AN EVALUATION OF THE COMPLIANCE OF WAVE CONCEPTS IN RECOMMENDED PHYSICS TEXTBOOKS WITH THE NATIONAL PHYSICS CURRICULUM IN SECONDARY SCHOOLS IN SOUTHWESTERN NIGERIA

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ABSTRACT

This study evaluated the compliance of wave concepts in recommended secondary school Physics textbooks in Southwestern Nigeria. It examined the wave concepts and the instructional materials used in recommended Physics Textbooks for presenting wave concepts in achieving performance objectives stated in National Physics Curriculum. These were with a view to providing information on the level of compliance of wave concepts in secondary school physics textbooks with National Physics Curriculum. The study adopted descriptive survey research design. All of Southwestern Nigeria's approved physics textbooks make up the study's population . Eight out of the recommended Physics textbooks from three states in Southwestern Nigeria was selected as samples using simple random sampling technique. The research instruments used for the study to collect data are Recommended Physics Textbooks Compliance Checklist (RPTCC) and Instructional Materials for Teaching Wave Concepts Checklist (IMTWCC). Descriptive statistics of frequency and percentages were used to

analyze the data gathered.The results of the analysis showed that the level of compliance of textbook A with the wave motion concept is high (84.09%). The level of compliance of textbook B is high (79.59%). Level of compliance of textbook C is high (97.14%). Level of compliance of textbook D is high (94.7%). Level of compliance of textbook E is also high (78.69%). Level of compliance of textbook F is moderate (57.6%). This results above revealed the level of compliance of concepts of waves presented in each recommended Physics Textbooks inline with National Physics Curriculum in Southwestern Nigeria with textbooks G and H revealed a very high and very low level of compliance of (86.33%) and (40.27%) respectively.In assessing the level of wave motion analogies used my the textbook authors to activate the readers' interest in line with national Physics Curriculum, the result revealed the textbooks A, C, D and G are highly compliance in terms presentational analogies with mean and standard deviation of 2.80,1.00; 2.60, 0.73; 2.78, 0.53; and 2.56, 0.83 respectively while textbooks B, E and F showed an average compliance with mean and standard deviation of 1.60, 0.93; 1.40, 0.93 and 1.62,1.83 respectively and textbook H revealed a low compliance of presentational analogy with mean and standard deviation of 1.60 and 1.71. In assessing the compliance of textbooks with relevance instructional materials used as stated in the national Physics Curriculum, the result showed that out of the 69 recommended instructional strategies stated in the national Physics curriculum for the comprehension of Wave concepts to the readers, textbook A made use of a total of 40 (57.97%) instructional materials which shows that the level of compliance is moderate. Textbook B made use of 39 (56.52%) instructional materials. the result further shows that textbook C engaged 47 (68.11%) of the recommended instructional materials in the National Physics Curriculum and textbook D made use of 52 (75.36%) of the recommended instructional materials in their explanation. Also, textbook E made use of 49 (71.01%) recommended instructional materials. Textbook F made use of 39 (56.52%) instructional materials. Furthermore, textbook G made use of 46 (66.67%) of the recommended

instructional materials in their textbook. Finally, textbook H made use of only 12 (17.39%) of the recommended instructional materials in the book inline with National Physics curriculum. The study concluded that few textbooks complied with waves concepts in NPC in terms of contents, objectives and instructional materials for implementation of wave, the textbook with such attributes should be made recommended for both teachers and students.

Keywords: Compliance, wave concepts, recommended textbooks, secondary school physics, National Physics Curriculum.

Introduction

Physics is one of the science subjects taught at the senior secondary school level of the Nigerian educational system. The aim of Physics learning in schools is to bring about the technological development needed through the training of young scientists who would be able to produce the technological devices to make day-to-day activities easier and living more comfortably (Federal Republic of Nigeria, 2007). Thus, Physics is an indispensable subject for advancement of science and technology of any nation and a great tool to improving the economy to meet with the challenges of 21st century. Studying Physics in secondary schools is a foundational preparation for careers in sciences, engineering, medicines and other related carriers. It is obvious that without adequate knowledge of Physics, the scientific and technological progression in Nigeria might be a uncertain due to rapid changes in technology. The inter-dependence of Physics with other science subjects make life and society worth of living, also, Physics offers the fundamental knowledge and comprehension of concepts whose application greatly improves society's standard of living. According to Adebisi and Ajayi (2015), the interactions between other sciences and Physics are profound and dynamic, also Omosewo (2009) opined that the foundation of science and technology is physics. In recent years, many industrialized nations have acknowledged the significance of physics as a prerequisite for technological advancement. Without the practice of Physics, technological culture will not take root. Omosewo (2009)argued for a

functional scientific curriculum, particularly about physics in Nigeria, since they recognized the critical role that physics plays in national development. Given its application to life, industries and many professions. Every learner must be given ample opportunity to gain an understanding its concepts, values, and skills.

The goal of any subject cannot be successfully achieved without the searchlight from the curriculum. According to Taiwo (2018) curriculum is the set of organized, supervised, and directed learning activities with a specific goal that is created via methodical reconstruction of information and experience under the supervision of a school to support the learners' ongoing and deliberate advancement. Thus, all what learners do or learn at school until they leave formed the term curriculum (Ekpo, 2019). With all these importance of curriculum to education Sam (2018) viewed Curriculum as a tool for training a person to transform their attitude, behavior, action, and values to those of a good person who is concerned not only with developing themselves as well as with the world around them. Omen (2016) viewed curriculum as planned sequence of educational opportunities designed to further the learner's education. The goal of the curriculum is to give students the knowledge and skills they need to meet society's needs. Curriculum is a vital instrument which the teacher depends on, might have issues if not meeting up the expectation of society and the needs and aspirations of the students especially Physics curriculum (Rose, 2021).

Waves are one of the topics covered in secondary school physics classes. These topics include the production and propagation of waves, their forms and characteristics, light waves, sound waves, the human eye, the application of sound waves, and electromagnetic waves. In addition, light and sound waves are crucial to many aspects of contemporary technology. Concave mirrors are used as satellite dishes, torches, car headlights, and shaving mirrors, whereas convex mirrors are utilized as security mirrors in department stores and as driving mirrors due to the effect of light as its travel in straight lines.

According to Amusan (2019), sound waves assist in communications, echo systems, gas removal from liquids, music, sterilization (killing of bacteria), determining the depth of the ocean, and many other applications. Light waves are used in early cancer detection, capturing flames, multifunction sensors for smartphones, and exploring an asteroid.

With the importance of waves, the findings of previous studies on wave optics and its phenomena have shown that many students have conceptual difficulties (Matejak Cvenić,Ivanjek, Planinić, Sušac, Jeličić, Hope& Srnka, 2021). The study of waves like mechanics is a potential to aid creative thinking, problem solving and assist students basic process skills, all this lead to critical thinking. In recent time, teachers of mathematics and physics are becoming increasingly interested in the issue of students' critical thinking development in basic education (Moreira, 2014).

The interaction of matter, space and time, conservation principles, waves, motion without material transfer, fields at rest and in motion, energy quantization, duality of matter, and physics in technology are the six themes that make up the new physics curriculum. These themes are spread across three years programme in senior secondary school of year 1, year 2 and year 3 (Federal Ministry of Education [FME], 2008). The abilities of students to respond to questions in waves was generally poor, according to reports from WAEC external examiners (2018, 2019, 2022, and 2025). Since a knowledge of waves is necessary to comprehend a variety of physical phenomena, such as light and the wave qualities of matter, such as electrons and atoms, waves are a crucial component of physics (Otuka, Fatokun, & Oluwasegun, 2019).

The table below shows percentage of waves concept represented in objectives questions from 2017 to 2025.

Table 1.1 Percentage of Wave Concepts Questions in WAEC from 2017 to 2025

Year	2017	2018	2019	2020	2020	2021	2022	2023	2024	2025
Percentage	24	26	24	20	26	14	26	16	20	26

Source: (Researcher, 2025)

The National Physics curriculum is a document which clearly itemise the contents to be learned, activities to be used by the teachers and the activities to be carried out by the students to actualise the stated objectives in the curriculum. Therefore, for any meaningful and useful technological development to be experienced in our society, the Physics curriculum must be well implemented (Ajayi, 2013). This implies that students must be effectively taught Physics concepts in our secondary schools as specified in the Physics curriculum.

The effective dissemination of curriculum instruction cannot be done by teachers and adherence to curriculum instruction cannot be followed by the students without a core resource of curriculum –the text book. The majority of classroom teachers make use of textbooks as their primary curricular guide and instructional material, according to Attakumah (2020).Students utilize textbooks to corroborate factual information on how to solve issues and complete tasks, while teachers use them as instructional resources. Textbooks are the primary source of information for the majority of educators and learners worldwide. Textbooks stand out as the center of educational industry, according to Mwikali, Kiende, and Ogeta (2024). In other words, teachers utilize textbooks to influence fundamental education knowledge and define guidelines for their lessons.

The foundation of knowledge is found in textbooks, especially in third-world nations where there is a persistent teacher shortage, and online educational services implies that textbook is one of the mostly used and trusted curriculum materials by the teachers and students. The textbook is the written curriculum that connects the National Curriculum Statements' intended content to the enacted or implemented curriculum (i.e., classroom activities) (Amaral & Garrson, 2007; Tarr, Chavez, Reys & Reys, 2006; Tomlinson, 2016;

Mesa, 2004). Physics textbooks should play a vital role in explaining the concepts and principles of Physics and how to apply them in given situations. The contents of good and quality textbooks are expected to comply with National Physics curriculum in relation to the contents, specific activities, exercises, examples and learning opportunities. The concepts, rules and principles in the contents should be applicable to the reallife situations. Contents (topics and sub-topics) discussed in any science textbooks especially Physics should be made interesting to the learners for effective learning with the aid of well demonstrated experiments to make the subject to be real to the students. In addition, relevant activities are expected to be included for both teachers and students to be carried in teaching and learning of the subject.

The compliance of any textbook with National curriculum might not be determine without textbook contents analogy evaluation. Textbook contents analogy evaluation is the systematic analysis of a textbook contents presentation with aim of identifying the relative effectiveness of various aspects of the textbook contents materials through a system of objective criteria (Hrehovcik 2002). Therefore, if the Physics textbooks are not properly evaluated to ensure that their contents are in line with those specified in the Physics National curriculum before recommending them for use in schools, the students will be put off during learning and these can be consequential to poor performance and negative attitude towards Physics subject.

Statement of Research Problem

The contents of waves are essential knowledge to be understood for students to have background information on a wide range of phenomena including light and the wave properties of matter as well as electrons and atoms. Further researches indicated that waves rank highest with high level of difficulty rated by both teachers and students. So, to undermine waves may contribute to poor performance of students in physics which could be consequential to students' pursuance of the subject to the higher institutions of learning. With this importance of waves concepts, there should be

readily textbooks material with detailed instructional materials on wave concepts. Several researches have been carried out on the use of recommended Physics textbooks with few or no researches addressed specifically to the compliance of wave concepts in recommended secondary school Physics textbooks with National Physics curriculum. Therefore, a thorough investigation is required to find out the level of compliance of wave concepts and instructional materials used in recommended secondary school Physics textbooks with National Physics curriculum, hence, this study.

Purpose of the Study

The study's objective is to evaluate the compliance of wave concepts in recommended Physics textbooks in secondary schools with Curriculum in Southwestern Nigeria. The study's specific objectives are to:

(i) examine the proportion of wave concepts in recommended Physics textbooks that are in use in Southwestern Nigeria;

(ii) assess the level of compliance of wave motion analogies used in recommended Physics textbooks with Curriculum in Southwestern**;** and

(ii) examine the relevance of instructional materials of wave concepts presented in recommended Physics textbooks with National Physics Curriculum in Southwestern Nigeria.

Research Questions

The following research questions were raised for the study:

(i) What are the proportions of wave concepts in recommended Physics textbooks that are in use in Southwestern Nigeria?

(ii) What are levels of compliance of wave motion analogies used in recommended Secondary School Physics textbooks with National Physics Curriculum contents in Southwestern Nigeria?

(iii) How relevant are the wave motion instructional Materials used in recommended Senior Secondary School Physics textbooks with National Physics Curriculum?

Methodology

This study employed a descriptive survey research design as the framework. This is with the aim of assessing the compliance of waves concepts in recommended physics textbooks **used** in secondary schools in Southwestern Nigeria with national physics curriculum. The design was used to gather information and responses across the sample of recommended textbooks for the study. The information was to describe and present data on the contents coverage and instructional materials used in the presentation of wave concepts in recommended senior secondary school physics textbooks in Southwestern Nigeria with national physics curriculum.

All the secondary school Physics textbooks recommended by the Ministries of Education in the Southwestern States of Nigeria made up the study's population. From a total of six states in Nigeria's southwest, three were selected at random. All recommended Physics textbooks for secondary schools from the selected states constituted the target population, the state are Osun, Lagos and Ogun States. Out of all recommended secondary school Physics textbooks from the three selected state, eight (8) most commonly used and accessible recommended secondary school Physics textbooks were selected through random sampling.

Two research instruments were used to collect data for the study, they are: Recommended Physics Textbook Compliance Checklist (RPTCC) and Instructional Materials for Teaching Wave Concept Checklist (IMTWCC). RPTCC was used to assess proportion of wave concepts and the level of compliance of wave concepts in the recommended Physics textbooks with National Secondary School Physics Curriculum. RPTCC consists of themes of wave concepts extracted from National Physics Curriculum and it was used to assess proportion of wave concepts and the level of compliance of wave concepts analogies in the recommended Physics textbooks. RPTCC was rated on three points of Likert scale of low compliance, moderate compliance and high compliance of 1, 2, 3 respectively with National Physics Curriculum.

Instructional Materials for Teaching Wave Concept Checklist (IMTWCC) was used to assess the relevance of instructional materials in the recommended Physics textbook for waves concepts. The textbook with instructional relevant materials in describing wave concepts in achieving the performance objectives of the curriculum are was rated on three points Likert scale of low compliance, moderate compliance and high compliance of 1, 2, 3 respectively.

Validation of Research Instruments

The three lecturers from the Department of Science and Technology Education (STE), Faculty of Education, Obafemi Awolowo, Ile-Ife, Nigeria, and two physics experts with more than ten years of teaching experience evaluated the instruments for face and content validity in order to determine their suitability for the study. The researchers then used the instrument to collect data after making the appropriate adjustments.

Procedure for Data Collection

The researchers read through the "Waves concept" in selected recommended secondary school Physics textbooks thoroughly, analyze the wave concepts offered, each selected textbooks were compared with the recommended wave concepts in the Physics Curriculum. The compliance of each textbook was done in relation to the concepts and analogies used in each of the topics that addressed wave concepts in the National Physics Curriculum. The numbers of wave concepts and the analogies contained in each textbook were counted as described in NPC. Frequency count and percentage were used to present the data obtained. The researchers also pay attention to objectives and assessed the objectives achievable as stated in national Physics curriculum. The numbers of objectives addressed by each topic were counted from each textbook. Frequency count and percentage were used to present the data obtained.

The researchers also carefully read through the "Waves concept" in the selected Physics textbooks, observed the instructional materials used in the chosen textbooks, made a list of all the identified materials

for instruction, and figure out the number of instructional materials identified in the textbooks to present wave concepts in line as stated in National Physics Curriculum (NPC), The numbers of instructional materials for wave concepts contained in each textbook were counted as described in NPC. Frequency count and percentage were used to present the data obtained. The scoring was done independently by the two researchers

3.8 Method of Data Analysis

The researcher made use of the data obtained from the RPTCC checklist as the raw score for each textbook on each topic based on it compliance with the wave concept presented in National Physics Curriculum. Desk-top analysis, the proportion of wave concepts was calculated through percentage

For each textbook, the researcher calculates the mean and standard deviation of the concepts represented in the recommended physics textbook and relevant of instructional materials for waves concepts.

Results

Research Question 1 What are the proportions of wave concepts in recommended Physics textbooks that are in use in Southwestern Nigeria?

Table 1 shows the percentages of wave concepts in selected recommended Physics textbooks

TEXTBOOKS	MEAN ($\bar{x}$)	S.D	REMARK
A	2.80	1.00	High Compliance
B	1.60	0.93	Average Compliance
C	2.60	0.73	High Compliance
D	2.78	0.53	High Compliance
E	1.40	0.94	Average Compliance
F	1.62	1.81	Average Compliance
G	2.50	0.83	High Compliance
H	1.60	1.71	Low Compliance

Source: Field Survey (2025)

This shows the level of compliance of wave motion analogies used by the textbook authors in the recommended Secondary School Physics textbooks to describe waves in achieving the stated objectives in curriculum. Textbook with a mean value between 0.00-1.00; 1.10-2.00 and 2.10-3.00 represent low compliance, average compliance and high compliance respectively. Textbooks A, C, D and G have high compliance, Textbooks B, E and F have average compliance while Textbook H has low compliance of analogy of waves concepts with Curriculum objective

Research Question 3: How relevant are the wave motion instructional Materials presented in the recommended Senior Secondary School Physics textbooks?

Table 3: The relevance of wave motion instructional Materials presented in recommended Senior Secondary School Physics textbooks

TEXTBOOKS	MEAN ($\bar{x}$)	S.D	REMARK
A	4.57	1.18	Average Compliance
B	4.43	0.95	Average Compliance
C	5.43	0.49	High Compliance
D	5.14	0.35	High Compliance
E	4.29	1.28	Average Compliance
F	4.00	1.77	Average Compliance
G	5.14	0.64	High Compliance
H	2.57	1.80	Low Compliance

Source; Field Survey (2025)

Discussion of Findings

The research looked at how compliance wave concepts in the recommended secondary physics textbooks with National physics curriculum in Southwestern. In this study, Eight (8) recommended secondary school physics textbooks were examined using RPTCC and IMTWCC.

According to the investigation of research question one, it was revealed that all the recommended Physics textbooks contain wave concept but the percentage of the wave concepts contained varies in line as stated in NPC based on the data presented in table 4.2.

According to Obioma (2007) opined that the curriculum outlines the minimum contents that must be taught in school, these contents must therefore be well contained in textbook in order to fulfil the curriculum goals. He stressed further those performance objectives, activities for both teacher and learners must be seen in the textbooks since the curriculum reflects the whole experience to which learners must be exposed. The conclusions supported the recommendation made in (Lump & Beck, 1996) study of high school biology textbook profiles using scientific literacy, that is, that the textbooks' contents should be objectively structured.

The findings on the level of compliance of wave concepts in recommended secondary school physics textbook with National physics curriculum. The study shows that most textbooks wave concepts deviated from what is described in the National physics curriculum and the analogy of the wave concepts presentation such as pictorial, verbal and pictorial-verbal including advance organizer, embedded-activator and post- synthesizer were not adequately presented for the comprehension of waves concepts. Yener (2012) asserted that analogy is mostly employed to comprehend both abstract and difficult-to-understand concepts. He stressed that textbooks containing adequate concepts in line with what is prescribed in the curriculum and having more presentational analogy should be used for teaching and learning processes. In a similar vein, Ojediran and Oyinwola (2022) advocated for textbook authors to employ more analogies such as advance organizer, embedded-activator and pictorial-verbal in their works in order to help readers grasp by connecting concepts to their everyday experiences. The research also found that wave concept analogies in each textbook were not appropriately used.

The findings of the relevance of wave motion instructional materials used in recommended secondary school physics in Southwestern Nigeria. The finding was against Daniel (2020) who opined that standard textbooks should contain or embedded with instructional materials to facilitate learning. Because teachers and students depend on textbooks for knowledge transfer, Abdulraheem (2014) further argued that as teachers and students rely on textbooks for knowledge transfer, meaningful teaching and learning in the classroom is impossible in the absence of instructional resources that are useful for textbook content.

In addition, the study's findings revealed that some wave motion instructional materials presented in recommended physics textbooks were not relevant and not adequately aligned with waves contents as described in Curriculum, this is against Ibenebe (2000) and Attakumah (2020) who observed that materials whether locally or imported can significantly improve the implementation of wave concepts if used sensibly. He further stated that implementation of wave concepts or contents can be difficult without the provision or utilisation of the relevant instructional materials of content explained in the textbook in relation the NPC objectives.

findings show that proportion of wave concepts, wavesmotion presentational analogies and usability of relevant instructional materials in the recommended secondary school physics textbooks in Southwestern Nigeria were not adequate in compliance with National physics curriculum.

Conclusion

The study concluded that few textbooks complied with waves concepts in NPC in terms of contents, content analogies, objectives and instructional materials for implementation of waves theme as described in the curriculum, the textbook with such attributes mentioned should be made recommended for both teachers and

students for teaching and learning of wave concepts including other themes in Physics. The studies also concluded that the textbooks that do not adequately presents wave concepts with instructional materials in terms of analogies which will aid comprehension should not be made recommended for students. Therefore, pictorial analogy should be more used in describing instructional material in textbook for concepts presentation which will aid easy recalling. Lastly, the curriculum developers need to examine and evaluate the textbooks based on suggestion made before being made recommended for school and the textbook authors should strength their book contents analogies in terms of pictorial, verbal and pictorial-verbal including advance organizer, embedded-activator and post- synthesizer which will aid learning and easy recalling.

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