DEVELOPMENT AND VALIDATION OF EDUTAINMENT INSTRUCTIONAL PACKAGES FOR TEACHING BIOLOGY AT SENIOR SECONDARY SCHOOL IN NIGERIA

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Abstract

This study was conducted to develop and validate Edutainment Instructional Package on Biology for teaching senior secondary school students in Nigeria. The WAEC (2015) reported poor performance of students who sat for West African Secondary School Certificate Examination (WASSCE). Several reports revealed the causes for poor students' performance to include: conventional teacher-centred instructional methods, abstract nature of some science concepts and resistance to employing innovative teaching strategies that will curb poor performance in science. Therefore, for Nigeria as a nation to be an active player in this technological era where students use devices that combine education with entertainment to learn, it becomes necessary to develop and validate edutainment instructional packages that can be used to tackle some concepts that students have learning difficulties especially in Biology such as ecology. The first package was developed using HTML, CSS and JavaScript Language while the second package was built with action script 3.0. The packages were developed using ADDIE model. The validation was done in three stages: content validation (biology university lecturers, secondary school biology teachers and examination bodies); expert's validation (computer programmers and educational technology experts) and field trial validation (one-on-one validation by students). The observations, comments and suggestions during the validation were used to modify the package. After the package, development and validation were found to enhance students' performance in ecology concept.

Keywords: Edutainment Instructional Package; Ecology; Biology;

Computer-Supported Collaborative Learning; Secondary School; Nigeria.

Introduction

The teaching of science subjects in Nigeria public schools is mostly done using conventional method and this was identified as one of the major causes of students' poor performance in Biology. Several kinds of research have indicated that students have learning difficulties in science subjects and ecology is one of the concepts in Biology they find difficult to understand. The West African Examination Council (WAEC) Chief Examiners Report (2007, 2015) revealed that only a few candidates attempted questions on ecology and they exhibited a poor understanding of the concept. Given this, the conventional classroom instruction usually employed by secondary school teachers have been defective and that constitute to the poor performance of students in sciences. Students are expected to acquire scientific knowledge and skills that will enable them to gain job opportunities in this 21st century where some science, technology, engineering

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and mathematics are the baseline. There is, therefore, a gap between the observed classroom instruction and the expected demand in the technological era, which this study sought to fill by developing and validating Edutainment Instructional Packages.

Edutainment is a learning process designed to make education and entertainment to be combined harmonically to make fun learning (Katsaliaki, Korina & Mustafee, Nakonil, 2014). It is a multimedia package made up of visual text, verbal narration supplemented by simulation or animation and games in form of "Who Wants to Be a Millionaire (WWTBAM)". These have the potential to enhance learning. Edutainment Instructional Package of this nature enables students to learn at their own pace. It was developed to be interactive so that the students can become active participants of their learning process. The nature of this process is to make a fun learning to make students interested in learning. Edutainment supports students to succeed the learning by optimizing their potential. Aksakal (2015) further opined that the idea underlying edutainment is to promote learning by merging educational contents and entertainment activities that increase engagement, emotion, and motivation. Edutainment is, therefore, engaging entertainment and media-based materials to promote the learning process where students can only proceed after mastering a giving concept before proceeding to another one. The packages are portable, so students can download them in their laptops, mobile phones, in flash/ CD drives, tablets and other devices that will help them learn at home at any convenient time or place. By so doing, poor performance in science and Biology, in particular, will be eradicated.

Rawda (2015) investigated the usage of edutainment (games and animation films) in vocabulary learning for some intermediate students. The result reveals that students in the experimental group generally preferred online learning supplemented with digital educational games and animation films to conventional activity-based lessons. In the same way, Ruby and Joyce (2016) carried out a study on the effect of using Edutainment to Facilitate Mathematical Thinking and Learning. It was found that students performed better using edutainment than those taught with a conventional method.

Based on the above, this study focused on the development and validation of Edutainment Instructional Package on Biology for teaching senior secondary school students in Nigeria.

Purpose of the Study
The main purpose of this research was to transform the Biology content of the Nigerian secondary school Biology curriculum into edutainment instructional software. Specifically, this study sought to find out if:
1. the design of the EIP conformed to acceptable standards of Biology teachers, educational technology experts and computer programmers.
2. the development of the EIP conformed to acceptable standards of Biology teachers, educational technology experts and computer programmers.
3. the content of the developed Edutainment Instructional Package (EIP) sufficiently and appropriately covered the chosen areas of biology (ecology) sequentially.

Research Questions

1. Does the design of the EIP conform to acceptable standards of Biology teachers, educational technology experts and computer programmers?
2. Does the development of the EIP conform to acceptable standards of Biology teachers, educational technology experts and computer programmers?
3. Does the content of the developed Edutainment Instructional Package (EIP) sufficiently and appropriately cover the chosen areas of biology (ecology) in a sequential manner?

Methodology

Development of Edutainment Instructional Package (EIP)
Edutainment Instructional Package (EIP) for senior secondary Biology is a design-based approach. It is a form of computer-assisted instructional package developed by the researcher and a programmer using ADDIE model instructional design. The stages of ADDIE model is shown in figure 1.

The ADDIE Model Instructional Design

| Analysis | Design | Development | Implementation | Evaluation |
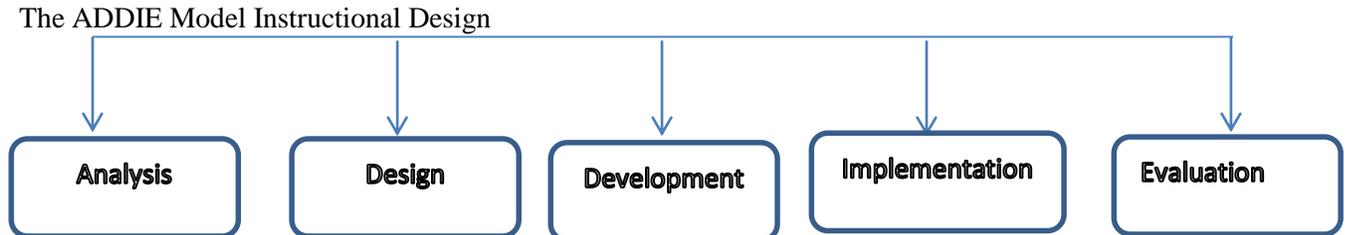
 The stages of ADDIE include: Analysis, Design, Development, Implementation and Evaluation and were sequentially followed in the development of EIP:

Interview: Some students were also interviewed orally to determine their preference and interest in the package. During the interview which was recorded, all the SS1 biology students interviewed agree that EIP is an awesome package that enhanced their understanding of ecology concept of biology.

Validation of Instrument
The instrument used for field trial validation of the package was a researcher-developed questionnaire. All the items in the instrument were constructed to elicit responses from various validators (expert, teachers, computer specialists, educational technology specialists and students) concerning the use of the package. The questionnaire was divided into six parts, namely, content, interactivity, navigation, feedback, screen design and students' preference toward the use of interactive EIP package compared to normal classroom instruction methods of learning. The 4-point Likert scale consisting of 30 questions was used in the questionnaire, namely, 4 as Strongly Agree, 3 as Agree, 2 as Disagree and 1 as Strongly Disagree.

Procedure for Validating the Edutainment Instructional Package (EIP)
The validation of EIP was done in three stages: (i) content validation (biology specialists); (ii) experts validation (computer programmers & educational technology experts); and (iii) field validation trial (individual learners).

Contents Validation
The biology contents of the package were validated by four biology experts from Ahmadu Bello University, Zaria and Federal University of Agriculture Umudike, three subject officers from National Examination Council (NECO), measurement and evaluation expert from NECO, and three biology teachers from three secondary schools in Abuja before the package were developed. They were requested to carry out the validation of the contents of the instrument by ensuring that all items were derived from the content that would be presented to the students. The face validity concerning the background of the students was also considered. Subject matter of the EIP adequately and sufficiently covered the Nigerian secondary school Biology curriculum. After the package was developed, it was validated to determine the appropriateness of the package for teaching the chosen topics; clarity and simplicity of the packages as well as its suitability for the level of the students; the extent to which the contents cover the topics they are meant to cover; possible errors in suggested answers; and the structuring of the package. After the validation, some sentence errors and spelling mistakes were corrected. Some paragraphs and formatting errors discovered were also

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corrected. The test items and contents of the package were also corrected and modified based on suggestions and recommendations of the experts.

Expert Validation

The developed package was given to four computer programmers to determine the appropriateness of the package in terms of language, typography, legibility, navigation, interface, animations, functionality, packaging, and durability. Their suggestions and commendations were used for modifying the package. Similarly, five educational technology experts were requested to validate the package in terms of its suitability for instruction, simplicity, unity among illustrations, emphasis on key concepts, colour use, and text. The experts' comments were used to correct some mistakes while their suggestions were used to improve the package. Based on the experts' suggestions some of the font sizes were increased, some background colours were changed to avoid distraction; the package was burned on CD, copied in flash-drive to ensure good storage.

Field Trial Validation

The Edutainment Instructional package (EIP) was trial-tested on 39 SS1 Biology students from a selected senior secondary school in Abuja. The 39 students from an intact class of the school were made to watch the video (simulation package) and play the Who Wants to be A Millionaire (WWTBAM) computer game package installed in the computers in the school computer laboratory. The simulation package consists of the introductory part and four lessons (Lesson 1-4) in this order: Lesson 1: Abiotic and Biotic Factors; Lesson 2: Types of Habitat; Lesson 3: Energy Flow; Lesson 4: Food chain and Food web.

The lessons in the package were assigned to each student to watch a video projected in the computer laboratory. The Game Package (WWTBAM) on the other hand consists of 15 questions that were played by individual student after watching the simulation package to test the students' understanding of the package. The sampled students were exposed to Biology using the EIP for 80 minutes duration per lesson which lasted for three days. The students were allowed to work on the computer systems to ensure the functionality of the package in terms of content visual quality, interactivity, navigation, and feedback from the game package, screen design, students' preference towards the package and general attitude to the package. At the end of this stage, a 30-item questionnaire consisting of tables 1-6 was administered to the students and retrieved immediately after they had responded to it. Some students were also interviewed orally to determine their preference and interest in the package. The students' responses were analysed using simple percentages.

Results

Research Question 1

Does the design of the EIP conform to acceptable standards of Biology teachers, educational technology experts and computer programmers?

Analysis: This is the need/task analysis stage. At this stage, the researcher has seen the poor performance of students in Biology and having looked at the WAEC chief examiner's report on some of the concepts that students fail such as ecology. Therefore, the researcher decided to seek for a way to improve the students' performance in ecology concept of biology. From the researcher's experience as a teacher, most students prefer to learn in a conducive environment by combining education with entertainment. The necessity for a researcher-made edutainment instructional package was based on the fact that Edutainment Instructional Package was not commonly developed/produced and used for teaching and learning in Nigeria. Even when they are available, they may not be suitable for Nigerian curriculum. As a result of this, developing an edutainment instructional package for biology instruction by the researcher to enhance effective teaching of biology becomes necessary.

Design: This is the second stage in the development of EIP. In this stage, biology scheme of work on ecology began was used to prepare the content of the chosen concept. From the prepared ecology concept, Biology Edutainment Achievement Test (BEAT) was developed based on SSI Biology curriculum on Ecology concept covered in the EIP. To elicit response from students during the field trial validation of the package, a researcher-developed questionnaire was used. Furthermore, all the items in the questionnaire were constructed to elicit responses from various validators (expert, teachers, computer specialists, educational technology specialists and students) concerning the use of the package. The questionnaire was divided into six parts, namely, content, interactivity, navigation, feedback, screen design and students' preference toward the use of interactive EIP package compared to normal classroom instruction methods of learning. The 4-point Likert scale consisting of 30 questions was used in the questionnaire, namely, 4 as Strongly Agree, 3 as Agree, 2 as Disagree and 1 as Strongly Disagree.

Research Question 2
Does the development of the EIP conform to acceptable standards of Biology teachers, educational technology experts and computer programmers?
In answering this question, the processes of developing EIP using ADDIE model were discussed.

Development Stage: The development of EIP simulation/game package is two-in-one package, developed by the researcher and a computer programmer. The simulation package was developed using HTML, CSS and JavaScript languages. These languages are general-purpose scripting language used to develop dynamic web applications and in which various simulated and animated contents can be embedded. The game package, on the other hand, was built with action script 3.0. Action script is an object-oriented programming language originally developed by Macromedia Inc (later acquired by Adobe Systems). It is influenced by HyperTalk, the scripting language for HyperCard. Action Script is primarily for the development of websites and software targeting the Adobe Flash Player platform, used on Web pages embedded in SWF files. The simulation package contained four topics which were subdivided into four lessons: Lessons one, two, three and four respectively. The main menu of the package consisted of introduction and logout.

The game package termed (WWTAM) developed to access the students on the ability to retain and recall what they have learnt consists of fifteen (15) questions. This package allows students to log in and logout at any time they want to use the package. Its' Next' button allows the students to move to the next question, while the restart game allows the students to start the game again after failing a question.

Implementation Stage: Immediately after the content expert validation by biology teachers, subject officials from external examination body and test measurement experts is done, implementation stage begun. The EIP was pilot tested on 46 randomly selected SS1 Biology students from a selected secondary school in Abuja. Before the administration of BEAT, 124 questions were extracted from past questions paper on ecology and 50 were found suitable to form the final BEAT. Each of the questions of the BEAT had four options (A - D) as possible answers to the question. Students were required to indicate their correct answers by ticking one of the letters (A - D) that corresponds to the correct option in each item. On the scoring of the multiple-choice items, '1' was awarded for each correct answer and '0' for each wrong answer. The test was administered once on the pilot samples. After the test, the data obtained from the pilot study were analysed using Pearson Product Moment Correlation Coefficient and 0.78 reliability coefficient was obtained which was considered adequate for the research study.

The instrument used for field trial validation of the package was a researcher-developed questionnaire. All the items in the questionnaire were constructed to elicit responses from various validators (expert, teachers, computer specialists, educational technology specialists and students) concerning the use of the package. The questionnaire was divided into six parts, namely, content, interactivity, navigation, feedback, screen design and students' preference toward the use of interactive EIP package compared to normal classroom instruction methods of learning.

The lessons in the package were assigned to each student to watch a video projected in the computer laboratory. The Game Package (WWTBAM) on the other hand consists of 15 questions that were played by individual student after watching the simulation package to test the students' understanding of the package. The sampled students were exposed to Biology using the EIP for 80 minutes duration per lesson which lasted for three days. The students were allowed to work on the computer systems to ensure the functionality of the package in terms of content (visual quality), interactivity, the navigation, and feedback from the game package, screen design, students' preference towards the package and general attitude to the package.

Evaluation: The BEAT was pilot tested on 46 randomly selected SS1 Biology students. Each of the questions of the BEAT had four options (A - D) as possible answers to the question. Students were required to indicate their correct answers by ticking one of the letters (A - D) that corresponds to the correct option in each item. On the scoring of the multiple-choice items, '1' was awarded for each correct answer and '0' for each wrong answer.

For the EIP, the students were trial tested to work on the computer systems to ensure the functionality of the package in terms of content visual quality, interactivity, the navigation, and feedback from the game package, screen design, students' preference towards the package and general attitude to the package. At the end of this stage, a 30-item questionnaire consisting of tables 1-6 was administered to 39 intact class biology students and retrieved immediately after they had responded to it. The students' responses were analysed using simple percentages. The results of this are presented in Table 1-6.

Content Validation
The content validation of the Edutainment Instructional Package (EIP) for biology in senior secondary students in class one (SS1) was conducted using Content Validation Questionnaire. Eleven specialists in biology which include three secondary school biology teachers, four university lecturers in biology and four biology experts from NECO responded to the questionnaire. The results obtained showed strongly agreed with every statement in the questionnaire. They all agreed that the content of the EIP package covered senior secondary school biology year one syllabus. Other statement items of the questionnaire were strongly agreed and agreed respectively. Their comments, observation, and suggestions on the contents were noted and fully implemented. These include typographical errors such as spelling errors, misrepresentation of words and punctuation marks, among others.

Expert Validation
This includes three experts (each from computer programming and educational technologists units). Three computer programmers were requested to determine the appropriateness of the package in terms of language, typography, legibility, navigation, interface, animations, interactivity, packaging, and durability of the programming language used. They rated each of the statement very good and excellent respectively. However, two of the experts suggested that the food chain should be illustrated in a linear form and not cyclical. Based on the comments and suggestions of the experts, corrections and other recommendations were made.

Field Trial Validation
The EIP was validated by experts and trial-tested on 39 SS1 Biology students from a selected school in Abuja. The 39 students from an intact class of the selected school were made to watch the video (simulation package) and play the Who Wants to be A Millionaire (WWTBAM) game package installed in the computers in the school computer laboratory. At the end of the administration of the package, a validation questionnaire was administered to the students. This questionnaire was collected by the researcher and analysed using simple percentage. All the students were in support of the use of the package for teaching Biology. The results obtained are showed in tables 1-6.

Research Question 3
Does the content of the developed Edutainment Instructional Package (EIP) sufficiently and appropriately covered the chosen areas of biology (ecology) in a sequential manner?

Table 1:
Content in the Package

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	The messages in the package are easy to understand	36 (92.3)	3 (7.7)	0 (0)	0 (0)
2	The content in the package has been well organized (arranged in order)	30 (76.9)	9 (23.1)	0 (0)	0 (0)
3	The images/pictures/illustrations in the package are very clear to me.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
4	The examples used in the various sections of the lessons in the package are relevant.	38 (97.4)	1 (2.6)	0 (0)	0 (0)
5	It was easy to understand the lesson because the information was presented from simple to more difficult one.	33 (84.6)	6 (15.4)	0 (0)	0 (0)
	Total	**82.22**	**10.78**	**0**	**0**

From Table 1, 82.22% of the students strongly agreed while 10.78% agreed that the content of the package was suitable for the learning of Biology. Students liked the content of the package because it is well organized and easy to understand. Therefore, none of the student disagrees with the statement items on the contents of the package.

Table 2:
The interactivity of the Package

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	It is easy to operate the package with computer keys and icons.	27 69.2)	12 (30.8)	0 (0)	0 (0)
2	This package permits me to repeat the section, and exit the lesson at any time.	38 (97.4)	1 (2.6)	0 (0)	0 (0)
3	The frequent display of images/pictures/ illustrations to the learners does not interrupt the learning process.	33 (84.6)	6 (15.4)	0 (0)	0 (0)
4	This package enables me to apply what I have learnt rather than memorize it.	34 (87.2)	5 (12.8)	0 (0)	0 (0)
5	This package allows me to discover information through active learning.	35 (89.7)	4 (10.3	0 (0)	0 (0)
	Total	**85.62**	**14.38**	**0**	**0**

From Table 2, 85.62% of the students strongly agreed while 14.38% agreed that the package was interactive for the learning of Biology. Students liked the package because it enables them to apply what was learnt rather than memorize it. Meanwhile, none of the student disagrees with the statement items on the interactivity of the package.

Table 3:
Navigation of the Package

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	From the main menu, learners are allowed to register his/her name.	38 (97.4)	1 (2.6)	0 (0)	0 (0)
2	The logout key enables me to exit from the lesson/programme.	35 (89.7	4 (10.3)	0 (0)	0 (0)
3	The previous key enables me to revisit the previous section(s) of the lesson.	36 (92.3)	3 (7.7)	0 (0)	0 (0)
4	The next key directs me to go to the next section of the lesson.	36 (92.3)	3 (7.7)	0 (0)	0 (0)
5	The option keys allow me to select the correct option.	38 (97.4)	1 (2.6)	0 (0)	0 (0)
	Total	**93.82**	**14.38**	**0**	**0**

From Table 3, 93.82% of the students strongly agreed that the package option keys allow them to select the correct option while 14.38% agreed. Meanwhile, none of the student disagrees with the statement items on the navigation of the package.

Table 4:
Feedback from the Package

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	This package provides immediate feedback after selecting the option.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
2	This package displays the correct or wrong answer chosen with some sound.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
3	This package allows me to proceed to the next lesson only if the chosen answer is correct.	38 (97.4)	1 (2.6)	0 (0)	0 (0)
4	This package terminates my activities if after one attempt I got the answer wrong.	36 (92.3)	3 (7.7)	0 (0)	0 (0)
5	This package appreciates my efforts by congratulating me after completing the game correctly.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
	Total	**94.88**	**5.12**	**0**	**0**

From Table 4, a total of 94.88% of the students strongly agreed while 5.12% agreed that the package displays the correct or wrong answer chosen with some sound which allows feedback from the package. Meanwhile, none of the student disagrees with any of the statement items on the feedback of the package.

Table 5:
Screen Design of the Package

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	The presentations of the information in the package attract my attention.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
2	The use of proper lettering (fonts) in terms of style and size make the information legible.	29 (74.4)	10 (25.6)	0 (0)	0 (0)
3	The colours used for the various presentations are quite appealing.	32 (82.1)	7 (17.9)	0 (0)	0 (0)
4	The quality of the text, images, graphics and video are interesting.	35 (89.7)	4 (10.3)	0 (0)	0 (0)
5	The animations (moving picture) in the package assist in understanding the lessons better.	37 (94.9)	2 (5.1)	0 (0)	0 (0)
	Total	**87.2**	**12.8**	**0**	**0**

Results from table 5 shows that 87.2% of students strongly agreed on the nature of the screen design of the package while 12.8% agreed. They also agreed that the presentation of information is attractive. Meanwhile none of the respondents had a negative view on the statement items concerning the screen design of the package.

Table 6:
Students' Preferences toward the use of the EIP Package Compared to Traditional Methods of Learning

S/No	Statement	Response			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	I prefer to learn Biology with an interactive package like EIP with a teacher acting as a facilitator.	35 (89.7)	4 (10.3)	0 (0)	0 (0)
2	Learning Biology with an interactive package is more preferable than using textbooks.	33 (84.6)	6 (15.4)	0 (0)	0 (0)
3	The activities provided in this package are more effective compared to normal classroom instruction.	33 (84.6)	6 (15.4)	0 (0)	0 (0)
4	I will suggest to my friends to use Edutainment Instructional Package in learning Biology instead of textbooks.	30 (76.9)	9 (23.1)	0 (0)	0 (0)
5	I prefer the use of this instructional method than normal classroom instruction.	35 (89.7)	4 (10.3)	0 (0)	0 (0)
	Total	**85.1**	**14.9**	**0**	**0**

Results from table 6 shows that 85.1% of students strongly agree while 14.9% on the use of Edutainment instructional package than normal classroom instruction. They also agreed that the activities provided in this package are more effective compared to normal classroom instruction. Meanwhile, none of the student had negative view on the preference towards the use of EIP.

Discussion of Findings

The ADDIE instructional design model adopted for this study has been considered by other researchers to be the most commonly used by researchers like (Shibley, Amaral, Shank, & Shibley, 2011, Bolaji, 2016). The usage by previous studies made it suitable for edutainment as an instructional in the package for teaching Biology. However studies conducted by Anunobi, Gambari, Alabi, and Abdullahi (2017), Olafare, 2011 adopted other Instructional Design models like Dick and Carey instructional system design model, Recursion, Reflective, Design and Development Model. The simulation package of EIP was developed using HTML, CSS and JavaScript languages. This is in line with the study of Gambari and Yusuf (2014) that developed and validated a computer instructional package on physics for secondary schools in Nigeria. They used Macromedia Dreamweaver 8 in addition to Microsoft Word, Macromedia Fireworks 8, and Macromedia Flash 8. Also in the same direction with the study conducted by AlSultan, Lim, MatJafri, and Abdullah (2006) that developed a CAI package on remote sensing processing using Macromedia Flash. The EIP was rated very positive by experts and students thus confirming its suitability and appropriateness for teaching and learning of ecology concept in Biology. The results from the experts and students agree with Adekunle (2008) who noted that when students are given the chance to learn through more senses than one, they learn faster and easier.

Conclusion

After the development and the validation of the EIP package to determine its suitability for teaching ecology to SS1 biology students, it was revealed that students' performance in biology increased as each student actively participated in the learning process. This enabled the researcher to conclude that EIP will be very useful for better students' achievement in biology and that EIP can be used to minimize the belief that some concepts in biology are difficult to teach by teachers and learn by students.

Recommendations

Based on the findings of this study, the following recommendations were made:
1. Teachers should adopt EIP for classroom instruction as it is student-centred instruction that engages the students to learn better.
2. Teachers should be trained on how to develop and use innovative technologies like EIP to facilitate better teaching and enhance students' academic achievement.
3. The government should make the fund available to school management to develop EIP in any subject area since students' academic achievement and retention could be enhanced through this medium of instruction.

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