0.37 | E |
| 10 | Measurement of heat energy | 2.35 | 0.88 | 0.43 | D |
| 11 | Gas laws | 2.08 | 0.84 | 0.27 | VE |
| 12 | Waves | 2.32 | 1.00 | 0.43 | D |
| 13 | Light waves | 2.52 | 1.01 | 0.49 | VD |
| 14 | Application of Light waves | 2.72 | 0.92 | 0.56 | VD |
| 15 | Sound waves and their applications | 2.68 | 0.96 | 0.55 | VD |
| 16 | Molecular theory of matter | 2.24 | 0.98 | 0.35 | E |

As shown in Table 1, four (4) concepts were considered very easy, four (4) concepts were considered easy, five (5) concepts were considered difficult, three (3) concepts were considered very difficult. The physics concepts considered difficult are Equilibrium of forces, Simple harmonic motion, Projectile Motion, Measurement of heat energy and Waves; while Light waves, Application of Light waves, Sound waves and its applications were considered very difficult by physics students in Rivers state. From the analysis, Light waves and their applications; Sound waves and their applications ranked highest in level of difficulty to the students.

Table 2: Mean, Standard Deviation, and Difficulty Index of Teachers' Reponses on the Level of Diffifficulty of SS II Physics Concepts

| S/N | TOPICS | MEAN \bar{X} | SD | DIFFICULTY INDEX d_i | LEVEL OF DIFFICULTY |
|-----|------------------------------------|-------------------|------|------------------------------|------------------------|
| 1 | Vectors | 2.50 | 1.02 | 0.50 | VD |
| 2 | Motion | 1.70 | 0.56 | 0.08 | VE |
| 3 | Equilibrium of forces | 2.00 | 0.88 | 0.25 | E |
| 4 | Simple harmonic motion | 1.92 | 0.83 | 0.21 | VE |
| 5 | Projectile Motion | 1.75 | 1.62 | 0.33 | E |
| 6 | Linear momentum | 2.00 | 0.88 | 0.25 | E |
| 7 | Newton's laws of motion | 2.42 | 1.02 | 0.46 | D |
| 8 | Machines | 2.00 | 0.88 | 0.25 | E |
| 9 | Temperature and its measurement | 1.75 | 1.62 | 0.33 | E |
| 10 | Measurement of heat energy | 2.75 | 0.99 | 0.63 | VD |
| 11 | Gas laws | 1.92 | 0.83 | 0.21 | VE |
| 12 | Waves | 2.75 | 0.99 | 0.63 | VD |
| 13 | Light waves | 2.42 | 1.02 | 0.46 | D |
| 14 | Application of Light waves | 2.50 | 1.02 | 0.50 | VD |
| 15 | Sound waves and their applications | 2.25 | 0.99 | 0.38 | D |
| 16 | Molecular theory of matter | 1.92 | 0.83 | 0.21 | VE |

As shown in table 2, four (4) concepts were considered very easy, five (5) concepts were considered easy, three (3) concepts were considered difficult while four (4) concepts were considered very difficult by the teachers. The concepts considered difficult by the teachers are Newton's laws of motion, Light waves and Sound waves and their applications while Vectors, Measurement of heat, Waves and Application of Light waves were considered very difficult by the teachers.

4.1 Research Question 1

To what extent are the concepts in SS2 physics curriculum difficult?

From Table 1, four concepts were considered very easy, four concepts were considered easy, five concepts were considered difficult and three concepts were considered very difficult by the students. Also from table 2, four concepts were considered very easy, five concepts were considered easy, three concepts were considered difficult and four concepts were considered very difficult by teachers. Thus, the concepts in SS2 physics curriculum are at different levels of difficulty.

4.2 Research Question 2

Which of the concepts in SS2 physics curriculum is most difficult for students and teachers?

According to Table 1, the concepts of Light waves, Application of light waves, Sound waves and their applications, were found very difficult by students but Application of Light waves ranks highest in level of difficulty. According to Table 2, the concepts of Waves, Measurement of heat energy, Applications of Light waves and Vectors were found very difficult by the teachers while Waves and Measurement of heat ranks highest in level of difficulty.

5. DISCUSSION OF RESULTS

It is important to note that there exists a relationship between the students and teachers' responses concerning the level difficulty of the concepts. The concepts considered either difficult or very difficult by the students were also considered either difficult or very difficult by the teacher. These concepts are Measurement of heat energy, Waves, Light waves, Applications of light waves, and Sound waves and its applications. If a concepts is considered difficult by a teacher, definitely it will be poorly presented to the students. Little wonder the students find those concepts difficult to understand. However, the responses of students and teachers were at variance on the level of difficulty of five concepts namely Vectors, Equilibrium of forces, Simple Harmonic motion, Projectile motion and Newton's laws of motion.

The finding of this study is in consonance with the findings of [3] who found that the students considered the concepts of Waves, Light waves and its applications, Sound waves and its applications difficult. He also found the concept of Polarization of transverse waves difficult for the teachers. The findings of this study also agree with [4] who found that the concepts of Mirror and Images (Light waves) and Sources and uses of Sound waves were difficult for the students. On the global level, the findings of this study also agree with [5] who found that the concepts of Projectile motion, Simple harmonic motion and Diffraction of light waves were difficult for the students.

This finding may be due to the perceived difficult nature of physics as reported by Eyetsemitan [10]. Also, [11] from his study, revealed that student still believe that physics is difficult and boring, hence they may not likely succeed in it. Another likely reason for the finding of this study is the mathematical requirements of physics which many students lack according to [11], who observed that many students have problem with the logical-mathematics operations that are demanded in physics learning. [12] also discovered that a major weakness of physics students is their deficiency in mathematical concepts which affects their ability to manipulate symbolic relationships. Another likely reason as reported by [9 & 13] is the psychological effect of some physics teachers' harsh comments on the students. These are comments like 'you are daft'; 'you cannot know physics', etc, and worse still, some physics teachers would publicly tell students that physics is for specially endowed 'super humans'.

6. IMPLICATIONS OF THE STUDY

Some concepts in the SS2 physics curriculum are actually perceived difficult by both teachers and students. These concepts, if not given appropriate attention, may lead to poor performance of students in the West African Secondary School Examination (WASSCE)[14], considering their percentage in the curriculum.

7. CONCLUSION AND RECOMMENDATIONS

SS2 physics curriculum is very important in the students' three years of learning physics in the secondary school. This is because it contains about 42% of the senior secondary school physics concepts and it is the penultimate year to their final exam (WASSCE). From the study, 50% of the concepts in SS2 physics curriculum were considered difficult by the students while 44% of the concepts were considered difficult by the teachers. If students find 50% of physics concepts difficult in the penultimate year to their school certificate examination (WASSCE), what kind of

performance is expected in their school certificate examination?. This explains the recurrent poor performance of students experienced in WASSCE physics experienced over the years.

There is therefore an urgent need to address in SS2 physics curriculum in order to reduce their level of difficulties. Both teachers and students should pay more attention to the teaching and learning of these difficult concepts so as to reduce the level of difficulty of these concepts and improve the performance of students in physics. Teachers should cultivate a positive attitude and commitment to the teaching of physics so as to encourage students to study physics with less difficulty. Physics teachers should endeavour to make laboratory work a compulsory and integral part of the physics lessons so as to give the students opportunity to have independent hands-on experience of physics concepts. They should use familiar, local and relevant examples and analogies to bring down physics concepts to the level of understanding of the students.

Undergraduate and Post graduate curricula used in training physics teachers should be made to contain hands-on experiences especially on these difficulty concepts so as to better prepare the physics teachers to teach secondary school physics. Workshops, in-service training and seminars should be organized for physics teachers in other to address the teaching of these concepts considered difficult by students and teachers in terms of teaching methods, learning materials and learning experiences.

Independent educational researchers and educational research institutes should be funded and encouraged to investigate into the causes of the difficulty experienced in these concepts and proffer solutions to the problem. Further studies should address the reduction of the difficulty of these concepts in terms of teaching methods, analogies, teaching materials, learning experiences etc.

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