

Identifying Factors Influencing the Use of Computer 3D Animation in Teaching Biology Among Secondary Schools' Teachers in Kiambu County, Kenya

Hassan Bob Rogers

Master of Science Education, Department of Educational Communication & Technology, School of Education, Kenyatta University

Abstract: Biology teachers' ability to use ICT positively impacts their students' learning and contributes to their students' academic performance. Moreover, when teachers lack basic ICT skills necessary to teach biology using 3D animation, it has a detrimental ripple impact on how well students conceptualize abstract biological concepts, principles, or laws which cannot be simply demonstrated by oral presentation or lecture method. The purpose of this study was to identify related factors faced by biology teachers in secondary schools in teaching biology-employing computer 3D animation. The study's findings identified and established three major factors considered as hurdles influencing the use of computer 3D animation faced by biology teachers when employing computer 3D animation in teaching biology. These factors or hurdles are: institutions have little or no resources to assist teachers in teaching biology using computer 3D animation, teachers lacking basic skills-procedure (in operating ICT devices) related to computer 3D animation use, and teachers lacking the basic skills in teaching biology (content) utilizing computer 3D animation. When these barriers are overcome, 3D animation would improve students' conceptual understanding of biological concepts, principles or laws, and processes, as well as their academic achievements. It is recommended that biology teachers receive ICT training, and administrators should provide access to ICT tools needed by teachers for better content delivery.

Keywords: Computer 3D animation (C3D), Information Communication Technologies (ICT), Factors, Barriers, Teaching Skills.

INTRODUCTION

Information and communication technologies, or ICT, includes computer 3D animation, internet or wireless networks, mobile phones, and other communication channels. The usage of 3D animations or ICT in the teaching-learning process requires teachers to have more knowledge of ICT and the skills needed to do so in today's scientific and technological society (Bhattacharjee & Deb, 2016). In the modern world, using computers animation is advantageous in a variety of fields. The evolution of animations has altered with time and usage context, and they now clarify complex events and ideas. Although they may not always be helpful, teachers who employ animations must comprehend their significance (Rohana Mansor, *et al.*, 2020).

In addition, teachers must be knowledgeable about 3D animation-ICT and technologically savvy in order to foster the traits of 21st century learners, such as self-directed and lifelong learners, visionary leaders, collaborative communicators, aware and adopt information managers, adopt and literate performers, healthy individuals, caring global citizens, flexible critical thinkers, etc.

Kwasu and EmaEma, (2015) findings indicated that animation is an effective tool for the teaching and learning processes. Inanimate objects come to life through animation, which also concretizes knowledge and makes the teaching and learning process enjoyable. The performance rate of the students will be greatly improved by these. All

other linked issues, including the high dropout rate, will also decrease with a decrease in the failure rate. According Kumar, *et al.*, (2023), computer graphics and 3D animation require technical know-how, motivation, and creativity in order to be employed effectively. Three-dimensional (3D) animation and computer graphics have radically altered how we currently teach and learn. However, neither teachers nor students are well-versed in the use of 3D animated video. A number of cutting-edge teaching tools are available for the effective application of 3D animation in the learning process. However, students and teachers are not adequately informed about the utilization of 3D animated video. Habibu, *et al.*, (2012) proposed that in order to use ICT effectively in educational settings, there are a number of challenges that need to be overcome. These challenges include the lack of genuine software, inadequate computers in the classrooms, slow internet, a lack of interest on the part of teachers and students to use ICT, a lack of proper training skills, the lack of the newest ICT equipment, a lack of skilled technical staff, poor administrative support, etc. Studying these challenges may help educators overcome them.

Objective of the Study: The objective of this study was to identify factors influencing the use of computer 3D animation in teaching biology.

Research Question: What are the major factors influencing the use of computer 3D animation teaching biology for conceptual understanding?

REVIEW OF RELATED LITERATURE

Working with 89 nurse educators Fongang, *et al.*, (2017) carried a research to investigate barriers which impede or influence usage of simulation in public and private institutions training nurses. The researchers employed a descriptive study design and stratified sampling for institutions selection. Structured questionnaires were employed as tools for collection of data by researchers. Results of the research findings pointed out these factors as factors enhancing the use of simulation (a) changes in the training curriculum for nurses to more practical activities indicated by 85.5% of the respondents (b) technological advancement representing 87% of respondents (c) ethical consideration in health care services indicated by 78.3% of the respondents (d) fewer number of nurse educators in hospital representing 44.9% of respondents, (e) overcrowded classes indicated by 10.1 % and (f) limited knowledge of clinical educators to appropriately teach practical skills indicated by 36.2%. These factors outlined by the researchers are meaningful for consideration to be applicable for teaching practical demonstration in biology for secondary students, particularly in overcrowded classrooms.

In addition, the findings also outlined factors impeding the use of simulation which includes (a) 78.2% of the respondents indicated limited training of the use of simulation; (b) 76.8% of respondents indicated huge cost to purchase and maintained simulation resources; (c) 65.2% of respondents indicated time constraints; (d) 52.2% of respondents indicated fear of getting wrong feedback due to simulation breakdown; (e) 47.8% of respondents indicated intimidating nature of the simulation environment and (f) 44.9% indicated inability to portray reality using simulation.

In so doing most of the impeding elements affecting the usage of simulation in instructions at higher institutions of education can also be found to impede the use of simulation in secondary schools. These can be resolved at the administration level by providing funds to solve these problems and not solely be considered as the classroom teachers' responsibilities.

Twelve science teachers from seven schools partook in an investigation led by Vikki, *et al.*, (2018) to investigate the perceived benefits of

computer animation with high school biology teachers along with computer animation implementation in teaching. The research was quantitative. The instrument for data collection was interviews conducted face-to-face. Vikki, *et al.*, findings pointed out that teachers adopted simulations for demonstration purposes only to be used for teacher-centered instruction, indicating that teachers could not afford to make the simulation accessible to every learner, and makes an effort to give learners choices to use the computer models for independent exploration did not appear to function well due to limited facilities, internet availability, and technological knowledge. Moreover, another factor influencing teachers' implementing simulation in the findings was an urgent need for instructors to wrap up the needful curriculum in a short instructional time constraint. This means that simulation should be incorporated into the curriculum for every lesson, which will help teachers and administrators to allocate adequate time for teaching using simulation.

Andoh, (2012) conducted a survey study to investigate the factors (barriers or variables) having an impact on how instructors endorse and incorporate computer simulation or ICT into the classrooms. The following factors (barriers) influencing the use of simulation technology or ICT were identified by the researcher. These factors (barriers) were divided into hurdles at the instructor's level, school, and system levels. Barriers at the teacher level include absence of the following: teaching staff's confidence, digital literacy, and didactic training, monitoring of the new technology-based teaching methods, and differentiated training programs. The lack of the followings: platform for ICT, outdated-faulty equipment, scarcity of project-related experience, restricted access to instructional technology, and an inadequate level of ICT integration into schools are the restrictions at the school domain/level. The stern structure of traditional educational systems, customary evaluation, constrained syllabus, and constrained organizational structures are the barriers at the system level. Making a choice about how to address them may be aided by understanding the extent to which these barriers have an impact on learners and institutions. Additionally, from the perspective of the researcher, teachers in public schools who possess ICT skills to apply to teaching sciences may attempt to implement their skills to support students' understanding of the subject matter. Teachers run into difficulties with the sourcing and

upkeep of animation content, becoming a barrier to the continuation of such interventions, leaving them with no choice but to return to abstract teaching in the conventional manner. To fill in this gap, the researcher did source 3D animations and teachers were mentored how to teaching the sourced 3D animation.

Elementary biology teachers in the Siberian educational setting had their perspectives and attitudes on using Computer Simulations (CS) in the classroom analyzed, as did the correlations between the instructors' ages and duration of instruction in the field. Instructors' negative attitudes toward CS application were found to increase with both their age and years they served within the classroom (Županec, *et al.*, 2014). Similar findings were emphasized in a study Korte and Husing (2006), although Spain (52%) Sweden (48%), and Iceland (47%) ranked highest in the number of school computers and internet access, these authors found that teachers in those countries had the most negative attitudes toward CS. Teachers' advanced age and years of experience were major contributing factors. In addition, these findings entails that when teachers master an approach over many years in teaching a particular subject they might likely resist adopting new approach due to their long experience and advanced age thereby thwarting new teaching approaches.

MATERIALS AND METHODS

Mixed-methods design was adopted for the study. This design involves both quantitative and qualitative data collection. Dawadi, *et al.*, (2021) stated that mixed-methods design is appropriate when a researcher wants to generalize the findings

to a population based on different aspects of a phenomenon from different participants, identifying relationships or making comparisons, beliefs, opinions, and motivation. Thirteen biology teachers at the secondary school's level participated in the study. These teachers were selected from county mixed schools (are schools with boys and girls enrollment) based on sample random sampling.

The duration of the study lasted for four weeks. After all of the presentation and demonstrations sections- with Form Two Students (Grade 10 Students), involving C3D animations pertaining the mammalian circulatory system, teachers were asked to response to questionnaires individually to indicate their opinions considered as factors influencing the use of computer 3D animation in teaching biology. The questionnaires had two sections. Section A was on demographic information of teachers while section B was on items relevant to the research questions raised in the study focusing on factors influencing the use of computer 3D animation in teaching biology. Data collected from the questionnaire were analyzed using descriptive statistics.

RESULTS

Respondents' (teachers') demographic information was collected from thirteen biology teachers within the study locale (Kiambu County-Thika-East) in public secondary schools. This was necessary in order to comprehend the nature of the responses of biology teachers who participated in the study. Teachers' demographic information included their gender, age, educational level, and years of teaching experience.

Table 1: Gender and Educational Level of Respondents (Biology Teachers)

Gender	Frequency	Percent (%)
Male	6	46.2
Female	7	53.8
Total	13	100.0
Highest Edu. Level	Frequency	Percent (%)
Bachelor	12	92.3
Master	1	7.7
Total	13	100.0

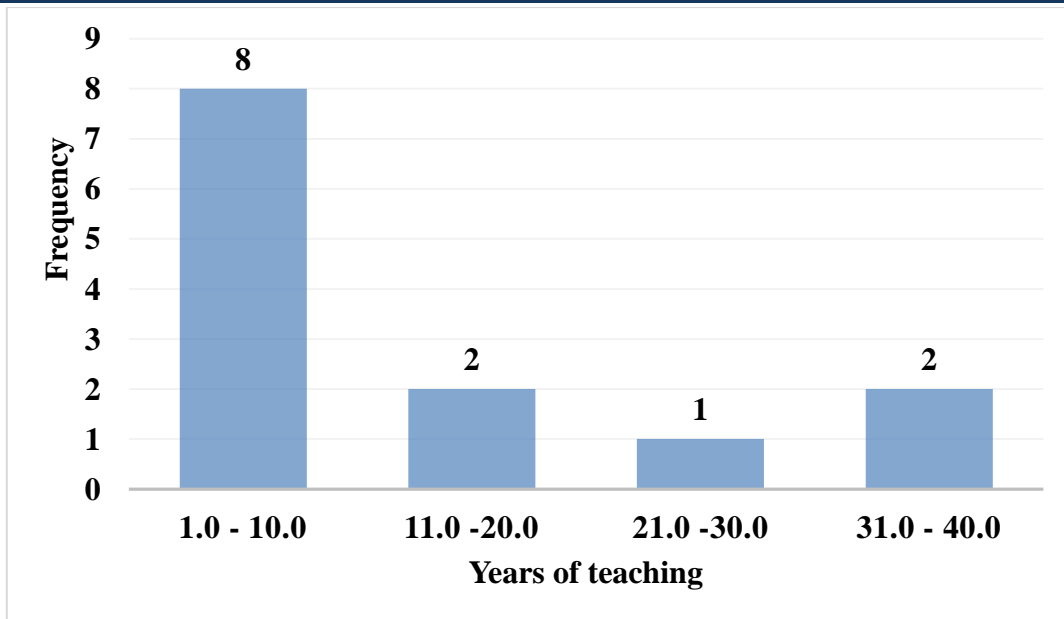


Figure 1: Participants-biology teachers’ years of teaching experience

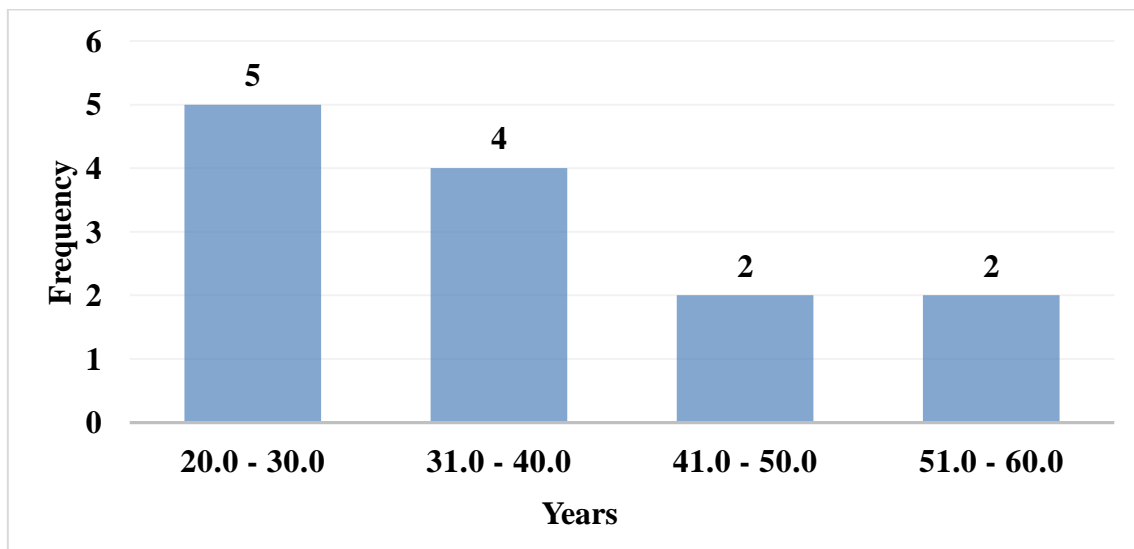


Figure 2: Age range of participants-biology teachers

Table 1 displayed the gender and educational levels of biology teachers, and Figure 1 and 2, displayed the age range and years of teaching experiences of respondents (biology teachers). This revealed that all of the sampled teachers were competent secondary school biology teachers within the study locale and had considerable years of teaching experiences.

Table 2 contains teachers' comments on the variables affecting the usage of computer 3D animations in biology instruction. For ease of

presentation, the data in Table 2 were condensed into frequencies and percentages from the questionnaires given to biology teachers. For simplicity and ease of data analysis and presentation, the following: Strongly Disagree = SD, Disagree (D), Not Sure (NS), Agree (A), Strongly Agree (SA), were condensed into the following: Agree and Strongly Agree into Agree (A), Strongly Disagree and Disagree into Disagree (D) and Not Sure (NS) remain constant.

Table 2: Summary of Frequencies and Percentages of Factors Influencing C3D Animation

No.	Statements	Types of Response		
		D	NS	A
		F (%)	F (%)	F (%)
1.	Computer 3D can help me to teach many new things in teaching biology	1(7.7)	0 (0)	12(92.3)
2.	I am able to use computer 3D animation in teaching biology	2(15.3)	3(23.1)	8(61.6)
3.	The school has enough resources to help me teach biology using computer 3D animation	4(30.8)	2(15.3)	7(53.9)
4.	I am able to access online resources to help me in teaching biology using computer 3D animation	1(7.7)	1(7.7)	11(84.6)
5.	The class size is too large to allow me to teach biology using computer 3D animation	10(76.9)	0 (0)	3(23.1)
6.	I am not able to deal with technical problems involving computer 3D animation	6(46.2)	3(23.1)	4(30.7)

DISCUSSION OF FINDINGS

From Table 2, it can be deduced that out of the six statements, three statements were identified as the major factors influencing the use of C3D animation in teaching biology based on teachers' responses, namely statements two, three, and six. Statement two states: I am able to use computer 3D animation in teaching biology. Nearly forty percent of teachers disagreed with this statement. Statement three which states: The school has enough resources to help me teach biology using C3D animation. More than forty-five percent of teachers disagreed with this statement, and statement six states: I am not able to deal with technical problems involving computer 3D animations. More than fifty percent of teachers agreed with this statement. For respondents who chose 'Not Sure' for statement number two, the researcher considered those respondents to lack the confidence needed to teach biology using C3D.

For statement number two, 15.3% of teachers disagreed, which can be interpreted as lacking the confidence needed in presenting biology lessons using C3D animation. Moreover, 23.1% of teachers also were not sure to have ability (confidence) to teach biology by employing C3D animation during instruction. Combining these two percentages which summed up to 38.4 % representing nearly half of the thirteen teachers having low confidence/ability in teaching biology involving C3D animation. Based on such finding

the researcher concluded that nearly half of the sampled teachers are not confident with teaching biology using C3D animation, but instead preferred the conventional/traditional mode of teaching biology.

For statement number three, 30.8% and 15.3% of teachers (respondents) disagreed and were not sure respectively, that their institutions have enough or the required resources (such as projectors and computers) to aid them to teach biology using C3D animation. Combining the percentages of teachers who disagreed and were not sure that their institutions have the needed resources summed up to 46.1 % (6 teachers) representing nearly half of the respondents sampled. The researcher considered a deficit in instructional resources as a major factor influencing the use of C3D animation in teaching biology.

In addition, 30.7% of teachers indicated that they lacked or have a deficit in dealing with technical problems relating to C3D animation. Whereas 23.1% were not sure or to have the basic and required skills (ICT) needed to deal with C3D animation when teaching biology. Combining these two percentages summed up to 53.8% representing slightly more than half of the sampled respondents (teachers) who lacked the basic ICT skills to deal with C3D animation.

Majority of the teachers (more than 80%) agreed that they are able to access C3D animation online

resources to teach biology, whereas a combined percent of 15.4% of teachers disagreed and were not sure they were able to access online resources to aid them in teaching biology using C3D animation. Since slightly more than half of teachers were not able to deal with technical problems involving C3D animation entails the majority of the teachers who are able to access C3D online resources will only use C3D animation for their personal use and then resort to the conventional mode of teaching of what they have learned from the online resources they have accessed.

The major factors identified that are influencing the use of C3D animation in teaching biology during this study were: teachers lack of confidence or ability to teach biology by employing C3D animation during instruction. This finding confirmed the findings of Fongang, *et al.*, (2017) such as the intimidating nature of the animation/simulation and fear of getting wrong feedback) which portrays lack of confidence and basic skills needed when employing animation in teaching biology.

The next major factor influencing C3D animation was institutions not having enough of the required resources (such as projectors and computers) to aid them to teach biology using C3D animation. This thwarts the willingness of teachers to do more in easing the difficulties in enhancing students' conceptual understanding of biological concepts. This finding was also confirmed by Andoh, (2012) which he referred to as a hurdle of ICT instructional resources at school/institution level.

Another factor was biology teachers' lack of competency in dealing with technical problems relating to C3D animation when teaching biology. Slightly more than half of the total number of biology teachers lack such skills. Fongang, *et al.*, (2017) findings on factors impeding the use of simulation in public and private institutions training nurses, concord with this finding as well. Teachers with such a deficit will always prefer traditional mode of teaching than to employ C3D animation to teach biology. Another factor identified as a major influence of C3D animation was teachers not being able to access C3D animation for teaching biology which was reported by less than a quarter of the participants. This might be due to the high cost and maintenance of internet availability and limited facilities facing public schools. Even though this number seem to be small but might have a negative profound effect

in enhancing practical conceptual understanding of considerable number of students being taught by these teachers at the secondary school level, where practical laboratory is a serious challenge. Vikki, *et al.*, (2018) reported similar findings when working with twelve biology teachers from seven schools involving computer animation.

Class sizes in the study locale was not considered to be a major factor posing challenge to teachers employing C3D animation in teaching biology. This was indicated by slightly more than two-third of respondents. Moreover, class sizes were considered to be moderate (40-50 students) throughout the study.

CONCLUSION

Teachers must be exposed to 3D animations on a regular basis in order to develop fundamental ICT skills, evaluate and pick the most effective resources for ease of presentations of complex topics in biology, and improve students' conceptual understanding. The study established three major factors influencing the use of C3D animation, which include: teachers lacking the basic skills in teaching or presenting biology (content) utilizing C3D animation, institutions lack of resources to assist instructors in teaching biology using computer 3D animation and teachers lacking the basic ICT skills needed to use C3D animation effectively.

RECOMMENDATIONS

Considering the study's findings and conclusion, the following recommendations were made:

1. Schools' administrators see the need to help source 3D animation teaching and learning resources for biology teachers to help ease the challenges teachers encounter when sourcing 3D animation.
2. Teachers training institutions see the need for biology teachers to be taught the basic presentation skills require for 3D animation.

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