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Effect of Computer Animation via Movies on Biology Academic Achievement Among Students of the Faculty of Educational Sciences and Arts/ UNRWA

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Abstract
This study investigated the effect of computer animation via movies on biology academic achievement among students the Faculty of Educational Sciences and Arts/ UNRWA (FESA). Moreover, it investigated its effects on achieving higher and lower levels of thinking in biology. The population of the study consisted of all the students of the faculty of UNRWA Educational Sciences and Arts/ (FESA) enrolled in the Class teacher major for the year 2017-2018, the sample consisted of all 70 students enrolled in the biology course for the same year. A 40 items test was prepared to assess students' academic achievement in biology as a whole, and their achievement of higher and lower levels of thinking in biology. To ensure the validity of that scale, a group of experts in the field of education were requested to determine its content validity. In addition, the Koderrchardson-20 (K, R-20) measurement was utilized to assess its reliability. Furthermore, the study adopted a pre-test post-test control group quasi-experimental design. Finally, SPSS software was adopted to analyze the data adequately. The findings of the study showed that there are differences of statistical significance at (0.05) level. This revealed that students taught with animation have higher achievement in biology than those taught with conventional method. The findings imply that animation had a positive effect on students' achievement in biology on general, and on achieving the higher and lower levels in thinking in biology. It is recommended to use the computer animation via movies extensively in teaching university courses.
Keywords: Computer animation via movies; Achievement; Higher levels of thinking; Lower levels of thinking, Body Systems; FESA.

1. Introduction

Teaching science is something more than an instructional activity to transmit content knowledge in the curriculum to students. The practice of science education needs to be proactive and relevant to the context that we live in today so that students are better prepared for the changes and challenges in the present and the future (Kolosto, 2001). It is essential that teaching Science nurtures and supports high order thinking skills, inquiry skills, critical thinking skills, creativity and problem solving. Learning science is complex, this is due to its content which includes abstractions, difficult ideas, laws and theoretical entities that cannot be seen or handled. In fact, much of science learning is concerned with understanding largely invisible processes that cannot be easily observed as they may be too small, too slow or on too large at scale (Wishart, 2014).This is why we need to teach science in a way that ensures these processes are understood to all students.

While using several visualizations (e.g. drawing on the blackboard or the overhead acetate) could be useful for naming the components and providing a rough approximation of their relative orientation at the beginning of a process, this approach is not effective when we attempt to illustrate how these molecules or structures interact (McClean, P, et al. , 2004).The most effective visualizations reveal the complexity of the objects involved in the process, illustrate how and where the objects interact, provide a spatial representation of the molecules during the process, and smoothly represent the transitional states the objects undergo during the length of the process. High quality, 3D representations have all of these attributes. Animations are a form of dynamic representation that display processes that change over time. Animations have been included in educational technologies with increasing frequency since the early 1980s. They are used for a variety of reasons across a whole range of topics, for example, they can show the flux of high and low pressure areas in a weather map, the shifting movements of the continents, display blood pumping around the heart, or represent invisible processes such as the movement of molecules (Ainsworth, 2008).

The value of Animation appears to be associated with the dual-coding theory which suggests that long-term memory retention is facilitated by a combination of verbal and visual cues. As such, animations are valuable aids in supporting the visual aspects of long-term memory. Furthermore, by combining narration and animation, dual coding is further supported (Mayer and Anderson, 1992). It is through active processing of the visual and verbal pathways that students construct mental modules, these mental models are incorporated within student's prior knowledge, so that meaningful learning occurs. It is through this active meaningful learning that students achieve

better outcomes in different levels of cognitive domains (kasaji, 2010).

While reasons why Animations can help students come to understand complex ideas more easily varies, e.g. they are more motivating (Rieber, 1991), and they can communicate ideas and processes that change over time which reduces the abstractions associated with the temporal transitions of the process (Rieber, 1994). Some researchers suggest that Animations of events may be ineffective because animations violate the second principle of good graphics, the Apprehension Principle, according to which graphics should be accurately perceived and appropriately conceived (Tversky and Morrison, 2002). On the other hand (Lowe, 2003)raised questions about the widely assumed intrinsic superiority of animations over static graphics as resources for learning, he said that Animations required selective processing that involved perceptually driven dynamic effects analogous to the field–ground effects associated with the visuospatial characteristics of static graphics.

While Biology is an important branch of science, research says that student's performance in the subject has, however, been very poor, different reasons that included that some of the concepts are difficult, abstract and include phenomena that are not physically observable (Aremu& Sangodoyin, 2010).

Other reason why students may have difficulty with the concepts (e.g. diffusion, osmosis, protein transport into an organelle, the electron transport chain)is because these concepts require students to visualize and think about chemical processes at the molecular level (Sanger, Brecheisen & HynekSource, 2001), and students struggle to visualize the complexities underlying the most essential molecular and cellular processes(McClean P, et al , 2004).

2. Literature Review

Animation continues to be used extensively in learning environments; however, research regarding its effectiveness in facilitating different kinds of learning objectives remains inconclusive. Dwyer & Dwyer (2006) employed systematically designed content, four individual criterion measures assessing different kinds of learning outcomes, and a variety of animation and animation enhancement strategies in five independent studies involving 781 subjects. Results show significant implications for the use of animation in facilitating knowledge acquisition. Aremu & Sangodoyin (2010) investigated the effects of computer animation on the academic achievement of Nigerian senior secondary school students in biology. The pretest-posttest, control group, quasi-experimental design was adopted for the study. Findings show that there is a significant main effect of treatment on students' achievement in biology, so computer animation was effective in improving students' achievement. In their study to investigate the effects of animation on students' achievement and retention in Basic Electricity at Technical Colleges in Benue State, Numgwo et al., (2017) obtained Students' performance after being treated with animation instructional technique and conventional teaching method. The findings of the study revealed that students taught with animation have higher achievement and retention in Basic Electricity than with conventional method. In another study, Goff, E. et al., (2016) investigated the effectiveness of an online meiosis-learning module as a stand-alone learning tool, they conducted an experiment using participants enrolled in the introductory biology course meiosis in one of two treatments: the interactive-learning module or a traditional lecture session. Analysis of student achievement showed that students who viewed the learning module as their only means of conceptual presentation scored significantly higher than students who only attended a traditional lecture on the topic. Their results showed that the animation-based learning module effectively conveyed meiosis conceptual understanding, which suggests that it may facilitate student learning outside the classroom. Moreover, these results have implications for instructors seeking to expand their arsenal of tools for "flipping" undergraduate biology courses. Ikwuka & Samuel (2017) in their study on the effect of computer animation on achievement in chemistry had shown that students taught using computer animation Chemistry instruction (CACI) performed better in the academic achievement in Chemistry than students taught using conventional method (CM). They explained that this difference could be as a result of the ability of the CACI to provide aural and visual representations of the experimental procedures and the microscopic concepts which were since imagined are made visible by CACI. They also argued that CACI has the potential of making students learn more because fun and entertainment are naturally ways through which students learn, therefore, improving performance of students

On the other hand Falvo (2008) reviewed the literature related to using Animations in teaching and learning, he concluded that while animations assist students to better understand dynamic molecular processes in chemistry and biochemistry. However, students often take animation features literally and hence misinterpret the concepts presented in the animation. Additionally, students attempt to explain what they see by using their prior knowledge, which may be flawed or applied inappropriately. Instructional use of animations and visualizations must be accompanied by pre- and post-explanations and discussions to address misrepresentations. Solid foundational (prior) knowledge prepares students to learn and retain structural and process concepts conveyed by animations. Daly, C. J, et al. (2016) also investigated the use of animated images versus still images by creating two versions of a 4-min multimedia presentation on vascular neuroeffector transmission for pharmacology and physiology undergraduates. The results showed that while feedback from students was extremely positive with

increasing student satisfaction, they did not find strong evidence in favor of animated images over still images, in this particular format the difference was not statistically significant difference when using one version comprised narration and animations, whereas the other animation comprised narration and still images. They concluded that using complex multimedia instructional movies needs further research because if the design of such presentations does not take account of cognitive load and multimedia theories, then their effectiveness as learning aids will be compromised.

While some research investigated the effect of Animations on student's achievement, other studies aimed to study the impact of computer animation on students' acquisition of different thinking skills and patterns. (Mayer & Anderson (1992), for example, conducted a series of experiments in their study on the effect of different types of animations on problem solving skills of college students. (e.g. an animation with a verbal explanation given before the animation with an animation with a verbal explanation given during the animation). The main finding in their experiments was that subjects in the words-with-pictures group generated about 50% more creative solutions to problems than did subjects in the words-before-pictures group. McClean et al. (2004) investigated the effect of using Animation to represent transcription, translation, bacterial gene expression, messenger RNA (mRNA) processing, mRNA splicing, protein transport into an organelle, the electron transport chain, and the use of a biological gradient to drive adenosine triphosphate synthesis. The results showed that student retention of content material was significantly better when students received a lecture coupled with the animations and then used the animation as an individual study activity. On the other hand, Younis (2017) investigated the effect of scientific inquiry simulations on higher order thinking skills of chemical reaction and attitude of students toward learning chemistry; the results indicated that computer simulations have positive impact on students achievement compared to traditional teaching methods. The researcher proposed this result to some advantages of the scientific inquiry simulations. These benefits are students who use simulations to conduct scientific inquiry focus more on the process in place of the material and the equipment they perform their inquiry in a safe experimental environment and conduct the experiments individually as given from the focus group results. Students who learned by scientific inquiry simulations mentioned that they were excited doing their activities. The result could be because the simulations were attractive and suitable learning environment for the age group. Even though, the present study has found that scientific inquiry simulations are better than scientific inquiry activities in promoting higher order thinking skills and attitudes toward chemical reaction. Teachers should combine both methods in their learning environments to get benefit from each method characteristics. Especially when the inquiry is dangerous, and the apparatus are not available.

Kidwai, K et al., (2017) investigated the effect of visual scaffolding and animation on Students' performance on measures of higher order learning**,** The results of the analyses indicated that specific types of visual scaffolding (simple and complex) are important variables for facilitating specific types of performance outcomes. Initial interpretation of the results indicated that visual scaffolding strategies, specifically designed, developed and positioned, have the potential for focusing and illustrating procedural understanding thereby reducing the cognitive load associated with the higher processing levels in the knowledge acquisition domain.

The results of a preliminary study indicated that animation has a significant impact on acquisition of factual and conceptual knowledge. On the other hand, visual scaffolding strategies, used as a complement to instruction that already involved animation did not have a significant impact on students' performance on measures of higher order learning.

3. Problem of the study

Throughout their experience in teaching biology at FESA, the researchers noticed students low achievement in tests, especially tests measuring high levels of thinking as classified in Blooms revised taxonomy of learning domains. This could be due to the fact that some of the concepts of biology are abstract and students struggle to understand them, especially those related to the systems of the human body and the process related to the functions of these systems, and the fact that most of these students do not have the sufficient scientific academic background, This challenges the instructors to search for teaching strategies that could support students in acquiring the different outcomes of the biology course. Against this background, and because of the contradictions research results of using Animations to improve students' achievement, it was important that this study investigates the effects of computer animation via movies on the academic achievement in biology among the students of the Faculty of Educational Sciences and arts by attempting to answer the following questions:

1. "What is the effect of computer animation via movies on improving the academic achievement in biology among the students of the Faculty of Educational Sciences and Arts/ UNRWA?"
2. What is the effect of computer animation via movies on improving the achievement of lower levels of thinking in biology among the students of the Faculty of Educational Sciences and Arts/ UNRWA?
3. What is the effect of computer animation via movies on improving the achievement of higher levels of thinking in biology among the students of the Faculty of Educational Sciences and Arts/ UNRWA

3.1 Hypotheses of the study

- There were no statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of students in the control and experimental groups in the academic achievement test in biology as a whole.
- There were no statistically significant differences at ($\alpha \leq 0.05$) between the mean scores of students in the control and experimental groups at lower levels of thinking in biology.
- There were no statistically significant differences at ($\alpha \leq 0.05$) between the average scores of students in the control and experimental groups at higher levels of thinking in biology.

3.2 Limitations and limits of the study

This study is limited to the purposive sample that was selected from the students of the faculty of Educational Sciences and Arts/UNRWA (FESA) during the first semester of the year 2016/2017. The sample of the study consisted of (70) male and female students. Furthermore, the results of the study are limited to the instrument used and to the reliability and validity of that instrument. Accordingly, the results cannot be generalized, and they are only limited to that instrument's characteristics.

4. Methodology and Design of the study

This study adopted a pre-test posttest control group quasi-experimental design. The independent variables are the teaching strategy at two levels (use of computer animation via movies and conventional teaching method). The dependent variable is the academic achievement in biology. Biology content pre-test was used as a covariate. The design is structurally shown as follows:

EG: O1X1 O2
CG: O1 X2 O2
Where
EG : Experimental Group
CG : Control Group
O1 = the pre application of the achievement test for experimental and control groups (covariate)
X1= Treatment, i.e. computer animation via movies
O2 = the post application of the achievement test for experimental and control groups
X2 = Conventional teaching method

4.1participants

The study participants' were selected from the students of the Faculty of Educational Sciences and Arts / UNRWA studying biology course in two study divisions: (a), 35 students, and (b), 35 students. The researcher used the random assignment for the distribution of the two divisions in the two groups: control and experimental, where the division (B) in the experimental group and taught using the computerized animation method, while the division (A) in the control group and taught using the method of lecture. Table (1) shows the distribution of study participants' in the experimental and control groups

Table 1. The sample distribution according to groups (experimental, control)

Group	Teaching Method	Section	Number of Students
Experimental	Computer Animation Method	(B)	35
Control	Lecture Method	(A)	35
Total			70

4.2 The equivalence of the two study groups

ANCOVA is used because the design of the study is made up of two groups: experimental and control, with pre-test and post-test. ANCOVA adjusts students' results at pre- application. It does not affect the results of the post-application, whether the groups are equivalent or not. Therefore, there is no need for an analysis of equivalence on the pre- test of the two groups because the ANCOVA analysis solved this problem in the case of differences between the experimental and control groups

4.3 Instrument of the study

The scale of the effect of computer animation via movies on biology academic achievement among the students of the faculty of educational sciences and arts/ UNRWA

To achieve the purpose of the study, the researcher prepared the academic achievement test in biology, in order to measure the academic achievement in biology among students of the Faculty of Educational Sciences and Arts / UNRWA in general, and in the areas of the achievement of the higher and lower levels of thinking. The test consisted of (40) paragraphs in the form of multiple choice in its initial form.

4.3.1 Validity and Reliability of the scale

Before administering the scale to the sample of the study, the validity of the scale was ensured through presenting the scale before a panel of experts (trustees' validity) and carrying out a pilot study(structure's validity).Validity of the instrument was firstly ensured by presenting the instrument of the study before a group of 12 professors working in Jordanian universities who have experience in education and science. The professors were asked to provide their comments, notes and recommendations on the appropriateness of the items of the scale and to what extent it measures the academic achievement of biology in the subject of body systems. In this regard, the researchers adhered to the suggestions and amendments as recommended by the professors. In order to assure the (structure's validity) of the instrument of the study, a pilot study was conducted on 30 male and female students who did not form part of the final sample. Then, the difficulty and discrimination coefficients for test were calculated. The values of the difficulty coefficients for the test scores applied to the survey sample ranged from 0.33 to 0.63, which means that there are no paragraphs with a coefficient of difficulty greater than 0.85 or less than 0.20. It is also noted that the values of the discrimination coefficients for the test scores were between (0.33 - 0.73), which means that there are no paragraphs with discrimination coefficients less than 0.20. These values are considered to be acceptable for the use of this test in the current study. Accordingly, no paragraph of the achievement test has been deleted in light of the difficulty and discrimination factors.

The researcher verified the reliability of the test using the Koderrchardson-20 (K, R-20) for reliability. The reliability coefficient for the total test was 0.809, Cap (1995), citing various other authors, explains that the reliability coefficient of .71 to .86 is regarded as high, so this value is appropriate and indicates that the test has a high reliability and it was used as the pre-test as well as the post-test.

4.3.2 The distribution of the test paragraphs in accordance with the levels of thinking measured by the test

The distribution of the test paragraphs in accordance with the levels of thinking measured by the test is shown in Table (2).

Table (2). Distribution of test items according to the levels of thinking measured by the test

Achievement Levels	Paragraphs Total	Numbers of Paragraphs	Great mark
High levels of thinking	10	6-7-8-15-19 -22-26-32-39-40	10
Low levels of thinking	30	1-2-3-4-5-9-10-11-12-13-14-16-17-18-20-21-23-24-25-27-28-29-30-31-33-34-35-36-37-38	30
Achievement)Overall(	40		40

4. 4 Statistical treatments

In order to answer the study questions and test hypotheses, means and standard deviations scores for the students grades in the experimental and control groups at the pre and post applications of the scale were calculated. In addition, the analysis of covariance (ANCOVA) was used to underline the differences between the students' grades means at the pre scale application. Moreover, ANCOVA was employed to discover the differences between the means of the students' grades at the post application of the scale in accordance with the variable method of teaching.

To determine the effect size of the variable teaching method on improving students' achievement, Eta square was used in accordance with the following Formula (Kiess, 1989)

Eta Square= N2=t2\t2+df

5. Results and conclusions of the study

5.1 Results of the study related to the first question "What is the effect of computer animation via movies on improving the biology academic achievement among the students of the Faculty of Educational Sciences and Arts/ UNRWA?" The following hypothesis emerged from this question: "There were no statistically significant differences ($\alpha \leq 0.05$) between the mean scores of students in the control and experimental groups in the academic achievement test in biology as a whole".

To test this hypothesis, means and standard deviations of the students' grades in the two groups: experimental (studied using computerized animation) and control (studied using the lecture method) at the pre and post applications of the academic achievement test in biology as a whole were calculated. And Table (3) shows this.

Table 3. The means and standard deviations of the scores of the experimental and control groups in the pre and post-application of the academic achievement test in biology as a whole

Group	Pre Test		Post Test		Estimated	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Error
Experimental Group (Computer Animation)	15.29	4.13	30.60	2.94	30.57	0.64
Control Group (Lecture Method)	14.26	3.49	26.43	4.37	26.46	0.64

* maximum degree (40)

Table (3) indicates that there is a difference between the mean scores of the students in the experimental and control groups at the pre and post applications of the scale as a whole. This difference was statistically controlled using ANCOVA. Also it indicates that there is an apparent difference between the mean scores of the students in the experimental and control groups in the post-application of the academic achievement test in biology as a whole. The mean for the experimental group (30.60) and the standard deviation (2.94), while the mean for the Control group (26.43) and the standard deviation (4.37), that is, there is a difference (apparent) in means between the two groups on the academic achievement test in biology as a whole (4.17).

To determine whether the difference in mean scores of the students in the experimental and control groups in the post-application of the academic achievement test in biology as a whole was statistically significant at ($\alpha \leq 0.05$). And In order to isolate the difference between the two groups on the academic achievement test in biology as a whole, The ANCOVA test was used, the results were as in Table (4).

Table (4). Results of the ANCOVA analysis of the scores of students in the experimental and control groups on the academic achievement test in biology as a whole

Source	Sum of Squares	df	Mean Square	F	Sig.	(η^2) effect size
Pre Test	17.237	1	17.237	1.229	0.272	
Group (Teaching method)	290.556	1	290.556	*20.717	0.000	0.236
Error	939.692	67	14.025			
Total	1247.486	69				

* Statistically Significant.

The results in Table (4) indicate that there is a statistically significant difference between the mean scores of students in the control and experimental groups on the academic achievement test in biology as a whole, as the total value of (P) calculated for the difference (20,717). This value is statistically significant at the level of (α= 0.05). Based on the adjusted means in Table 4, it is clear that the difference was for the benefit of the experimental group, and this indicates the effectiveness of employing computerized animation in improving academic achievement in biology among FESA students / UNRWA. In order to determine the effect of the change in the method of teaching on the improvement of academic achievement in biology among students, the ETA square(η^2) was calculated. The value of (η^2) was 0.236. Thus, we can say that 23.6% of the difference in the improvement of the academic achievement in biology between the experimental and control groups is related to the use of computerized animation in the teaching of the experimental group students.

This agrees with the findings of Aremu & Sangodoyin (2010), which indicated that computer animation was effective in improving students' achievement, and likewise the findings of Numgwo et al., (2017), Ikwuka & Samuel (2017), Tversky and Morrison (2002), Goff, E, et al.(2016), McClean (2005). While these disagree with Daly (2016) who concluded that using complex multimedia instructional movies needs further research because if the design does not take account of cognitive load and multimedia theories, then their effectiveness as learning aids will be compromised. As well Valvo (2008) who stressed the need for Solid foundational (prior) knowledge to prepares students to learn and retain structural and process concepts conveyed by animations.

According to the researchers, the above results might belong to the following reasons:

These results could be due to the fact that Animations provide a spatial representation of the molecules during the biological processes, illustrate how and where the objects interact, display processes that change over time, or represent invisible processes such as the movement of molecules (Ainsworth, 2008; McClean, P, et al. , 2004). Students were able to see processes such as tracking food through the digestive tract, and how the enzymes work to complete the chemical digestion process, tracking the bloodstream through the micro and large circulation, and how the gas exchange took place in the lungs and the body tissue, and other processes performed by the body systems at the molecular level. Animations helped students imagine the processes that change over time which reduces the abstractions associated with the temporal transitions of the process (Rieber, 1994), this made understanding these processes easier

Studies show that if you only stimulate the auditory sense people will retain just 10% of what they hear. Stimulating both the auditory and visual sense results with a retention rate of 58%. Animation provide both auditory and visual representations for the biological processes, this helped students actively use a combination of pathways for coding information and producing their own mental models, it is through the active engagement of students in producing the mental models and incorporating these mental models into their prior knowledge

that meaningful learning occurred. It is through this active meaningful learning that students achieve better outcomes in different levels of cognitive domains (Kasaji, 2010).

Finally, we think that one of the reasons that led students to a better understanding and thus a better performance in this study was that students found the Animations used interesting and unconventional. This motivated them to follow up and focus on the content of the films, and to raise many questions, which made them active participants in the learning process and increased their level of understanding and achievement of biological concepts at different levels. Another factor that could not be overlooked is the enthusiasm that we had when using computer animation as a teaching strategy. We believe could be one of the factors that ensured the efficiency of the intervention. The role of teachers in integrating new technologies and strategies could never be overemphasized. The novelty of the teaching strategy made it attractive enough for students to learn, so students will be more willing to engage in science subjects and perform better. The fact that they can see the structure of the body systems in colorful diagrams and graphics, and how they perform their functions is quite motivating, and has always been the rationale for using computers in the classroom, and they are reasons why such an intervention of this nature would be successful. Animation has the capability of motivating students to higher performance by bringing about higher gains in achievement when compared to conventional teaching methods (Rieber, 1991).

5.2 Results of the study related to the first sub-question "What is the effect of computer animation via movies on improving the achievement of lower levels of thinking in biology among the students of the Faculty of Educational Sciences and Arts/ UNRWA?" The following hypothesis emerged from this question: There were no statistically significant differences (α≤0.05) between the mean scores of students in the control and experimental groups in the lower levels of thinking in biology

To test this hypothesis, means and standard deviations of the students' grades in the two groups: experimental (studied using computerized animation) and control (studied using the lecture method) at the pre and post applications on the lower thinking levels of the academic achievement test in biology were calculated. The adjusted mean scores were calculated, and Table (5) illustrates this.

Table 5. The means and standard deviations of the scores of the experimental and control groups in the pre and post-application on the lower levels of thinking of the academic achievement test in biology

Group	Pre Test		Post Test		Estimated	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Error
Experimental Group (Computer Animation)	12.37	3.37	24.46	2.47	24.45	0.53
Control Group (Lecture Method)	12.11	3.00	21.26	3.60	21.26	0.53

* maximum degree (30)

Table (5) indicates that there is a difference between the mean scores of the students in the experimental and control groups at the pre and post applications on the lower levels of thinking of the academic achievement test in biology. This difference was statistically controlled using ANCOV. Also it indicates that there is an apparent difference between the mean scores of the students in the experimental and control groups in the post-application on the lower levels of thinking of the academic achievement test in biology. The mean for the experimental group (24.46) and the standard deviation (2.47), while the mean for the Control group (21.26) and the standard deviation (3.60), that is, there is a difference (apparent) in means between the two groups on the lower levels of thinking of the academic achievement test in biology (3.20).

To determine whether the difference in mean scores of the students in the experimental and control groups in the post-application on the lower levels of thinking of the academic achievement test in biology was statistically significant at (α≤0.05). And In order to isolate the difference between the two groups on the lower levels of thinking of the academic achievement test in biology, The ANCOVA test was used, the results were as in Table (6).

Table (6). Results of the ANCOVA analysis of the scores of students in the experimental and control groups on the lower levels of thinking of the academic achievement test in biology in the post application

Source	Sum of Squares	df	Mean Square	F	Sig.	(η^2) effect size
Pre Test	2.244	1	2.244	0.233	0.631	
Group (Teaching method)	177.862	1	177.862	*18.434	0.000	0.216
Error	646.466	67	9.649			
Total	826.571	69				

* Statistically Significant.

The results in Table (6) indicate that there is a statistically significant difference between the mean scores of students in the control and experimental groups on the lower levels o f thinking of the academic achievement test in biology in the post application, as the total value of (P) calculated for the difference (18.434). This value is statistically significant at the level of (α≤ 0.05). Based on the means in Table 6, it is clear that the difference was

for the benefit of the experimental group, and this indicates the effectiveness of employing computerized animation in improving the achievement of the lower levels of thinking in biology among FESA students / UNRWA. In order to determine the effect of the change in the method of teaching on the improvement of the lower levels of thinking in biology among students, the ETA square (η^2) was calculated. The value of (η^2) was 0.216. Thus, we can say that 21.6% of the difference in the improvement of the lower levels of thinking in biology between the experimental and control groups is related to the use of computerized animation in the teaching of the experimental group students

5.3 Results of the study related to the second sub-question "What is the effect of computer animationvia movies on improving the achievement of higher levels of thinking in biology among the students of the Faculty of Educational Sciences and Arts/ UNRWA?" The following hypothesis emerged from this question: There were no statistically significant differences (α≤0.05) between the mean scores of students in the control and experimental groups on the higher levels of thinking in biology

To test this hypothesis, means and standard deviations of the students' grades in the two groups: experimental (studied using computerized animation) and control (studied using the lecture method) at the pre and post applications on the higher thinking levels of the academic achievement test in biology were calculated. The adjusted mean scores were calculated, and Table (7) illustrates this.

Table 7. The means and standard deviations of the scores of the experimental and control groups in the pre and post-application on the higher levels of thinking of the academic achievement test in biology

Group	Pre Test		Post Test		Estimated	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Error
Experimental Group (Computer Animation)	2.91	1.42	6.14	1.33	6.18	0.25
Control Group (Lecture Method)	2.14	1.35	5.17	1.54	5.14	0.25

* maximum degree (10)

Table (7) indicates that there is a difference between the mean scores of the students in the experimental and control groups at the pre and post applications on the higher levels of thinking of the academic achievement test in biology. This difference was statistically controlled using ANCOVA. Also it indicates that there is an apparent difference between the mean scores of the students in the experimental and control groups in the post-application on the higher levels of thinking of the academic achievement test in biology. The mean for the experimental group (6.14) and the standard deviation (1.33), while the mean for the Control group (5.17) and the standard deviation (1,54), that is, there is a difference (apparent) in means between the two groups on the higher levels of thinking of the academic achievement test in biology (0.97).

To determine whether the difference in mean scores of the students in the experimental and control groups in the post-application on the higher levels of thinking of the academic achievement test in biology was statistically significant at (α≤0.05). And In order to isolate the difference between the two groups on the higher levels of thinking of the academic achievement test in biology, The ANCOVA test was used, the results were as in Table (8).

Table (8). Results of the ANCOVA analysis of the scores of students in the experimental and control groups on the higher levels of thinking of the academic achievement test in biology in the post application

Source	Sum of Squares	df	Mean Square	F	Sig.	(η^2) effect size
Pre Test	0.003	1	0.003	0.002	0.968	
Group (Teaching method)	17.690	1	17.690	*8.461	0.005	0.112
Error	140.078	67	2.091			
Total	157.771	69				

* Statistically Significant.

The results in Table (8) indicate that there is a statistically significant difference between the mean scores of students in the control and experimental groups on the higher levels of thinking of the academic achievement test in biology in the post application, as the total value of (P) calculated for the difference (8.461). This value is statistically significant at the level of (α= 0.05). Based on the adjusted means in Table (8), it is clear that the difference was for the benefit of the experimental group, and this indicates the effectiveness of employing computerized animation in improving the achievement of the higher levels of thinking in biology among FESA students / UNRWA. In order to determine the effect of the change in the method of teaching on the improvement of the higher levels of thinking in biology among students, the ETA square (η^2) was calculated. The value of (η^2) was 0.112. Thus, we can say that 11.2% of the difference in the improvement of the higher levels of thinking in biology between the experimental and control groups is related to the use of computerized animation in the teaching of the experimental group students. It was with computer animation that students' enthusiasm to learning biology increased. It stimulated students' active and intellectual learning by more involving students in

their learning so students remembered what they learned better, and they were able to apply, analyze, evaluate and achieve higher levels of learning outcomes. On the other hand, when using the lecture with no Animations, students were passive listeners; they did not construct their own models and the information they obtained from listening to lectures were easily forgotten because this information was not transferred to the long term memory and not incorporated within their prior knowledge. This led them to lower achievement.

These results agree with the results of Younis (2017), which indicated that scientific inquiry simulations are better than scientific inquiry activities in promoting higher order thinking skills. Other similar results were found in the study of both Mayer & Anderson (1992) and McClean et al. (2004). While it disagrees with the result of Kidwai, K et al., (2017) which indicated that visual scaffolding strategies that already involved animation did not have a significant impact on students' performance on measures of higher order learning.

5.4 Conclusion

Based on the results obtained from this research, it has been proven clearly that computer animation has effectively improved student's academic achievement in biology. Results of the statistical analysis showed that a significant difference exist in the mean scores of students in the control and experimental groups on the academic achievement test in biology as a whole, and on the lower and higher levels o f thinking of the academic achievement test in biology. This implies that computer animation is a viable instructional method for improving students' achievement and the achievement of higher and lower levels of thinking. It is therefore imperative to Adopt animation as an instructional technique in teacher training institutions so that student teachers on graduation should acquired the necessary skills needed for classroom development and presentation of animation, thereby contributing to higher achievement levels of their students

6. Recommendations

In the light of the results above, the researchers recommend what follows:

- Using computer animation via movies extensively in teaching university courses since it has been found to enhance the academic achievement in Biology; Biology teachers should employ it more in the teaching of the subject especially for topics that are abstract.
- Training the student teachers at the faculty of educational sciences and building their capacity in the preparation and effective use of computer animation via movies as a tool for learning and teaching.
- Conducting further studies on the impact of computer animation via movies on other variables such as the reflective and creative thinking.
- Adopting animation as an instructional technique in teacher training institutions so that student teachers on graduation should acquired the necessary skills needed for classroom development and presentation of animation.

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Appendix

FESA /UNRWA
Achievement Test –The Human Body –Biology Couse
2016-2017 First Semester
Instructor: Dr. Amal Awad

Circle the correct answer for each of the following paragraphs:

1- Begins in the mouth with chewing or mastication and continues with churning and mixing actions in the stomach:

A-Ingestion B-Mechanical digestion C- Chemical digestion D-Absorption

2- What are enzymes?

A-Small pieces of food that cannot be digested
B-A mucus that helps moisturize food
C-Small molecules that help break down food
D-Acidic molecules that provide a suitable medium for digestion

3- What is the role of saliva in the digestion process?

A-Provides a connective tissue that protects the mouth B-Enzyme secretion
C-Pushing food to the throat D-All of the above

4- Which of the following enzymes plays a role in Protein Digestion?

A-Pepsin B-Amylase C-Lipase D-all of the above

5- What is the major role of the large intestine during digestion?

A-Completion of protein digestion B-Absorption of water
C-Secreting digestive enzymes D-All of the above

6- Which of the following does not resemble the mechanical digestion?

A- Cutting butter into small pieces B-Cutting bread into small pieces C-Wheat crunching D-Making

pickles

7- What can you say about the digestion and transfer of food by blood?

A-Digested materials are soluble so they are easily transferred by blood.
B-Blood transferred liquid food to all cells where digestion occurs.
C-Digested food is transferred by blood and non-digested food is transferred to the urine
D-Digested materials are attached to blood cells when transferred by blood.

8- If you had starch for breakfast, what would happen to starch in your digestive system?

A-Converted to simple sugars that are absorbed by blood B-It will not be digested and will be discarded.
C-Converted to Fatty Acids that are absorbed by blood D-Converted to Amino Acids that are absorbed by blood

9- Which of the following is NOT a function of the digestive system?

A-Filtering and removing urea from the body B- Eliminating undigested wastes from the body
C-Breaking down food into molecules that the body can use D-Absorbing food molecule into blood

10- Which organ of the digestive system produces enzymes that break down starches, protein and fats?

A-Gall bladder B-Pancreas C-Small intestine D- Large intestine

11- What completes the mechanical digestion in the stomach?

A-The Cilia B- Hydrochloric Acid C-The cartridge rings D-Muscle contraction

12- What is the muscle that mixes and changes the chemical combination of proteins?

A-The pharynx B-Esophagus C-The stomach D-The small intestine

13- What organs does the esophageal sphincter connect?

A-The stomach and the esophagus B-The esophagus and the pharynx
C-The stomach and the small intestine D-The small and the large intestine

14- Which part of the digestive system digests proteins?

A-The mouth B-The stomach C-The small intestine D-The duodenum

15-How does the stomach protect itself from self-digestion?

A-Hydrochloric Acid B-Mucus C-Pepsin Enzyme D-Bicarbonates

16- Which of the following could be compared to soldiers?

A- Your heart B- Red blood cells C- White blood cells D- Your lung

17-What blood vesicles carry deoxygenated blood to the heart?

A-Pulmonary Arteries B-Vena cava C-Pulmonary Veins D-Coronary Arteries

18-What separates the right side and left sides of the Heart?

A-Atrium B- Ventricle C- Valves D-Muscular wall

19-Which champers produces the highest pressure in the blood?

A-Right atrium B- Left atrium C- Right ventricle D- Left ventricle

20- Which of the following is NOT function of blood cells?

A- Guard against infection B- Fight parasites C- Attack bacteria D- Carry oxygen.

21-What blood vesicles carry blood to the heart?

A-Arteries B-Veins C-capillaries D-valves

22-Which parts of the heart pump blood?

A-Right and left atrium B- Left atrium and right ventricle
C- Right and left ventricle D- Left ventricle and right atrium

23-Which of the following circulate blood to all cells?

A-Contraction of the Right Atrium B-Contraction of the left Atrium
C-Relaxation of Right Atrium D-Contraction of left Ventricle

24-What pushes blood to the Lungs?

A-Relaxation of the Right Atrium B-Contraction of the left Atrium
C-Contraction of Right Atrium D- Contraction of left Ventricle

25- What artery block leads to heart attacks?

A-Aorta B-Pulmonary Artery C-Coronary Artery D-vena cava

26-The heart contracts twice for every heartbeat. One contraction is the atrial contraction while the other is the ventricular contraction. During ventricular contraction, which two valves of the heart open?

A-Pulmonary and aortic valves B-Aortic and mitral valves
C-Aortic and tricuspid valves D-Pulmonary and tricuspid valves

27-What is the result of the contraction of the left atrium?

A-Transferring oxygenated blood from the left atrium to the left ventricle
B-Transferring oxygenated blood from the left atrium to the body
C-Transferring deoxygenated blood from the left atrium to the lungs
D-Transferring de oxygenated blood from the left atrium to the right atrium

28-Where is oxygen freed from Hem group
A-The Lungs B-The Heart C-The tissues D-Inside cells
29-What is the role of the blood platelets?
A-Transferring O2 and CO2 B-Blood Clotting C-Protection against germs and toxins D-Producing anti bodies
30-What blood vesicles carry oxygenated blood from the lungs to the heart?
A-Pulmonary Artery B-Pulmonary Veins C-blood capillaries D-Coronary Artery
31-Air bags in which gases are exchanged are called:
A - Capillaries b - Bronchial c - Bronchioles d – Alveoli
32-When there is a nosebleed, we can breathe through the mouth because:
A - The body needs oxygen B - The mouth can open and close to allow oxygen to enter
C - The nose is the only way to insert oxygen D - mouth connected to the trachea
33- What is the muscle that pulls the lungs down to enter the air inside the body?
A – Skeletal muscle B - abdominal muscles C- smooth muscle D- diaphragm
34-What is the long tube, which is divided into two parts, each heading towards one of the lungs?
A - Bronchus B - Bronchioles C - Throat D - Pharynx
35-The biophysical process through which the exchange of gases in the lungs are:
A-Diffusion B- Facilitated diffusion C- Active Transport D- Osmotic Property
36-The air transfer between the lungs and outside the body during the movements of the respiratory through:
A- Air pressure difference B- Gas concentration difference
C- Gas flow force difference D- Difference in osmotic pressure of gases
37-The functional unit in the kidney is:
A - Nephrone B - Vesicles C - Mitochondria D - Ribosome
38-Long Loop of Hanley to increase:
A- time B- surface area C- re-production of cells D- production of carbon dioxide
39-**After examining a patient's urine, a physician has come to the conclusion that the patient is dehydrated and does NOT have diabetes mellitus. What properties would you expect the patient's urine to have?**
A-The urine is light yellow and has a specific gravity less than 1.035
B-The urine is dark yellow and has a specific gravity greater than 1.035.
C-The urine is light yellow and has glucose present.
D-The urine is dark yellow and has glucose present
40-What is the function of the urinary system?
A - Rid the body of water and excess B- Rid the body of toxic nitrogen waste
C- Maintain the balance of fluids in the body D - all of what

THE END