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Analysis of Experts' Opinion on the Human Excretory System Model for Teaching Biology in Nigeria

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ABSTRACTS

To establish the accuracy and usability of the instructional model, it must be verified by experts in the area of the subject content. The model of the human excretory system (MHES) has to be examined and verified by a qualified Biology education expert to ascertain its accuracy while the usability has to be verified by an educational technology expert. Hence, it is needed to determine the experts' validation of MHES before it can be used to teach a Biology concept. Descriptive research of the survey type was adopted for this study. The sample for this study comprised three educational technology experts from the Department of Educational Technology and three Biology education experts from the Department of Science Education, University of Ilorin, Nigeria. Two instruments were developed for the study: Educational Technology Experts' Rating Scale and Biology Education Experts' Rating Scale. Descriptive statistics of the mean score and standard deviation were used to analyze the research questions. The findings of this study revealed the experts' overall assessment of the effectiveness of the model for instruction was high, suitable, and found to be adequate. Based on the findings of this study, it is concluded that the developed MHES can be used to enhance Biology students' academic performance on the topic human excretory system.

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1. INTRODUCTION

Science is the study of phenomena and events around us through systematic observation and experimentation. Science education cultivates students' curiosity about the world and enhances scientific thinking. Through the inquiry process, students will recognize the nature of science process skills to help them evaluate the impacts of scientific and technological development. The role of science education in the socio-economic development of any nation needs no arguments. Science education is an important element in the development of any nation, that is why every nation has taken it very seriously in all institutions of learning (Kola, 2013). Based on this insight, nations across the world adopted the integration of science education curriculum into their educational system (Ganiyu *et al*., 2017). Science education curricula are expected to prepare as well as train students with skills that will bring about self-reliance, career opportunities, and advancement in their chosen careers (Udu, 2018). Science subjects have some difficult ideas that can best be comprehended by sequencing directions. Sequencing gives a logical movement of discovery that can be accomplished through the utilization of different instructional resources (Ong'amo *et al*., 2017). Anaeto (2016) expressed that, for any country to achieve the condition of confidence, science must be a significant educational segment of that country.

Integrated science instructional materials are an essential and meaningful tool necessarily applied aiming at promoting learning efficiency and improving students' performance. In this case, the integration of science can be conducted by using the interdisciplinary approach. Instructional materials are a wide variety of equipment and materials used for teaching and learning by teachers to stimulate self-activity on the part of the students (Usman & Saminu, 2017). Instructional materials perform such functions as the extension of the range of experience available to learners, supplementing and complementing the teacher's verbal explanations thereby making the learning experience richer and providing the teacher with interest in a wide variety of learning activities. To boost the attainment of objectives of teaching a subject matter, it behaves on Biology teacher to assist his teaching with appropriate instructional material that will enable him/her to achieve his/her objectives and this improves the academic achievement of the students taught (Bisiriyu, 2016).

The parts of science are biology, physics, chemistry, and agricultural science among others, and can be comprehensively classified into natural and applied sciences. Adegboye *et al*., (2017) defined biology as a unique branch of science that seeks an in-depth understanding of natural phenomena and events. Biology as a branch of science and the prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation. This includes medicine, forestry, agriculture, biotechnology, and nursing. The study of Biology in senior secondary school can equip students with useful concepts, principles, and theories that will enable them to face the challenges before and after graduation (Akinwumi & Falemu, 2020). The significance of biology has made it a course or subject of impact in the life of individuals and the nation world in general; in this way prompts the learned to make it a mandatory course of study in every level of instruction primary, secondary, and tertiary institutions (Akinfe *et al*., 2012). The study of Biology in senior secondary school can equip students with useful concepts, principles, and theories that will enable them to face the challenges before and after graduation (Akinwumi & Falemu, 2020). The position of biology in the education of secondary school students is to allow the students to manipulate and experiment with suitable equipment and materials. This will prepare them for acquiring adequate laboratory and field skills in biology (Babalola, 2022).

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Also, biology is a field of science that is presented in theoretical and practical forms. The Practical presentations of biological concepts offer students the opportunity to carry out scientific processes in the laboratory and outside the laboratory, which are far different from theoretical presentations of some of its topics (Hamzat *et al*., 2017). The review on students' academic performance in Biology revealed that Biology is one of the subjects that usually attract the widest enrolment and is usually regarded as the simplest to understand among all the science subjects. Although Biology is the simplest to comprehend among the science subjects, the level of academic achievement is not much different from other science subjects among the students. Students' achievement in Biology in Senior Secondary Certificates Examination (SSCE) has been unsatisfactory for many years (Auwalu *et al*., 2014). Biology is enriched with topics like cells, circulatory system, photosynthesis, digestive system, respiratory system, excretive system, organs, and so on. Although there might be a problem in teaching these topics due to the unavailability of teaching aids teach the topics (Chavan, 2016).

The excretory system consists of organs that remove metabolic wastes and toxins from the body. In humans, this includes the removal of urea from the bloodstream and other wastes produced by the body. The removal of urea happens in the kidneys, while solid wastes are expelled from the large intestine. The excretory system in humans consists mainly of the kidneys and bladder. The kidneys filter urea and other waste products from the blood, which are then added to the urine within the bladder. Other organs, such as the liver, process toxins but put their wastes back into the blood. It is up to the kidneys to filter the blood so that toxic substances do not accumulate. One of the challenges in teaching some concepts in biology is the inability to have the in-depth study of internal organs in the body which is probably because these organs are not visible and accessible. The instructional model can bridge this gap if carefully designed, developed, and validated.

Models are direct imitations, images, or duplicates of real, original, or natural objects or figures. They are made in place of the original figure or object for obvious reasons and they are therefore used as such in place of the original objects or figures. Meaningful instruction takes place only with the appropriate use of instructional materials, especially in their real form. Models come in form of 3-dimensional forms; it includes instructional material that has length, breadth, and depth. A model is a representation of an actual object. It may be longer or smaller or of the same size as the original. To successfully use models for instruction, professionals or experts in the area of the subject content must verify the model to ascertain its accuracy and usability. Therefore, this study determined experts' validation of the developed model of the human excretory system to help students have direct access to what they have learned or heard in the classroom, and enhance the teaching of the topic Human Excretory System.

This study provided answers to the following research questions

(i) What is the educational technology experts' rating for validation of the developed model of the human excretory system?

(ii) What is the biology experts' rating for the validation of the developed model of the human excretory system?

2. METHOD

Descriptive research of the survey type was adopted for this study. This method was considered the most suitable design for this study because it involves selecting a chosen sample from a large population. The study validated the developed model of the human

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excretory system to teach a Biology concept in secondary schools. The population for this study comprised all educational technology experts and biology education experts in Ilorin. The target population was all educational technology experts and biology education experts at the University of Ilorin. The sample for this study comprised three educational technology experts from the Department of Educational Technology, University of Ilorin, Nigeria, and three Biology education experts from the Science Education Department, University of Ilorin, Nigeria. Descriptive statistics of mean and standard deviation were used to analyze the research questions. The distribution of the expert participants is shown in **Table 1**.

Table 1 shows that 6 experts participated in the validation of the MHES. Three educational technology experts with a total of 50% and three biology education experts with a total of 50%. It shows that an equal number of educational technology and biology education experts participated in the validation process of this study. **Figure 1** further presents the demographic information of the expert participants in a pie chart.

Table 1. Demographic information of the expert participants**.**

Respondents	Frequency	Percentage (%)
Educational Technology Experts (ETE)	3	50
Biology Education Experts (BEE)	3	50
Total	**6**	**100**

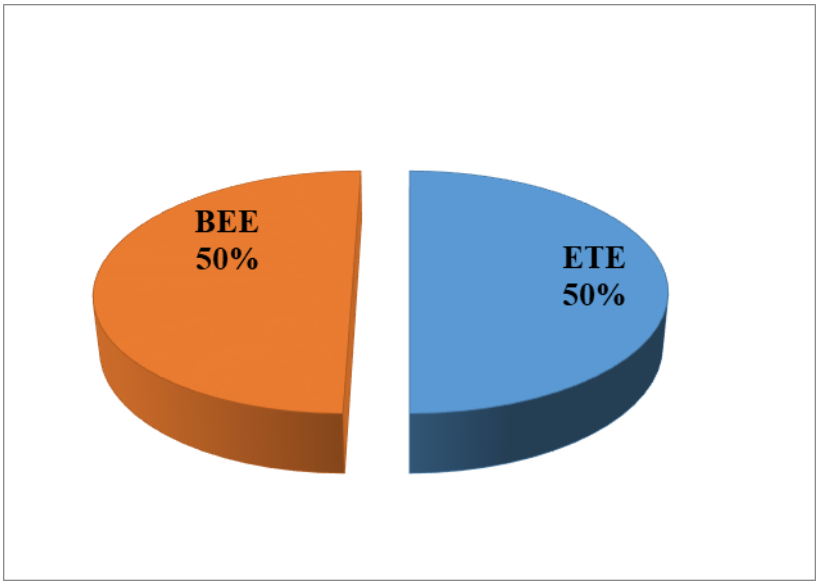

Figure 1. Demographic information of the expert participants.

For Research Instruments, the Educational technology experts rating guide and biology expert rating guide was used in the validation of the developed human excretory system to teach a biology concept in secondary schools in Ilorin, Nigeria. The rating guide contained two sections; Section A contained the demographic information of respondents, while Section B contained items on the rating guide on the developed human excretory system to teach a biology concept in secondary schools in Ilorin. The items in section B were rated on a Likert Scale of Strongly Agree (SA), Agree (A), Strongly Disagree (SD), and Disagree (D) with a weighted value of 4 to 1 in terms of scoring.

For Validation of the Research Instruments, Educational Technology Experts' Rating Scale (ETERS) and Biology Education Experts' Rating Scale (BEERS): the experts' rating scale was

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adapted from Olumorin *et al*. (2021). This was used to ascertain experts' opinions on whether the developed model conforms to the acceptable standards and procedures in the fields of Educational Technology and Biology Education. The validation was carried out by three educational technology experts and three Biology Education experts from the University of Ilorin, Nigeria. The experts were requested to express their views on whether they strongly agreed (SA), Agreed (A), disagreed (D), or strongly disagreed (SD) with the statement on the validation questionnaire presented to them as they responded while observing the model.

3. RESULTS AND DISCUSSION

3.1. Research Question One: What are the Educational Technology Experts' RATINGS for Validation of the Developed Model of the Human Excretory System?

The Educational Technology Experts rating for the validation of the Model of Human Excretory System (MHES) was carried out by three (3) Educational Technology experts. The experts rating scale contains 11 items respectively. The mean and standard deviation of the rating of each of the items and the grand mean score of the three (3) experts is shown in **Table 2**. From **Table 2**, the grand mean of 3.37 for Educational Technology experts' opinions on the developed model of the human excretory system shows that the developed MHES satisfied the required standard in the field of educational technology. Thus, experts agreed that the model of the human excretory system is adequate and good for learning. This is because the grand mean of 3.37 is greater than the average benchmark of 2.44.

Table 2. Mean and standard deviation of educational technology experts' rating for the validation of the MHES.

S/No	Statements	Mean	SD	Decision
1.	The model has a resemblance to Human Excretory System	3.33	0.58	Agree
2.	Concept is relevant to learners' need	4.00	0.00	Agree
3.	Information relevant to age group curriculum	3.67	0.58	Agree
4.	The model will enhance the presentation of the concept Human Excretory System	3.33	0.58	Agree
5.	The model contains detailed and accurate information about the Human Excretory System	3.00	0.00	Agree
6.	The design of the model can enhance students' retention ability	3.67	0.58	Agree
7.	The design and structure of the model are clear and understandable	3.33	0.58	Agree
8.	The color of the model will motivate and arouse learners' interest throughout the instructional process	3.33	0.58	Agree
9.	The quality of the model is good	3.33	0.58	Agree
10.	The structure of the model would motivate learners on the topic	3.00	0.00	Agree
11.	The model can aid students' and teachers' interaction	3.33	0.58	Agree
	Grand Mean	**3.37**		

3.2. Research Question Two: What are the Biology Experts' Ratings for the Validation of the Developed Model of the Human Excretory System?

The Biology Experts rating for the validation of the Model of Human Excretory System (MHES) was carried out by three (3) Biology Education experts. The experts rating scale contains 11 items respectively. The mean and standard deviation of the rating of each of the items and the grand mean score of the three (3) experts is shown in Table 3. From table 3,

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the grand mean of 3.52 for Biology experts' opinions on the developed model of the human excretory system shows that the developed MHES satisfied the required standard in the field of Biology education. Thus, experts agreed that the model of the human excretory system is adequate and good for teaching Biology. This is because the grand mean of 3.52 is greater than the average benchmark of 2.44.

Table 3. Mean and standard deviation of biology education experts' rating for the validation of the MHES.

S/No	Statements	Mean	SD	Decision
1.	The content in the developed model is in-line with the biology curriculum.	3.67	.58	Agree
2.	The use of the developed model of the Human Excretory System to teach a biology concept will stimulate learners' interest.	3.67	.58	Agree
3.	The developed model of the Human Excretory System can concretize the abstraction in biology teaching.	3.00	.00	Agree
4.	The developed model of the Human Excretory System can motivate and arouse learners' attention throughout the instruction process.	3.33	.58	Agree
5.	Presentation of the model of the Human Excretory System will enhance the understanding of the topic by the students	3.67	.58	Agree
6.	The developed model is adequate and can help achieve the stated objectives of the lesson	3.67	.58	Agree
7.	The selected concept is drawn from the SSII biology syllabus	3.33	.58	Agree
8.	The labeling of the model is adequate	3.33	.58	Agree
9.	The model can be used as an improvised Human Excretory System in Biology practical classes	3.67	.58	Agree
10.	The model could enhance guided discovery for Biology students	3.33	.58	Agree
11.	The model is a faster means of enhancing effective teaching and learning processes	4.00	.00	Agree
	Grand Mean	**3.52**		

Key: SD = Strongly Disagree, **D=** Disagree, **A =** Agree, **SA =** Strongly Agree
Decision Value: ***Disagree*** **=**0.00-2.44, ***Agree*** **=** 2.45-4.00

The results of the experts' validation of the developed Model of Human Excretory System (MHES) by subject and content experts revealed Educational Technology experts agreed that the developed Model of Human Excretory System satisfied the required standard in the field of Educational Technology with the grand mean of 3.37 while experts in Biology Education also agreed that the developed MHES satisfied the required standard for teaching Biology with the grand mean of 3.52. Thus, experts' overall assessment of the effectiveness of the model for instruction was high, suitable, and found to be adequate. The finding agreed with earlier findings of Olumorin *et al*. (2021) who reported that before the accuracy and usability of the instructional model can be ascertained, the model must be verified by a professional or expert in the area of the subject content.

4. CONCLUSION

The results obtained from the data gathered and analysed in this study show that the MHES can enhance the teaching and learning of biology. This study demonstrated the various stages

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of validating a model of the human excretory system. The developed MHES has to be inspected and verified by a qualified biology education expert to ascertain its accuracy while the usability has to be verified by an educational technology expert. The failure rate in Biology at senior certificate examinations could be attributed to many factors; one of such factors is the lack or total absence of instructional materials. In teaching and learning, instructional materials play a key role in concretizing learning. The model of the human excretory system is a step forward in this direction; it will help students to have direct access to what they have learned or heard on the conceptual structure of the human excretory system.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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