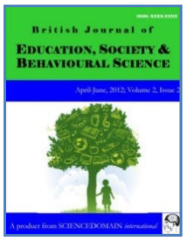

British Journal of Education, Society & Behavioural Science
4(2): 201-210, 2014

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Effectiveness of Animation and Multimedia Teaching on Students' Performance in Science Subjects

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Authors' contributions

This work was carried out in collaboration between authors OOT and OOI. Author OOI designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Author OOT worked on the analyses of the study, the literature searches and general corrections. The two authors jointly approved the final manuscript.

Case Study

Received 18th February 2013
Accepted 5th July 2013
Published 4th November 2013

ABSTRACT

This paper presents the effect of animation and multimedia teaching on academic performance of students in sciences.100 students were randomly selected from four secondary schools in Ado Ekiti Local Government Area of Ekiti State. The research design employed for this study was quasi- experimental research design of two groups' pre test, post test control design. The study lasted for the period of six weeks due to the experimental nature of the research. The pre test was administered to all the participants in other to be sure of their homogeneity. The treatment was administered to the experimental class with the use of cartoon style animation and multimedia teaching and the second group was taught with conventional teaching approach. The pre-test and post-test scores of the students in the conventional and multimedia teaching group were used for the purpose of data analysis. The results were analysed using t-test, three hypotheses were postulated. The result showed that (i) t- calculated (1.89) < t-table value (2.01), (N=100, $\ddot{x}$ (19.50, 20.26), SD (5.02, 5.79), Df= 98) which confirmed the homogeneity of the two groups at the pre-test (ii) t-calculated (6.12) is greater than the t-table (1.98), (N=100, $\ddot{x}$ (23.92, 50.66), SD (4.73, 6.43), Df= 98) which confirmed the effectiveness of the treatment of

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animation on the performance (iii) t- calculated (0.09) is lesser than the t-table value (2.00) (N=50, $\bar{x}$ (23.42, 23.92), SD (3.86, 4.73), Df= 48) which confirmed no significant difference in the performance of male and female students at 0.05 level of significance,. The findings therefore revealed that there was a significant different in the performance of students exposed to cartoon style multimedia teaching and those that are conventionally taught. It was therefore recommended that the use of cartoon style animation and multimedia teaching should be encouraged so as to complement other methods of teaching science in schools and colleges.

Keywords: Animation; audio visual; cartoon style; computer; multimedia; science; synchronized.

1. INTRODUCTION

Science and technology education form the foundation for sustainable national development by protecting human societies from ignorance, illiteracy, disease and poverty [1]. The teaching of science starts from nursery through primary to secondary and tertiary institutions. The knowledge acquired from the elementary stage is the basis for some courses as such medicine, biochemistry, microbiology, zoology, botany and environmental sciences. Science education is meant to expose the learners to scientific nature (facts, principles and concepts), processes, attitudes and then equip learners with skills of professional scientist. The objectives of the science curriculum as provided in the National Policy of Education [2] include; adequate laboratory and field skills in science, meaningful and relevant knowledge, ability to apply scientific knowledge to everyday life. Science curriculum has developed a package of animation and multimedia teaching, an indication that science and technology has gone beyond their conventional approaches into the use of animation teaching for schools and colleges.

Teachers play vital role in the implementation of the curriculum; their responsibility is to ensure that science students attain national goals. Incidentally, the learners have their peculiar characteristics which may manifest special learning needs [3] Learners expect that the materials and method of instruction should be easily transferable to the real world. Thus, the task of the teacher includes, among others, to provide the materials and experiences to aid learning and meet the learner's expectations [4]. Basically, learning *from* multimedia sees the audio- visual and synchronized system as tutor.

[5] emphasized the use of computers for educational purposes, which have become increasingly common. The development which has shifted education from mere acquisition of declarative knowledge and skills to the application of conceptual and integrated knowledge so that science students are better able to apply their knowledge to a friendly, expensive, novel situation in which learners must perform [6]. The application of dynamic visualization such as animation is potentially well suited for learning contents and is not easily affordable in classroom settings. Such teaching can be made real through multimedia in such that instruction would be simplified and appreciated.

The volume of knowledge is increasing exponentially in the 21st century. The teachers in sciences teach efficiently when there is a collaboration of methods. However, it would be short-sighted to focus only on the traditional way of chalk and talk approach since the world is dynamic in technology. According to [7] higher order thinking is born out of passion for

knowledge than the simple recall of facts. It is a function of interaction between synchronized system and teachers' guidance that make multimedia teaching works.

Multimedia teaching (MM) embraces the use of animation and cartoon style for its effective delivery. Multimedia approach can be used in teaching basic science subjects like Biology, Chemistry, Physics and Mathematics. Multimedia involves the use of two or more different types of animated instructional media in a presentation [8] Supporting this view,[9] noted that animated teaching involving the use of Video Compact Disc (VCD) Digital Video Disc (DVD), power point or 16mm film. Animation teaching could be in form of lesson presentation, in that, still pictures; text, graphics, motion picture, background sound as well as some narrations are synchronized or combined at the same time in order to enhance learners' understanding of concepts. It also includes the use of interactive elements such as graphics, text, video, sound and cartoon teaching [10,11,12]. On the other hand, since animation is composed of several pictures displayed in sequence and frame which is available for a short period of time. [13] affirmed that processing animated information imposes higher cognitive load due to the temporal limits of its working memory.

Animation teaching is a device that has the features of both audio and visual presentations that are being used in the teaching/learning process for effective dissemination of knowledge; it involves the program or instruction to be delivered which are recorded in a video tape or disc. This method applies to both the sight and hearing senses of the learner thereby fostering the retentive memory and recalling ability of the learners. Animation teaching is able to use information from figurative point of view (i.e using an imagery representation rather than a symbolic description of facts) to build internal representation of phenomenon as supported by [14] Animation may be described as the rapid succession of pictures indicating a series of slides, appearance and disappearance of iconic element continually.

Despite the innovation in science [15] discovered that the rate at which science students do shift to arts and commercial subjects is alarming. All efforts to attract prospective students to science appear to be inadequate because students' performance in science is still not satisfactory. Hence, he suggested two programmed instructional strategies; Computer Assisted Instruction (CAI) and Video Tape Mediated Instruction (VMI) for teaching science subjects in secondary schools. The use of animated materials such as cartoon instruction reduces the learning task and time; it creates room for consistency and learning mastery by increasing retention, safety and motivation. Learners enjoy interactive learning through cartoon teaching since it is efficient, effective and flexible. It facilitates communication and appeals to senses of sight and hearing at the same time, it provides concrete basis for the comprehension of abstract concepts and makes for a more meaningful and permanent learning [16,10] With the advent of the internet and electronic learning that can be communicated over the World Wide Web, teachers now have several new and exciting ways to present information. The cartoon style allows the incorporation of animation, moving pictures, and sound into lessons, which extends teachers abilities to present materials that encourage student interaction with the subject matter. Pictures and animations help bring to life scientific principles, and multimedia allows students to take a more active role in learning: they can watch experiments in action, see microorganisms up close, and use a mouse or keyboard to navigate images, simulations and interactive materials.

According to [17] the use of audio-visual aids in sciences has been found to be an effective way of communicating ideas and concepts to students. Literature has also established that audio-visual-aided instruction has greatly improved the performance of students in science

especially those with special needs and slow learners [10,18,19]. However, some teachers are not flexible with the use of multimedia and audio-visual aids when teaching physics, chemistry, basic sciences, technology and computer science. Some teachers find it quite complex to use audio-visual aids to complement the traditional lecture method while others see the use of multimedia as waste of time. Animated teaching is an effective instructional medium which the teacher can use to deliver learning experiences to science students. This paper therefore examines the effect of synchronized animated teaching on science students' academic performance.

Several criticisms have been raised on the sexes that enjoy animation viewing in relation to learning. The learners have no control over the pace of presentation of animation, which involves disappearance and appearance of images and information. Psychologist believes that a particular sex has an advantage over the other in spatial reasoning test, verbal or oral test. [20] opined that the interactive principle of male students on multimedia is higher than that of their female counterparts, which in turn affect their academic performance in science subject. In addition, learners that are engaged in presentation may suffer other personal problem such as audio (hearing) and visual (sighting) problems. Many factors in and outside the classroom results in girls being turned away from computer technology [21]. These factors include the media depicting men as experts in technology, societal expectations of different goals for boys and girls. [22] applied animation module on gender and found that the gain in the mean for the female was 37 points, while the gain in animation knowledge and skills for the male was only 16 points. [23] declared that the user interaction with multimedia can be beneficial by allowing the segmentation of the presentation into chunks that will be more easily organized into a mental model.

Active selection of relevant information is cognitively demanding [20] Individual differences in learning can be attended to through animation teaching, although the socio economic background of the learners cannot be overlooked while trying to juxtapose gender influence on animation teaching. In general, socio-economic family background affects students' academic achievements. Students with low socio-economic family background often get lower test scores and are more likely to drop out of school than students with high socio-economic family background [24,25]

2. METHODOLOGY

The purpose of this research is to investigate the effectiveness of cartoon style multimedia teaching on academic performance of secondary school students' in science subjects in Ekiti – State, and to ascertain whether there is variability in the performance of the students taught with the multimedia approach and those taught conventionally. The study made use of a quasi –experimental research design. The population of this study consisted of all Senior Secondary School Two (S.S.S 2) students in public schools within Ado Ekiti Local Government Area of Ekiti State. The sample was made up of 100 students were selected using stratified random and multi stage sampling techniques. 50 male and 50 female students were selected from four public schools respectively. Treatment in physics test items were given to the students on mechanics and optics; Treatment in chemistry test items were given to the students on mixtures, compound, solubility, acid, base and salt; while in biology, treatment were given to the students on reproduction and excretion.

2.1 Instrumentation and Data Collection

The instrument used for this study was designed by the researchers. The instrument is known to be Science Achievement Test (SAT), which contains 20 items each from physics, chemistry and biology. The instrument consists of sections, A and B. Section A consist of Students Bio-data, Section B consist of 60 multiple choice items with four options (A-D) each, in which 20 items each were drawn from physics, chemistry and biology. The face and content validity of the instrument was ascertained by given the instrument to inter–raters that are physics experts, chemistry experts and biology experts respectively for ratings. The average score of the inter–rater co-efficient yielded 0.82, which is high enough to confirm the validity of the instrument. Test – re- test method was used to obtain the reliability of the instruments and the reliability co-efficient was found to be 0.71 which was high enough to make the instrument reliable.

The study used different types of cartoon for selected topics in the three subjects and also displaced on the slide, compact disk and video for good understanding of the topics. Competent teachers in physics, chemistry and biology were trained for this exercise. The students in group X were taught by using the multimedia method, the second group Y were exposed to traditional lesson in physics, chemistry and biology for six consecutive weeks. The students' scores for pre-test and post test were collected and the hypotheses generated for the study were analysed.

2.2 Research Questions

The following research questions were raised for the purpose of this study.

1. Is there any difference between in the pre test scores of the students taught with conventional and multimedia teaching for solving problems in sciences?
2. Is there any difference between in the post test scores of students taught with conventional and multimedia approaches for solving problems in sciences?
3. Is there any difference between in the post test scores of male and female students taught with multimedia approaches for solving problems in sciences?

2.3 Research Hypotheses

Based on the above research questions the following hypotheses were raised;

HO_1 There is no significant difference between in the pre test scores of students exposed to the conventional and multimedia approach.
HO_2 There is no significant difference between in the post test scores of students exposed to multimedia and conventional approach.
HO_3 There is no significant difference between in performance of male and female students exposed to animation teaching approach.

2.4 Research Design

This study adopted quasi- experimental pre test post test two group design. The experimental group (X) was exposed to multimedia method of teaching using cartoon style, while the conventional group (Y) represent the control group was exposed to usual science conventional approach. The design of the study was as follows;

Experimental group X; O_1 X O_2
Conventional group, Y O_3 Y O_4

Where O_1, O_3; pre test (performance to the two groups)
O_2, O_4 post test (performance to the two groups)
X treatment is given through multimedia approach.
Y conventional method of teaching

2.5 Data Analysis

To test the null hypotheses, t-test was used on the difference between the pre-test mean score and the post-test mean score of science students taught with animated cartoon method. The alpha level of 0.05 was used as the acceptable significant level for rejecting or upholding all the assumptions.

3. RESULTS

3.1 Experiment 1

HO_1**:** There is no significant difference in the pre test scores of students exposed to the conventional and multimedia approach.

To test hypothesis one, pre-test was given to both experimental and conventional class. Table 1 showed that t- calculated (1.89) < t-table value (2.01), (N=100, $\ddot{x}$ (19.50, 20.26), SD (5.02, 5.79), Df= 98) at 0.05 level of significance. Hence, the null hypothesis is therefore upheld. This implies that the two groups selected for the study were homogeneous since there is no different in their performance.

3.2 Experiment 2

HO_2**;** There is no significant difference in the post test scores of students exposed to multimedia treatment and conventional approach.

To test this hypothesis, the performance of students in the two groups after treatment were collated and tested using t-test as presented in the Table 2. Table 2 showed that t-calculated (6.12) is greater than the t-table (1.98), (N=100, $\ddot{x}$ (23.92, 50.66), SD (4.73, 6.43), Df= 98) at 0.05 level of significance; the null hypothesis was therefore rejected, contrary to the hypothesis stated. This implies that there is significant difference in the performance of the two groups. The experimental and the conventional groups were found with differences in the analysis of their performance in favour of the experimental group. The total mean for the treatment group (X) is 50.66 and conventional group (Y) is 23.92 showed that the performance of multimedia group was far better than the performance of conventional group. By implication, the students that were taught with animation teaching outperformed the students that were exposed to the traditional method of teaching. This is an indication that the treatment given to the experimental group is effective and responsible for the differences in the performance of students in favour of the treatment class.

3.3 Experiment 3

HO_3**:** There is no significant difference in performance of male and female students expose to treatment.

Table 3 shows that t- calculated (0.09) is lesser than the t-table value (2.00) (N=50, $\ddot{x}$ (23.42, 23.92), SD (3.86, 4.73), Df= 48) at 0.05 level of significance. Hence, the null hypothesis is therefore not rejected. This implies that there is no significant difference in the performance of male and female students in the treatment group..Therefore sex is not a major issue in learning and understanding science especially when animation method is used. By implication, the use of animation and multimedia teaching is not peculiar to a particular sex, since the performance of male and female are homogeneous. Hence gender differences have no significant influence on the teaching of science with animation.

Table 1. t- test summary on students' pre test score in groups

Variables	N	Mean	SD	t-calculated	t-table
Conventional	50	19.52	5.02		
Multimedia	50	20.28	5.79	1.89	2.01

Df= 98

Table 2. t- test summary on students post test scores in groups

Variables	N	Mean	SD	t-calculated	t-table
Conventional	50	23.92	4.73		
Multimedia	50	50.66	6.43	6.12	1.98

Df = 98

Table 3. t- test summary of the post-test of male and female students exposed to the treatment

Variables	N	Mean	SD	t-calculated	t-table
Female	25	23.42	3.86		
Male	25	23.92	4.73	0.09	2.00

Df = 48

4. DISCUSSION

The findings showed that the animated cartoons that were used to synchronize lesson presentation to the experimental group in science produced greater academic performance in the post-test. Animation teaching therefore enhances learning of science subject. This finding is consistent with those of [17,26,8] that effective and efficient use of animated cartoons in teaching and learning offer both audio and visual messages or information and these appeals to sense of sight and hearing, simultaneously. The study is in line with [27] who demonstrated that animating mechanical systems leads to more efficient knowledge acquisition Students feel a sense of reality in what they learn, which is further supported [1,29] Another finding of [27] was parallel to the initial study on knowledge acquisition and application as well as short term retention is better supported by animated imagery compared to static imagery when teaching human system interactions. A lot of frustrating situations can be saved if our teachers use relevant synchronized animated cartoons during

instructional development, among other efforts. The findings also showed the male and female students were marginal, since the use of multimedia teaching has no effect on the gender. The study is in agreement with [28,27] on the effectiveness of laboratory method of teaching and showed that there was no significant difference in the performance of male and female students in mathematics achievement test. Contrary [29,21] who found that female run away from computer technology classroom and perform poorly in science and technology learning task. The findings is also negated [30,24] who found that male achieved much better than female in application software, awareness, experience, terminology, general programming, word processing and games.

5. CONCLUSION

The use of multimedia teaching via cartoon and animation teaching is an innovative approach for teaching science subject. This method improves the teaching and learning of science subject in schools since students studying science subject performed poorly in their external examination. In an attempt to curb this ugly trend of student failure in science in secondary school, the use of animation would enable the students to retrieve or recall the previously learnt subject quickly and thereby enhance their fortune in teaching and learning science subject. These approach can be effective additions to regular science instruction and can help students visualize unseen phenomena, develop scientific language, improve understanding of the scientific process and contribute to the development of scientific thinking Based on the findings the following recommendations are hereby offered:

(i) Government should procure multimedia devices and organise seminars for science teacher on the need to imbibe latest teaching culture.
(ii) Science teachers should incorporate the use of cartoon style animation teaching to compliment their traditional chalk-talk method of instructional delivery.
(iii) Science teachers should frequently use MM and Animated cartoons during instructional development, especially when it is inevitable.
(iv) School authorities should invite specialists (educational technologists, instructional material technicians, computer experts, etc.) to assist science teachers with their animated cartoon packages that are relevant to the subject.

ACKNOWLEDGMENTS

The authors would like to thank the participants for making this study possible. We also wish to thank our research assistances for their dutiful and effectiveness in ensuring that the film and projector used for the exercise reach the appropriate quarters when needed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=302&id=21&aid=2426