



Experts' Validation of the Developed 3-Dimensional Automated Model of the Human Heart to Teach A Biology Concept in Ilorin, Nigeria

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ABSTRACTS

To ascertain the accuracy and usability of the instructional model, it must be verified by a professional or expert in the area of the subject content. The automated model of the human heart (3-DAMHH) 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. Hence, it is needed to determine the experts' validation of 3-DAMHH to teach a Biology concept in Ilorin, Nigeria. Two instruments were developed: Educational Technology Experts' Rating Scale and Biology Education Experts' Rating Scale. Percentage scores were used to answer research questions. The findings of this study revealed the percentage score of the rating for the validation of the 3-DAMHH by the experts satisfied the required standard in the field of Educational Technology. The percentage score of the rating for the validation of the 3-DAMHH by the experts satisfied the required standard in the field of Biology. This study concluded that the developed 3-DAMHH can be used to enhanced Biology students' performance on the topic structure of the human heart. It was recommended among others that content specialists' and experts' validation reports should be properly followed towards developing a standard instructional media.

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1. INTRODUCTION

The role of science education in the socio-economic development of any nation needs no arguments. Kola (2013) described science education as an important element to the development of any nation, that is why every nation has taken it very seriously in all institutions of learning. Based on this insight, nations across the world adopted the integration of science education curriculum in 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). Biology as a part of science and the essential subject for some fields of learning contributes hugely to the technological development of the nation. Anaeto (2016) expressed that, for any country to achieve the condition of confidence, science must be a significant educational segment of that country.

Okwara *et al.*, (2017) defined science as the organized group of learning acquired by strategies or procedures dependent on observation and experimentation as its power. Science tries to clarify the natural phenomenon utilizing inquiry procedures or exercises. Logical information is a prerequisite to the advancement of the nation, explicitly to the quality of human resources which knowledgeable to science and technology (Putra *et al.*, 2018). Science is an incredible enterprise which nations rely upon to progress technologically. Science and technology comprise the reason for progression in every one of the fields of human undertakings. Since learning is relied upon to create people that are equipped for taking care of their problems just as those of the society. Such people are required to be confident, self-sufficient, and independent. Science along these lines is receiving much emphasis in Education due to its significance and pertinence to life and society (Nnenna & Adukwu, 2018).

The parts of science are biology, physics, chemistry, 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 is the science that manages the investigation of varieties of living organisms including ourselves (plants and animals). It likewise examines how our environment advanced from the triple organism and this is personally part of our environment. Medicinal progression demonstrates the significance of biology in our day-by-day lives. The investigation of feared infections, their causative agents, fix just as the activity of medications are a method for Biological enlightenment that strives at limiting human suffering, its attempts to discover the solution for inherited variations from the norm like hemophilia, Down's syndrome, and so on.

Biology has an essential role in controlling environmental contamination and attractive sense of art and magnificence. High-yielding varieties of crop plants like rice, wheat, salt, sugar cane among others are currently reared experimentally. Ailment safe grain verbalized seeds are made (Biotechnology) and Fossils are significant in finding underground oil and natural gas resources. 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).

Biology as one of the branches of science incorporates a tremendous measure of information about living organisms. There is a mixed-up impression that it is a subject including memorization of various irrelevant realities. In the educational program, it is trusted that students will develop a broad, general comprehension of biological principles and ideas

and simultaneously secure a collection of fundamental realities. To make the investigation of science energizing and significant, it is proposed that it ought to be presented in real-life contexts. The selection of a wide scope of learning and teaching methodologies and assessment practices are intended to encourage interest in and create motivation for learning among students with a range of abilities and aspirations (CDCHKEAA, 2014).

Biology being a natural science can be studied both indoor and outdoor as the most biological specimen is plants and animals which possess large amounts of nature. However, some laboratory facilities may not be found outside the laboratories such as reagents, henceforth the need to have a well-stocked laboratory with accessible and sufficient facilities. For science teachers to play their roles in teaching science, laboratory facilities ought to be available and utilized properly to improve the performance of students. Students' poor performance in Biology particularly at Senior School Certificate Examinations (SSCE) level has turned into a wellspring of worry to all stakeholders in education in the country (Musah & Umar, 2017).

In teaching and learning, educational technology incorporates all forms of technologies to address educational needs and problems with an emphasis on the application of the most applicable and present-day devices. Educational technology is a subset of the field of education which is concerned with useful communication and instruction. It refers to different types of technology, which can be used to facilitate the teaching and learning process. Educational technology is described in terms of audiovisual aids, educational media, communications, and in terms of instructional technology. It is all about the application of human and non-human resources to facilitate and augment teaching and learning for meaningful and productive learning to be achieved. Educational technology facilitates the individualized instruction since it is how instruction is paced to the individual level of learners' understanding.

The concept of educational technology has its root in innovation which is viewed as equipment and a combination of both hardware and information to influence a positive change in circumstance. Educational technology goes further than the gathering of educational materials, however; it incorporates the utilization of media, instructional technology, communication theory, and systematic approach to solving educational problems in the course of utilization of knowledge. Learning is progressively pleasurable and the result increasingly changeless when educational technology is utilized (Kareem & Olafare, 2017).

The infusion and integration of technology in the instruction procedure have introduced new avenues by which instructors can enrich and enhance teaching and learning exercises. Teachers respond to their use in the classroom setting in many ways. First, there are those teachers who fear using any form of technology apart from those with which they are very comfortable. Secondly, others make use of some form of technology even if they do so infrequently for example overhead projectors and videotapes during class presentations. Thirdly, some teachers maximize the use of different technologies sometimes to the point of overuse during classroom activities. The various manners by which educators react to the need to incorporate innovation in classroom activities may be predicated on their pre-service preparation and additional encouragement provided in the different educational environments (Duhaney & Devon, 2010).

Therefore, instructional resources guarantee maximum value and effectiveness in the teaching and learning process. The instrument of instruction is communication which must be skillfully designed and developed if the objective of the instruction is to be accomplished. This requires the utilization of explicitly produced material used to make the process of instruction to be more pleasant and enjoyable. Materials that are utilized during the process

of instruction to make instruction more meaningful and pleasurable are called instructional materials.

Instructional Materials in its most straightforward term are those materials that help the Teachers to teach easily and the students to learn without pressure. Instructional Materials incorporate projected, non-projected, printed, and others, such as object/relic, 3-dimensional objects that are created through nearby source materials, program instruction, instructional package, and so on (Olumorin *et al.*, 2010). Instructional materials are resources for transmitting information, ideas, and notes that can help in facilitating learning. They help in making students comprehend, retain, and recall concepts, principles, or theories and acquire professional skills (Ogunlade & Amosa, 2015). The role of instructional materials if thoroughly considered cannot be completely detached from the teaching and learning process. For any meaningful educational program to be accomplished in terms of its implementation, the part of instructional materials must be given genuine need (Bisiriyu, 2016).

Instructional materials perform such work as the expansion of the range of experience accessible to students, enhancement and complement the instructor's verbal explanations, therefore, making the learning experience richer and giving the teacher enthusiasm into a wide collection of learning exercises. To help the attainment of objectives of teaching a subject matter, it acts on the teacher to help his teaching with suitable instructional material that will empower him to accomplish his objectives and this improves the academic achievement of the students taught (Awolaju, 2016). Instructional materials are those materials that are purposely used to attain improvement in instruction. They are those materials and equipment utilized by the teacher during teaching to improve student's learning, capacity, and skills, to monitor their assimilation of information, and to add to their general advancement and upbringing.

A key component of successful teaching is the choice of instructional materials that address the issues of students and fit the limitations of the teaching and learning condition. A common statement that is true in teaching is that, if you have not learned, I have not instructed. A sensible end at that point is that the significance of instructional materials in educating and learning science is most successfully outlined through student accomplishment results. The teacher and student interactions in numerous scientific studies are not beneficial on account of adequate resources. The inquiry-focused science teaching showing requests a ton of exercises concerning the student that requires scientific materials and equipment (Omorogbe & Ewansiha, 2013). Availability of textbooks, laboratory apparatus, and other learning resources contribute significantly to the performance of students in science subjects.

Building students' understanding of internal body organs, how these are linked, and why they work together as systems is a complex process. The heart is a muscular organ about the size of a fist, located behind and a bit left of the breastbone. The heart pumps blood through the system arteries and veins called the cardiovascular system. The heart has four chambers: The right atrium receives blood from the veins and pumps it to the right ventricle; The right ventricle receives blood from the right atrium and pumps it to the lungs, where it is loaded with oxygen; The left atrium receives oxygenated blood from the lungs and pumps it to the left ventricle and The left ventricle (the strongest chamber) pumps oxygen-rich blood to the rest of the body. The left ventricle's vigorous contractions create blood pressure. The human heart has four chambers: two upper chambers (the atria) and two lower ones (the ventricles), according to the National Institutes of Health. The right atrium and right ventricle together make up the right heart, and the left atrium and left ventricle make up the left heart. A wall of muscle called the septum separates the two sides of the heart.

ICT integration as the process of determining where and how technology fits in the teaching and learning situation. Worldwide research has shown that ICT can lead to improving students' learning as well as better pedagogical practices. Bingimlas, (2017) indicated that technology is widely used in this current society, most especially for teaching and learning. This is because modern technology offers many tools that can be used in the classroom to improve teaching and learning. Woo and Reeves, (2017) noted that technology has great potential to increase learners' motivation, link learners to various sources of information, support interactive learning, and allow teachers more time for facilitation in the classroom. Integrating ICT into teaching and learning has become a great concern for educational stakeholders

Automated instructional materials frequently seek to mimic the best practices of one on one human tutors to drive improved student learning outcomes in a manner that is both scalable and cost-effective. Imagine next-generation learners having access to both automated and human sources of instruction in a variety of learning contexts. It will be most effective if students can be assisted to appropriately navigate between these sources of instruction. For example, human tutors, when helping a struggling student, might benefit from having access to the learning profile an automated tutor possesses on the student, including what the student already knows, detected misconceptions, inferred effective state, and details about the student's work with the automated system before requesting human help.

Models are direct replicas of real objects or figures. 3-dimensional instructional models are those instructional materials that have length, breadth, and depth/height. The reasons for using models in teaching and learning as a result of insufficient certain real objects, model of such objects can be produced to give equal opportunity to the students. Non-availability of the object in the immediate environment that is if the object is not available in the community where the school is located model of the object can be produced for teaching; if the objects or figures are not accessible; where the object is too large to be brought to the class for use as instructional materials; when the objects or figures are immovable or too heavy to carry to the class for the student to visualize; if the original objects are too expensive to purchase just for class instruction.

In the statement of problems, Empirical evidence such as Samikwo, (2017) and Awolaju, (2016) reveals those factors that could be responsible for the poor performance of students in biology as lack of practical experience in the teaching and learning of biology that leads to poor mastery of important scientific skills and concepts. Among other factors that could be responsible for this failure, is the unavailability of instructional materials coupled with teachers' attitude towards the utilization during classroom teaching and learning situations, instructional materials which definitely must have a significant role to play in teaching and learning processes. Nneamaka, (2018) also concluded that Nigerian schools at all levels are lacking the essential teaching materials, especially for science practical classes. This, no doubt, affects the learning process. Most secondary schools lack science materials, hence, the students only cram theoretical steps rather than carrying out the practical. 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 3-dimensional automated model of the human heart to help students have direct access to what they have learned or heard in the classroom, enhance the teaching of the topic Structure of Human Heart.

In the research questions, this study provided answers to the following research questions:

1. What are the educational technology experts' ratings for validation of the developed 3-dimensional automated model of the human heart?
2. What are the biology education experts' ratings for validation of the developed 3-dimensional automated model of the human heart?

Several research instruments are in the following:

1. Educational Technology Experts' Rating Scale (ETERS): The Educational Technology experts' rating scale was adapted from Oyesiji (2017) to guide the researcher in ascertaining the opinions of respondents on whether the developed model conforms with the acceptable standards and procedure in the fields of Educational Technology. The instrument was used to validate the developed 3-Dimensional model of the human heart. The instrument also contained a 4-points Likert scale (Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1).
2. Biology Education Experts' Rating Scale (BEERS): Biology Education experts' rating scale was developed to guide the researcher to ascertain the opinions of respondents on whether the developed model conformed with the acceptable standards and procedure in the Biology Education department. The instrument was used to validate the developed 3-Dimensional model of the human heart. it also contained a 4-points Likert scale (Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1).

The validity and reliability of the instruments are in the following:

1. Educational Technology Experts' Rating Scale (ETERS): The instrument was validated for face and content validity by three lecturers within the Department of Educational Technology, University of Ilorin, Nigeria. Following the lecturers' validation reports, some items of the research instrument were corrected, adjusted, and modified as directed to reinforce the validity. This was used to ascertain experts' opinions on whether the developed model conformed with the acceptable standards and procedures in the fields of Educational Technology. A pilot study was administered from Kwara State University, Nigeria for the reliability of the research instrument. The research instrument was reliable at 0.84 at 0.05 level of significance, using Cronbach Alpha SPSS statistical tool.
2. Biology Education Experts' Rating Scale (BEERS): The researcher-designed biology education experts' rating scale was validated for face and content validity by three lecturers within the Department of Educational Technology, University of Ilorin, Ilorin, Nigeria. Following the lecturers' validation reports, some items of the research instrument were corrected, adjusted, and modified as directed to reinforce the validity of the instrument. A pilot study was administered from Kwara State University, Nigeria for the reliability of the research instrument. The research instrument was reliable at 0.84 at 0.05 level of significance, using Cronbach Alpha SPSS statistical tool.

2. METHODS

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 a 3-dimensional automated model of the human heart 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 in 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 percentage scores 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 3-DAMHH. Three educational technology experts with a total of 50% (2 male 33.3% and 1 female 16.75%) and biology education experts with a total of 50% (2 male 33.3% and 1 female 16.75%). This implies that one-third of both respondents are female while two-third of the respondents are male. It shows that an equal number of educational technology and biology education experts participated in this study.

Table 1. Demographic information of the expert participants.

Respondents	Gender		Frequency	Percentage (%)
	M	F		
Educational Technology Experts	2	1	3	50
Biology Education Experts	2	1	3	50
Total			6	100

3. RESULTS AND DISCUSSION

3.1. Research Question 1: What are the educational technology experts' ratings for validation of the developed 3-dimensional automated model of the human heart?

The Educational Technology Experts rating for the validation of the 3-Dimensional Automated Model of Human Heart was carried out by three experts. The experts rating scale contains 15 items respectively. The percentage of the rating of each of the items and overall percentage scores of the three experts is shown in **Table 2**. From **Table 2**, the percentage score of the three Educational Technology Experts' ratings for the validation of the 3-DAMHH (SA = 46.7%, A = 53.3%) shows that the developed 3-DAMHH satisfied the required standard. The reason being that all the items were agreed and strongly agreed upon by the three experts, none of the experts disagree or strongly disagree on any of the listed items.

Table 2. Percentages of the educational technology experts' rating for the validation of the 3DAMHH.

S/N	STATEMENTS	SA(%)	A(%)	D(%)	SD(%)
A	Evaluation of the Content				
1.	The content is adequate	1(33.3)	2(66.7)	-	-
2.	The concept is relevant to learners' need	2(66.7)	1(33.3)	-	-
3.	Information relevant to age group curriculum	1(33.3)	2(66.7)	-	-
4.	The content has durability over time	1(33.3)	2(66.7)	-	-
5.	The model will enhance the presentation of the concept	3(100)	-	-	-
6.	The model covers the topic structure of the human heart	1(33.3)	2(66.7)	-	-
7.	The model contains detailed and accurate information about the human heart	1(33.3)	2(66.7)	-	-
8.	The model has the resemblance to the human heart	1(33.3)	2(66.7)	-	-
B	Evaluation of the Design				
9.	The design of the model can enhance students retention ability	1(33.3)	2(66.7)	-	-
10.	The design and structure of the model is clear and understandable	1(33.3)	2(66.7)	-	-
11.	The color of the model will motivate and arouse learners' interest throughout the instructional process	1(33.3)	2(66.7)	-	-

Table 2 (Continue). Percentages of the educational technology experts' rating for the

validation of the 3DAMHH.

S/N	STATEMENTS	SA(%)	A(%)	D(%)	SD(%)
12.	The quality of the model is good	1(33.3)	2(66.7)	-	-
13.	The structure of the model would motivate learners on the topic	1(33.3)	2(66.7)	-	-
C	Design Factor: Interactivity				
14.	The model can aid students and teacher interaction	3(100)	-	-	-
15.	The 3-d perspective of the model allows for students to interact with the model	2(66.7)	1(33.3)	-	-
	Total	21(46.7)	24(53.3)	-	-

3.2. Research Question 2: What are the biology education experts' ratings for validation of the developed 3-dimensional automated model of the human heart?

The Biology Education Experts rating for the validation of the 3-Dimensional Automated Model of Human Heart was carried out by three (3) experts. The experts rating scale contains 14 items respectively. The percentage score of the rating of each of the items and overall percentage scores of the three (3) experts is shown in **Table 3**.

From **Table 3**, the percentage score of the three Biology Education Experts' ratings for the validation of the 3-DAMHH shows that the developed 3-DAMHH satisfied the required standard in the field of Biology (SA = 78.6%, A = 21.4%). The reason being that all the items were agreed and strongly agreed upon by the three experts, especially in the aspect of strongly agree none of the experts disagree or strongly disagree on any of the listed items.

Table 3. Percentages of biology education experts' ratings for the validation of the 3-DAMHH.

S/N	STATEMENTS	SA(%)	A(%)	D(%)	SD(%)
1.	The content in the developed model is in line with the biology curriculum	2(66.7)	1(33.3)	-	-
2.	The use of the developed model of the human heart to teach a biology concept will stimulate learners' interest	3(100)	-	-	-
3.	The developed model of the human heart can concretize the abstraction in biology teaching	2(66.7)	1(33.3)	-	-
4.	The developed model of the human heart can motivate and arouse learners' attention throughout the instruction process.	2(66.7)	1(33.3)	-	-
5.	Presentation of the model of the human heart will enhance understanding of the topic by the students	2(66.7)	1(33.3)	-	-
6.	The developed model is structure to perform the different tasks to aid learners' understanding of the topic	2(66.7)	1(33.3)	-	-
7.	The developed model is adequate and can help achieve the stated objectives of the lesson	3(100)	-	-	-
8.	The selected concept is drawn from the SSII biology syllabus	3(100)	-	-	-
9.	The labeling of the model is adequate	3(100)	-	-	-
10.	The model has a resemblance to the human heart	3(100)	-	-	-
11.	The model can be used as the improvised human heart in Biology practical classes	3(100)	-	-	-
12.	The model will allow Biology teachers to demonstrate creative skills	2(66.7)	1(33.3)	-	-
13.	The model could enhance guided discovery for Biology students	1(33.3)	2(66.7)	-	-
14.	The model is a faster means of enhancing effective teaching and learning processes	2(66.7)	1(33.3)	-	-
	Total	33(78.6)	9(21.4)	-	-

3.3. Discussion of Findings

The results of the experts' validation of the 3-DAMHH by subject and content experts', three Educational Technology Experts, and three Biology Education experts revealed that the developed 3-DAMHH satisfied the required standard and can be used to achieve the stated objectives. The quantitative analysis of the content and subject experts' responses to the content, design, interactivity, motivational value, and curriculum support indicated that they generally agreed with all the statements in the questionnaire. Responses of educational technology experts to the validation of 3-DAMHH indicated that the content, design, and structure of the model were strongly agreed and agreed which confirmed that the design and development of the instructional model conform to the standard of educational technology. The results of the biology education experts had a positive perception toward the use of the 3-DAMHH for instruction. Thus, experts' overall assessment of the effectiveness of the model for instruction was high, suitable, and found to be adequate.

4. CONCLUSION

The results obtained from the data gathered and analyzed in this study show that the 3-DAMHH can enhance the teaching and learning of biology. This study demonstrated the various stages of validating a 3-Dimensional Automated Model of the Human Heart. Lack of practical experience in the teaching and learning of Biology that leads to poor mastery of important scientific skills and concepts could be among those factors responsible for poor performance in Biology. A 3-dimensional automated model is a step forward in this direction; it enables students to have direct access to what they have learned or heard on the conceptual structure of the human heart.

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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