EVALUATION OF THE EFFECTIVESNESS OF A MODULE FOR TEACHING AND LEARNING OF THE HUMAN SKELETAL SYSTEM FOR BIOLOGY STUDENTS IN SECONDARY SCHOOLS IN DUTSIN-MA METROPOLIS

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Abstract

The study was design to evaluate the effectiveness of a module for teaching and learning of the human skeletal system for biology students in secondary schools in Dutsin-Ma metropolis. Four objectives, four research questions were formulated and answered. Research and development (R&D) design was used for the study. The population for the study was 684. The sample of the study was 229. The data collected were analyzed using descriptive statistics (mean and standard deviation) in answering the research questions. The findings from the study revealed that the respondents agreed with all the objectives, content, delivery methods and items of a module for teaching and learning of the human skeletal system for biology students in secondary schools in Dutsin-Ma metropolis. Thus, it was recommended that the module should be adopted and implemented for secondary school biology students to enhance teaching and learning of the human skeletal system.

Keywords: Evaluation, Effectiveness, Teaching and learning module, Human skeletal
system, Secondary schools

Introduction

Biology education plays a pivotal role in shaping students' scientific understanding, and the effectiveness of teaching methods directly influences the depth of comprehension (Ajaja, 2020). A well-rounded education in biology is essential for students to grasp the intricate workings of living organisms, and this begins with a strong foundation in fundamental concepts. Among these, the skeletal system holds particular significance, serving as a cornerstone in understanding the structural frame-work, shape, function and protection of the human body and other living organisms (Jackson, 2017). The government senior secondary schools in Dutsin-ma, Katsina State recognizes the crucial role of the skeletal system in biology education and acknowledges the need for a robust module to enhance teaching and learning in this area. The skeletal system, comprised of bones, joints, and associated tissues, provides structural support and facilitates bodily functions such as movement and protection of vital organs. Its intricate network is central to the study of anatomy, physiology, and overall biology. However, traditional teaching methods often fall short of delivering complex biological concepts, including those related to the skeletal system (Ajaja, 2022).

The development and validation of instructional modules is a crucial aspect of improving teaching and learning outcomes in science education (Adegoke, 2010). In Nigeria, the teaching and learning of Biology, a core science subject, has been plagued by challenges such as inadequate instructional materials, poor teaching methods, and low student achievement (Nworgu, 2014). The Human Skeletal System, a fundamental topic in Biology, is often misunderstood by students due to its abstract nature and the complexity of its structures (Aina, 2015).

To address these challenges, researchers have emphasized the need for the development and validation of teaching and learning modules that are tailored to the needs of secondary school

students (Obomanu & Anyanwu, 2015). A well-designed module can enhance student understanding, promote active learning, and improve academic achievement (Kalu & Oladejo, 2013).

However, there is a dearth of research on the development and validation of modules specifically designed for teaching and learning the Human Skeletal System in secondary schools in Dutsin-Ma Metropolis, Nigeria. This study seeks to bridge this gap by developing and validating a module for teaching and learning the Human Skeletal System for Biology students in secondary schools in Dutsin-Ma Metropolis.

Statement of the Problem

The teaching and learning of Biology, particularly the Human Skeletal System, is a crucial aspect of secondary education in Nigeria (Nworgu, 2014). Understanding the Human Skeletal System is essential for students to grasp concepts in Biology, Health Science, and related fields (Aina, 2015). However, research has shown that students often struggle with the topic due to its abstract nature and the complexity of its structures, leading to poor academic achievement and low interest in Biology (Kalu & Oladejo, 2013). The use of ineffective teaching methods and lack of instructional materials have been identified as major contributors to these challenges (Obomanu & Anyanwu, 2015).

Despite the importance of the Human Skeletal System, there is a dearth of research on effective teaching and learning strategies for this topic in secondary schools in Dutsin-Ma Metropolis, Nigeria. Existing studies have focused on other aspects of Biology education, leaving a gap in knowledge on how to improve instruction and learning outcomes for the Human Skeletal System (Adegoke, 2010). Furthermore, the few available studies on instructional modules for Biology have not been validated for use in the Nigerian context, particularly in Dutsin-Ma Metropolis (Kalu & Oladejo, 2013).

A study on the development and validation of a module for teaching and learning the Human Skeletal System will benefit Biology students, teachers, and curriculum developers in secondary schools in Dutsin-Ma Metropolis. Students will benefit from improved instruction and learning outcomes, while teachers will gain access to effective teaching strategies and materials. Curriculum developers can also use the findings to inform the design and development of Biology curricula that meet the needs of Nigerian students.

Research Questions

The following research questions were formulated to guide the study:

What are the objectives of the human skeletal system module for teaching and learning biology for students in senior secondary schools Dutsin-ma?

What are the contents of the human skeletal system module for teaching and learning biology for students in senior secondary school Dutsin-ma?

What is the delivery method for implementing of the human skeletal system module for teaching and learning biology education students in senior secondary schools Dutsin-ma?

Methodology

This study adopted Research and Development (R&D) growth of educational research as one of scientific research has come to the state where researchers in this field make their studies to generate a model for better educational practices. One of the most outstanding model designs is Research and Development (R&D) Method Borg & Gall (1983), nevertheless, the widely use of this method prompts a question whether it is the only proper method in educational research. This paper is aimed to discuss in depth the R&D Method in some educational research by comparing the simplified steps and characteristics in those research. This paper also provides some alternatives of model design for educational research in which the usage and its implementation are adjusted in accordance to the research context and researchers characteristics. The study was conducted in Katsina State North-West of Nigeria. Also, accredited Government secondary schools in Dutsin-Ma Metropolis offering biology was covered. The population for this study was 684 comprises of all public secondary schools within Dustin-ma metropolis.

The instruments were face validated by three biology education experts. The researcher personally

administered copies of the instruments to the respondents with the help of three research assistants. Research questions 1, 2, 3, and 4 was analyzed using descriptive statistics (mean and standard deviation). The decision rule for research questions was benchmarked based on four point rating scale. The criterion mean is 2.50. Therefore, any mean rating from 2.50 and above was agreed or strongly agreed and where otherwise was not disagreed or strongly disagreed.

Results

Research Question One

What are the objectives of the skeletal system module for teaching and learning biology in secondary schools in Dutsin-Ma metropolis?

The output of the descriptive statistics presented in table 1 indicated that all the items on the objectives are required in developing the human skeletal system module for teaching and learning biology students in Dutsin-Ma secondary schools, they have a mean score of 3.0 above. The mean score of items in the objectives of the respondents ranges from 3.22 to 3.70 and standard deviation 0.45 to 0.55 respectively. The variables also had overall grand mean 3.54 and standard deviation 0.50 for the respondents on the objectives.

Table: 1 Descriptive Statistics of the Objectives of the Human Skeletal System Module

S/N	Items	[	Mean	.D	emark
1.	dentify and describe the bones in the human body and their nctions.	29	.70	.55	greed
2.	xplain the functions of the skeletal system (support, protection, ovement, blood cell production, and storage of minerals).	29	.61	.51	greed
3.	escribe the basic functions of skeletal system	29	.60	.50	greed
4.	escribe Understand the structure and organization of the skeletal ystem (axial and appendicular skeleton).	29	.54	.50	greed
5.	dentify the importance of the skeletal system in human health and ovement.	29	.22	.45	greed
	rand Mean and Grand S.D		.54	.50	greed

Source: Field Work, 2026

Research Question Two

What are the contents of the skeletal system module for teaching and learning biology in secondary schools in Dutsin-Ma metropolis?

The output of the descriptive statistics presented in table 2 indicated that all the items on the objectives are required in developing the human skeletal system module for teaching and learning biology students in Dutsin-Ma secondary schools, they have a mean score of 3.0 above. The mean score of items in the objectives of the respondents ranges from 3.32 to 3.64 and standard deviation 0.50 to 0.53 respectively. The variables also had overall grand mean 3.50 and standard deviation 0.51 for the respondents on the objectives.

Table: 2 Descriptive Statistics of the Contents of the Human Skeletal System Module

/N	Items	[	Mean	.D	emark
6.	ntroduction to the skeletal system	29	.64	.50	greed
7.	omposition of the skeletal system	29	.50	.53	greed
8.	unctions of the skeletal system	29	.40	.50	greed
9.	ositions of the bones of the skeletal system	29	.43	.51	greed

10.	arts of the skeletal system; Appendicular skeletal system (upper nd lower limbs, girdles).Axial skeletal system (upper and lower)	29	.32	.50 greed
	rand Mean and Grand S.D		.50	.51 greed

Source: Field Work, 2026

Research Question Three

What are the delivery methods for implementing skeletal system module for teaching and learning biology in secondary schools in Dutsin-Ma metropolis?

The output of the descriptive statistics presented in table 3 indicated that all the items on the objectives are required in developing the human skeletal system module for teaching and learning biology students in Dutsin-Ma secondary schools, they have a mean score of 3.0 above. The mean score of items in the objectives of the respondents ranges from 3.41 to 3.62 and standard deviation 0.51 to 0.53 respectively. The variables also had overall grand mean 3.45 and standard deviation 0.51 for the respondents on the objectives.

Table: 3 Descriptive Statistics of the Delivery Methods for Implementing Skeletal System Module

/N	Items	[	Mean	.D	emark
11.	se of demonstration, lectures and power point presentations is an ffective to teach skeletal system	29	.62	.51	greed
12.	nteractive quizzes and games that focuses on the skeletal system at enhance student in teaching and learning	29	.50	.53	greed
13.	Collaborative learning and peer-to-peer teaching, formative ssessment and feedback	29	.40	.50	greed
14.	utdoor field trips to museums or medical facilities can provide eal-world context and application of skeletal system concept	29	.31	.50	greed
15.	eaching in detailed with the use of explanatory slides in teaching nd learning skeletal system content.	29	.41	.51	greed
	rand Mean and Grand S.D		.45	.51	greed

Source: Field Work, 2026

Research Question Four

What is the effectiveness of skeletal system module for teaching and learning biology in secondary schools in Dutsin-Ma metropolis?

The output of the descriptive statistics presented in table 4 indicated that all the items on the objectives are required in developing the human skeletal system module for teaching and learning biology students in Dutsin-Ma secondary schools, they have a mean score of 3.0 above. The mean score of items in the objectives of the respondents ranges from 3.21 to 3.61 and standard deviation 0.59 to 0.83 respectively. The variables also had overall grand mean 3.40 and standard deviation 0.61 for the respondents on the objectives.

Table: 4 Descriptive Statistics of the Development and Validation of Skeletal System Module

/N	Items	[	Mean	.D	emark
16.	ncorporating a skeletal system module in biology curriculum will nhance student understanding of the topic.	29	.61	.59	greed
17.	alidated skeletal system module will help students retain nformation better.	29	.42	.54	greed
18.	eveloping module for the skeletal system will make biology essons more engaging for students	29	.42	.55	greed

19.	Validated skeletal system module will improve student performance on their assessments and examinations	29	.35	.56	Agreed
20.	Development and validation of a skeletal system module is a valuable addition to biology students.	29	.21	.83	Agreed
	Grand Mean and Grand S.D		.40	.61	Agreed

Source: Field Work, 2026

Discussion of Findings

The findings of this study revealed were discussed as follows;

The findings of this study revealed five objectives of the skeletal system training module, to include; identify and describe the bones in the human body and their functions, Explain the functions of the skeletal system (support, protection, movement, blood cell production, and storage of minerals), describe the basic functions of skeletal system, describe and understand the structure and organization of the skeletal system (axial and appendicular skeleton), and identify the importance of the skeletal system in human health and movement. The findings was in agreement with the opinion of Obe (2019) which support that the used of objective items enhance teaching and learning.

Contents: The findings revealed five content items were agreed for the effectiveness of the skeletal system training modules for secondary school students in Dutsin-Ma metropolis. The findings was in agreement with the findings of Urevbu 2019 that content is relevant when it meets the need of a society such as unemployment; by teaching what is relevant or related to societal issues at hand through practical and theoretical concepts.

Delivery methods: The finding of the study revealed five delivery methods for implementing the skeletal system training modules for secondary school students in Dutsin-Ma metropolis. The finding was in agreement with the findings of Abubakar et al. (2018) which agrees that the use of e-content in teaching and learning simplifies the entire teaching and demonstration cycle including among others archiving, evaluation, generation and presentation of learning experience.

Effectiveness: the findings of the study revealed five items for the skeletal system training modules for secondary school students in Dutsin-Ma metropolis. The findings also agreed with the opinion of Daryanto (2015) and Khoirudin (2019), a module equipped with user friendly instructions for use can be used by students for independent learning. Also agreed with Widyaningrum et al (2013) that the implication of Vygotsky's theory explains that modules are not only used as independent teaching materials but also integrated into learning through discussions and experiments conducted in small groups.

Conclusion

Based on the result and findings presented, it was concluded that, objectives, contents, delivery methods and items on the module were effective, required and utilized for the development of teaching and learning the human skeletal system for biology students in secondary schools in Dutsin-Ma for the module development.

Recommendations

Based on the findings and result of the study, the following recommendations were made:

1. The module should be adopted and implemented in senior secondary schools to enhance teaching and learning of the human skeletal system hence, its effective.
2. Teacher Training: Teachers should receive training and support to effectively use the module and integrate it into their teaching practices.
3. Continuous Evaluation: The module should be continuously evaluated and refined to ensure its effectiveness and relevance.
4. Expansion to other Topics: The approach used in this project should be applied to develop modules for other biology topics.

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