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Impact of Integrating Videos and Animations on Conceptual Understanding of Cardiovascular Anatomy and Physiology. A Case of Applied Science and Technology First-year Students at Mukuba University

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Abstract The problem of difficulties in conceptual understanding of certain topics in Biology has pervaded all levels of education including universities. This study investigated the impact of integrating videos and animations in Applied Human Anatomy and Physiology (BIO 102) lessons on students' conceptual understanding of the Cardiovascular Anatomy and Physiology. The study was an action research conducted by the practitioners to improve practice and the quality of learning. First-year students in the School of Applied Science and Technology taking BIO 102 constituted the target population. The total sample size was 42; 40 females and 2 males. The research design was quasi-experimental, specifically the randomized subjects, pretest-posttest control group design. Purposive sampling was used to select students of interest to the study while subjects were randomly assigned to the control and experimental groups. Data collection was done using a Biology Achievement test and a Likert-type Attitude questionnaire. Descriptive statistics (Means and standard deviations) were used to analyze the data while the independent samples t-test was used to test for any statistically significant difference in the average Achievement in the two groups before and after the experiment. The findings from this study indicate that there is a statistically significant difference in the average Achievement of students' when videos and animations are integrated into the lectures and when they are not. The independent samples t-test in the post-test was significant with t, (39) = 12.708, P> 0.05. It can, therefore, be concluded that integrating videos and animations in Physiology and Anatomy lessons significantly improves conceptual understanding.

Keywords: *cardiovascular anatomy and physiology, conceptual understanding, videos, animations, applied human anatomy and physiology*

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1. Introduction

Applied Human Anatomy and Physiology is perceived to be difficult to learn resulting in high failure rates [19]. Literature indicates that the cardiovascular system which presents challenges to learners at various levels of education such as Junior Secondary, Senior Secondary and, colleges, and universities [18,19]. Relating the anatomical concepts to the physiology of the heart is the major observed challenge at almost all levels of education. Applied Science and Technology first-year students of Mukuba University also appear to have challenges understanding several topics in the Biology course; Applied Human Anatomy and Physiology (BIO 102), and one such topic is the Cardiovascular Anatomy and Physiology. This problem is evident by students' performance in continuous assessments and during sessional examinations in this course. During the 2018 sessional examinations for Open and Distance Learning (ODL) for example, 34% of the candidates who sat for this course cleared. This became a source of concern to the practitioners and the faculty in the Department of Biological Sciences because these students are going to become nutritionists and as such must acquire a meaningful understanding of not only the Anatomy of the heart but also the Physiology to understand the relationship between sound heart health and diet. Lecturing which is a traditional way of teaching is typically the mode of lesson delivery especially in Universities [1,2,3]. The teaching of any subject heart is

directly linked to the nature of the topic and as such, university practitioners ought to take this into account. In other words, conventional methods of teaching such as the lecture method have proved not to be very helpful especially in the 21st century and so modern teaching approaches ought to be explored [11,13]. The practitioners typically makes use of PowerPoint presentations, laboratory method, and group discussions in the teaching and learning of BIO 102. These techniques have not produced the desired results in terms of students' conceptual understanding in this course. The aim of this study, therefore, was to explore the impact of integrating videos and animations in Cardiovascular Anatomy and Physiology lessons on students' conceptual understanding.

1.1. Problem Statement

High failure rates of first-year students in BIO 102 in formative and summative assessments have been a source of concern to the practitioners. During the 2018/2019 Academic year, the pass rate was 65% and 34% for Regular and ODL students respectively. This is a matter that required urgent attention because understanding the form and function of the human body is necessary for the future nutritionists to propose and plan diets for people with various nutrition-related health problems [10]. This study, therefore, aimed at determining the impact of integrating videos and animations in Cardiovascular Anatomy and Physiology lessons on students' conceptual understanding to improve the quality of teaching and learning in this course.

1.2. Objectives

The main objective of this study was to determine the impact of integrating videos and animations in teaching the cardiovascular physiology on students' conceptual understanding. To achieve this objective, the following specific objectives were investigated;

1. To compare students conceptual understanding of the cardiovascular anatomy and Physiology when videos and animations are integrated into the lessons and vice versa
2. To find out the effect of videos and animations on students perceptions of cardiovascular Anatomy and Physiology.

1.3. Research Questions

The study sought answers to the following research questions:

1. What is the effect of integrating videos and animations on students' conceptual understanding of the Cardiovascular Anatomy and Physiology?
2. What is the effect of integrating videos and animations in lessons on students' attitudes towards Anatomy and Physiology?

1.4. Research Hypotheses

H_A1**:** Integrating videos and animations in lectures enhance students' conceptual understanding of Cardiovascular Anatomy and Physiology.

H_A2**:** Integrating Videos and animations in Anatomy and Physiology lessons facilitate the development of positive perceptions towards the content.

1.5. Theoretical and Conceptual Frameworks

This study was informed by Mayer's Cognitive Theory of Multimedia Learning. In this theory, seven principles that can be applied in multimedia messages design have been outlined [12]. The first principle in Mayer's theory is the multimedia principle which states that learning is more effective when words and pictures are combined than using words alone. This suggests that words ought to be accompanied by the pictures they describe for learning to be effective because this allows students' to mentally make connections between the text and the pictures they describe or explain. The second principle is the spatial contiguity principle which explains that, when related words and pictures are presented closer to each other, learning is better and vice versa. When complimentary words and pictures are presented far apart or separately from each other, they are seen as separate components of the lesson making students confused. To this effect, complimentary text and pictures must be presented together and closer to each other. Temporal Contiguity Principle is the third principle in this theory and it states that learning is better when related words and pictures are presented together than concurrently. In other words, the text and appropriate pictures must be presented simultaneously and not one after the other if learning is to be substantive. The Coherence Principle which happens to be the fourth principle suggests that students excel in learning when irrelevant words, pictures, and sounds are removed from lesson presentations and vice versa. In short, the presentation must only include materials relevant to the achievement of lesson objectives otherwise learners' may be lost in the material that is not necessary but was part of the presentation. The Modality Principle is the fifth principle and asserts that learning is better from animation and description compared to animation and on-screen text. This is consistent with Dale's cone of experiences which suggest that the more the number of senses involved in learning, the higher the retention of the learned material. When teaching and learning involve the sense of hearing as well as vision the cognitive process in terms of thinking using mental images is stimulated increasing the probability of learning taking place. The sixth Principle is the Redundancy Principle which affirm that, Students learn well from animation and description than animation, description and on-screen text. Finally, the Individual differences Principle expresses the fact that, design effects are stronger for low-knowledge learners and High-spatial learners than for High-knowledge learners and Low-spatial learners. In this study, therefore, conceptual understanding is seen to be influenced by the method of teaching, students' perceptions towards the material being learned and how well the methods of material presentation are appropriate for the nature of the material being learned [3,4,6,13,15,16]. The nature of Anatomy and Physiology is complex making conceptual understanding difficult [19]. A topic that poses challenges to understand causes students to develop a negative attitude towards it

making learning even more difficult. To address this problem, educators must carefully select teaching methods that take into account the nature of the content. If methods and material for teaching and learning are selected appropriately, learning becomes interesting bringing about the desired kind of learning. This relationship is summarized in Figure 1 below.

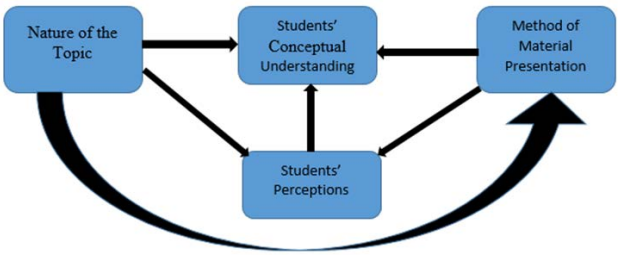

Figure 1. (Color online) Conceptual Framework of Factors related to Conceptual Understanding in Anatomy and Physiology

1.6. Study Area

Mukuba University is located about 15Km from Kitwe town, off Kitwe-Chingola Road. It was declared a University in 2013 by the act of parliament No. 4, part IV Section 14 (1). Since then, the University has been offering bachelor's degrees in Education natural sciences and Applied Sciences and Technology and is yet to begin offering bachelor's and higher degrees in Natural Sciences and Applied Science and Technology.

1.7. Target Population

All first-year students in the School of Applied Science and Technology doing BIO 102 during the 2019 academic year constituted the target population.

1.8. Sample and Sampling

Purposive sampling was employed to select all ODL first-year students doing BIO 102 during the 2019 academic year. This sampling procedure was suitable because this was the group of interest to the study [5,7]. Simple random sampling was used to assign the respondents to the experimental and control groups. The numbers 1 and 2 were written on small papers, folded, and then thouroughly mixed, respondents were then asked to pick a paper each. All those that picked 1 automatically belonged to the experimental group and vice versa. The total sample size was 42.

1.9. Experimental Design

The study employed a randomized subjects, pretest-posttest control group design. In this design, the researcher randomly assigned the subjects to the experimental and control groups. The two groups were then pretested to determine whether they were significant differences in the level of knowledge on the topic to be covered during the study before the experiment. The groups were then taught by the researcher for three weeks. During the teaching and learning process, the control group was taught using PowerPoint presentations, group discussions, and laboratory experiments. In addition to the later modes of teaching, videos and animations were integrated into the experimental group. After the period of teaching and learning, the two groups were then given a test to determine whether there were any significant differences in the average achievement in the two groups.

1.10. Data Analysis

Data were analyzed using the means and standard deviations while tables were used to summarize the data. The independent samples t-test was conducted to test for any statistically significant differences in the average achievement across the two groups. These analyses were done using the Statistical Package for Social Sciences (SPSS) version 20.

1.11. Ethical Considerations

Confidentiality of respondents was highly respected and to this effect, respondents were not required to put their names on the test papers and questionnaires except for numbers intended to identify the group to which they belonged (Control or Experimental). Consent was also obtained from the students so that they can willing decide to take or not take part in the study and the importance of the study was explicitly explained to them. Also, the lessons were conducted by the researcher in both groups and according to the University time table to avoid as much as possible disturbing the normal University programs thereby according respect to the research site. Finally, the control group was retaught after the study using videos and animations so that they are not deprived of the benefits of learning using videos and animations.

2. Results

2.1. Pre-intervention Descriptive Statistics

Based on the results of the pretest, a summary of achievement in the two groups and the independent samples t-test were conducted. Table 1 below presents the descriptive statistics of the pretest results in the two groups.

Table 1. Average Achievement in the two Groups before Intervention

	Group	N	Mean	Std. Deviation	Std. Error Mean
Achievement	experimental	21	13.67	5.102	1.113
	control	21	13.19	4.905	1.070

Table 1 indicates that before the intervention, the mean difference between the two groups was 0.476 and the standard deviations in the two groups were all 5 to one significant figure.

2.1.1. Levene's Test

To determine whether the two groups were equivalent before the intervention, the Levene's test was

conducted and the results of this statistic test are presented in Table 2.

Table 2. Levene's Test for Equality of Variances

F	df1	df2	P
0.715	39	38.266	0.403

Levene's test for equality of variance results as presented in Table 2 gave a non-statistically significant result with F (39, 38.266) = 0.715, P > 0.05. This means the average Achievement during the pretest in the two groups was approximately equal, and so any differences in the posttest can be attributed to the differences in delivery methods.

2.1.2. Pretest Independent Samples t-test

To confirm whether the difference in the average Achievement in the pretest was not significant, the independent samples t-test was conducted and the results are summarised in Table 3.

Table 3. Pretest Independent Samples t-test Results

T	Df	P (2-tailed)
0.308	40	0.759

The pretest independent samples t-test indicate a non-statistically significant result with t =0.308, P> 0.05 meaning that the two groups were equal before the experiment.

2.2. Posttest Descriptive Statistics

After exposing the two groups to different teaching and learning styles, a posttest was administered to determine if there were any differences in average achievement. A summary of performance in the two groups is given in Table 4.

Table 4. Posttest Descriptive Statistics in the Control and Experimental Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
posttest	Experimental	21	60.90	5.778	1.261
	Control	20	36.90	6.315	1.412

Table 4 indicates the mean difference of 24.005 between the experimental and control group and the standard deviation of 5 to one significant figure in both groups. The experimental group had the average Achievement of 60.90 while in the control group it was 36.90.

2.2.1. Posttest Independent Samples t-test

To determine if there were any differences in the effect of the methods of delivery in the experimental and control groups, the posttest independent samples t-test was conducted and the results were as outline in Table 5.

Table 5. Posttest Independent Samples t-test

T	Df	P (2-tailed)
12.708	39	0.000**

Table 5 indicate a statistically significant result with t = 12.708, P < 0.05. This suggests that the difference in the average Achievement across the two groups was not by chance.

2.3. Pupils' Perceptions of the Cardiovascular Anatomy and Physiology after the Experiment.

After the experiment, students' perceptions regarding Anatomy and Physiology were solicited to find out the effect of integrating videos and animations in Applied Human Anatomy and Physiology lessons on students Attitude towards this course. A Summary of students' responses is given in Table 6 and Table 7.

Table 6. Pre-intervention Students' perceptions of cardiovascular Anatomy and Physiology in the control group

S/N	Item	A (%)	B (%)	C (%)	D (%)	E (%)
1	I found Cardiovascular Anatomy and Physiology easy to understand	14.29	9.74	9.74	52.38	14.29
2	The lessons gave me a motivation for this course	14.29	71.41	0.00	9.74	4.76
3	The presentation of concepts showed how well the topic relates to our everyday lives	0.00	9.74	4.76	57.14	28.57
4	Learning cardiovascular Anatomy and Physiology was boring	4.76	80.95	0.00	14.95	0.00
5	The lessons on the topic were really interesting	0.00	9.74	4.76	85.71	0.00
6	Cardiovascular Anatomy and Physiology seem to be unrelated to our everyday lives	76.20	14.29	0.00	9.74	0.00
7	Having learned cardiovascular Anatomy and Physiology, I can relate what I learned to nutrition	0.00	4.76	9.52	76.19	9.52
8	Cardiovascular Anatomy and Physiology concepts are mere imaginations	0.00	71.43	9.74	14.95	4.76
9	After the three weeks of learning, all my misconceptions were cleared	14.29	9. 74	0.00	71.41	4.76
10	I can answer 70% of the questions on the cardiovascular Anatomy and Physiology very well	4.76	4.76	0.00	80.95	9.74

KEY: A = strongly agree, B = agree, C = neutral, D = disagree and E = strongly disagree.

Before instruction, 21% of students in the control group exhibited a positive attitude, 4% were neutral and 75% a negative towards the Cardiovascular Anatomy and Physiology.

Table 7. Post-intervention Students' perceptions of cardiovascular Anatomy and Physiology in the Experimental Group

S/N	Item	A (%)	B (%)	C (%)	D (%)	E %
1	I found Cardiovascular Anatomy and Physiology easy to understand	14.29	76.19	0.00	9.52	0.00
2	The lessons gave me a motivation for this course	23.81	66.67	0.00	4.76	4.76
3	The presentation of concepts showed how well the topic relates to our everyday lives	0.00	80.95	14.29	0.476	9.74
4	Learning cardiovascular Anatomy and Physiology was boring	4.76	4.76	4.76	57.14	28.57
5	The lessons on the topic were really interesting	4.76	85.71	9.52	0.00	0.00
6	Cardiovascular Anatomy and Physiology seem to be unrelated to our everyday lives	9.74	4.76	0.00	47.62	38.10
7	Having learned cardiovascular Anatomy and Physiology, I can relate what I learned to nutrition	33.33	61.90	4.76	0.00	0.00
8	Cardiovascular Anatomy and Physiology concepts are mere imaginations	28.57	52.38	9.74	4.76	4.76
9	After the three weeks of learning, all my misconceptions were cleared	19.05	71.43	4.76	4.76	0.00
10	I can answer 70% of the questions on the cardiovascular Anatomy and Physiology very well	23.81	61.90	4.76	4.76	4.76

KEY: A = strongly agree, B = agree, C = neutral, D = disagree and E = strongly disagree.
After intervention 72% of students in the Experimental group exhibited a positive attitude, 5% were neutral and 23% a negative towards Cardiovascular Anatomy and Physiology.

3. Discussion

The findings of this study suggest that integrating videos and animations in teaching Anatomy and Physiology is more effective than using PowerPoint presentations, experimentation, and group discussion without the two. Two major findings arose from this study, firstly using videos and animations in addition to Power Point presentations, group discussions and experiments enhance conceptual understanding which is shown by the high average Achievement exhibited by the students taught using these tools. The second major finding is that videos and animations when integrated in Applied Human Anatomy and Physiology lessons motivate learners resulting in positive attitudes towards the course. These findings are discussed under the two research hypotheses that governed this study along with the recommendations.

H_A* 1:** *Integrating videos and animations in lectures enhance students' conceptual understanding of Anatomy and Physiology.**

Videos and animations in this study enhanced conceptual understanding, this is as suggested by the independent samples t-test results presented in Table 5. This test static results indicate a statistically significant result with t = 12.708, df = 39 and P < 0.05. The findings of this study are in agreement with findings from various studies [9,12,17]. [8] for example found that videos and animations make the learning process active and enable learners to use the sense of vision and hearing to understand complex ideas and systems. This implies that, when animations are presented alone, learners use only the sense of vision. However, when videos and animations are used in a single lesson, students have the opportunity of using the sense of vision and hearing which according to Dale's cone of experiences is better than learning with a single sense. [3] also showed that videos and animations are more effective for teaching Anatomy and Physiology. Videos and animations make the understanding of difficult concepts easy because the explanations either in form of PowerPoint presentations or teacher/peer explanations are not just heard but also visualized thereby making the material being learned less difficult to comprehend [1,14]. In other words, videos and animations make explanations clearer and simpler for students especially when learning complicated topics [14,15,16,19]. Al-jarf, [1] however, pointed out that, the mere use of videos and animations does not bring about meaningful learning. This means that the careful selection of videos and animations so that they suit the topic and students they are intended for, and how well the teacher facilitates the learning process to ensure students take an active role in the lessons involving the use of videos and animations are critical to attaining meaningful learning.

***H_{A2}*:** *Videos and animations facilitates development of positive perceptions towards Anatomy and Physiology*. Many studies have shown that students' attitudes towards what is being learned is critical to the attainment of the learning outcomes [6,9]. The findings from this study suggest that videos and animations improve students' attitude towards anatomy and physiology. This perhaps could be the reason why students in the experimental group exhibited a higher average Achievement after the experiment than the control group. When learners are interested in what they are learning, they will make an effort to understand the concepts being learned or otherwise [12]. In other words, a positive attitude towards Anatomy and Physiology will make students find the course interesting to learn, and consequently, learners will make an effort to comprehend the concepts being learned despite the general overview that Anatomy and Physiology is difficult.

The recommendations arising from this study are that; animations and videos must be interactive so that learners are not passive when these tools are used to aid learning, videos and animations intended to aid learning must be selected carefully so that they suit the level of learners they are intended for in aspects such as language and content and that animations and videos to be explored in teaching and learning especially topics perceived to be difficult to understand at all levels of education. This will help learners develop positive attitudes towards what they are learning as they will begin to find learning entertaining.

4. Conclusion

Overall integrating videos and animation in Anatomy and Physiology lessons improve students' attitude towards the course and consequently enhances conceptual understanding. In other words, students will find learning with videos and animations interesting making them direct their attention and effort in trying to understand what they are learning. Videos and lessons for learning purposes must be selected thoughtfully and the educator must facilitate the learning processes in a manner that allows these tools to work effectively.

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