INTEGRATING SIMULATION IN 5E TEACHING APPROACH IN TEACHING AND LEARNING BIOLOGY

ARASUMANI D/O KRISHNAN

UNIVERSITI PENDIDIKAN SULTAN IDRIS

2012

INTEGRATING SIMULATION IN 5E TEACHING APPROACH IN TEACHING AND LEARNING BIOLOGY

ARASUMANI D/O KRISHNAN

PROJECT PAPER SUBMITTED IN FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF BIOLOGY

FAKULTI SAINS DAN MATEMATIK

UNIVERSITI PENDIDIKAN SULTAN IDRIS

2012

DECLARATION

I hereby declare that the work has been done by myself and no portion of the work contained in this Thesis has been submitted in support of any application for any other degree or qualification on this or any other university or institution of learning.

02.12.2012   Signature

                                              ARASUMANI D/O KRISHNAN

                                              M20111000307

ACKNOWLEDGEMENT

In preparing this project paper, I was in contact with many people, researchers, academicians and practitioners. They have contributed towards my understanding and thought. In particular, I wish to express my sincere appreciation to my main project paper supervisor, Dr. Sadiah Binti Baharom, so committed to share knowledge, skills, expertise and enthusiasm that are invaluable to me. Also do not forget the student, all instructors of UPSI, especially the lecturers in the Faculty of Science and Mathematics. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. Without their continued support and interest, this project paper would not have been completed.

I would also like to thank the administrators, teachers and friends all students involved in particular all members of SMK Aminuddin Baki, Chemor, Perak especially Mr. Suresh, for their continuous support and cooperation of all time.

Thanks and appreciation to my beloved husband Mr. Saravanan, and beloved children S.Kisshenthiran and S.Manoaharan whom very understanding and always support and pray for my struggle. Finally, Thanks for all parties involved in the completion of this project paper, either directly or indirectly.

Thank you.

ABSTRACT

The purpose of this study was to investigate whether the integration of Simulation in 5E teaching and learning approach is more effective than conventional teaching and learning. The study further investigate the comparisons of achievement in higher and lower of experimental group with higher and lower of control group. The quasi-experimental design 2x2 was used. This study involved 56 form four secondary school students in Chemor, Ipoh. The participants consist of two existing groups (science 1 and science 2), whereby each group has higher and lower achiever. Experimental group was exposed to Simulation in teaching and learning while control group experienced the conventional teaching and learning. The result shows that there is an increase in scores on the post test performance among students in the experimental group compare with the control group ($F_{2-60} = 0.004$, $p<0.05$). Therefore, the results indicated that the integration of simulation in teaching and learning caused statistically greater achievement than the conventional teaching and learning. The result suggest that the integration of simulation in teaching and learning Biology in the school should be encouraged.

ABSTRAK

Tujuan kajian ini adalah untuk menyiasat sama ada integrasi Simulasi dalam pendekatan pengajaran dan pembelajaran 5E adalah lebih berkesan daripada pengajaran dan pembelajaran secara konvensional. Kajian selanjutnya menyiasat perbandingan pencapaian antara kumpulan berpencapaian tinggi dan rendah daripada kumpulan eksperimen dengan kumpulan berpencapaian tinggi dan rendah daripada kumpulan kawalan. Reka bentuk kuasi-eksperimen 2x2 telah digunakan. Kajian ini melibatkan 56 pelajar tingkatan empat dari sekolah menengah di Chemor, Ipoh. Para pelajar in terdiri daripada dua kumpulan yang sedia ada (sains 1 dan sains 2), di mana setiap kumpulan mempunyai kumpulan berpencapaian tinggi dan rendah. Kumpulan eksperimen telah didedahkan kepada Simulasi dalam pengajaran dan pembelajaran manakala kumpulan kawalan mengalami pengajaran dan pembelajaran secara konvensional. Hasil kajian menunjukkan bahawa terdapat peningkatan dalam skor pencapaian ujian pasca di kalangan pelajar dalam kumpulan eksperimen berbanding dengan kumpulan kawalan ($F_{2-60} = 0.004$, $p < 0.05$). Oleh itu, keputusan menunjukkan bahawa integrasi simulasi dalam pengajaran dan pembelajaran menyebabkan pencapaian statistik yang lebih besar daripada pengajaran dan pembelajaran secara konvensional. Keputusan kajian ini mencadangkan bahawa integrasi simulasi dalam pengajaran dan pembelajaran Biologi di sekolah perlu digalakan.

CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATION

ICT	-	Information and Communication Technology
DNA	-	Deoxyribonucleic acid
SPM	-	Sijil Pelajaran Malaysia
MOE	-	Ministry Of Education
N	-	Total Sample Size
$\bar{x}$	-	Mean
α	-	Alpha

APPENDIX LIST

CHAPTER 1

INTRODUCTION

It is difficult and maybe even impossible to imagine future learning environments that are not supported, in one way or another, by Information and Communication Technologies (ICT). When looking at the current widespread diffusion and use of ICT in modern societies, especially by the young – the so-called digital generation – then it should be clear that ICT will affect and complete the learning process today and in the future. There is, in other words, a widespread belief that ICT has an important role to play in changing and modernizing educational systems and ways of learning. There is, however, little scientific evidence of the concrete contributions of ICT to the learning domain, despite the efforts of the last decades. Hence, there is a need to bring evidence

together on the impact of ICT on education and training in Malaysia.

The introduction of ICT as a programme in Malaysian secondary schools provides a valuable platform for students to gain computer and information literacy. The programme helps students to relate their ICT learning experiences to a progressive technology-based daily life. The programme also provides a platform towards producing a technologically capable work force as well as helping them to face the challenges of global economy. The Computer in Education (CIE) programme was first launched and piloted in 60 secondary schools in 1992 for all Form One (age 13 years old) and Form Two (14 years old) students. This programme has been well-received and is beneficial to pupils in enhancing learning in the area of technology. In 2002, this programme is extended to all schools equipped with computer labs. Thus, this curriculum offers learners with basic ICT skills to further develop their interest in specific areas offered in the syllabus. This subject had been revised and changed into Information and Communication Technology (ICT) in 2005 (Rohaida Mohd. Saat and Kamariah Abu Bakar, 2008).

The application of information technology and informational thinking in the biological sciences leads to the modification of students learning mode. It is very important not only to apply informational thinking and informatics technologies in study of the live world. Furthermore, biotechnologies also enrich development of informatics with ideas from informational system of the live world. Rapidly increasing power of computers enables detailed simulations of biological systems. Thus, it

is inevitably raises the question of whether computers will eventually replace to conventional practical classes.

According to Tam (2009), simulations are programs that contain a model of a system (natural or artificial, e.g., equipment), or a process. Simulations can broadly be divided into two types: simulations containing a *conceptual* model, and those based on an operational model. Conceptual models hold principles, concepts, and facts related to the (class of) system(s) being simulated. Operational models include sequences of cognitive and non-cognitive operations (procedures) that can be applied to the (class of) simulated system(s). Examples of conceptual models can be found in biology and in physics for example, to be found in radar control tasks. Operational models are generally used for experiential learning, in a discovery learning context we mainly find conceptual simulations.

1.1   Research Background

The ultimate goal of using simulation is to visualize how the process of mitosis is occurring in the cell. A eukaryotic cell separates the chromosomes in its cell nucleus into two identical sets, in two separate nucleuses. It is generally followed immediately by cytokinesis, which divides the cytoplasm, organelles and cell membrane into two cells containing roughly equal shares of these cellular components. Mitosis and cytokinesis together define the mitotic (M) phase of the cell cycle the division of the mother cell into

two daughter cells, genetically identical to each other and to their parent cell nuclear division that reduces the number of chromosomes in daughter cells to half that of the parent cell. Through integrating simulations in teaching and learning it is hoped that student can compliment conventional techniques and gain a better understanding of how process mitosis taking places.

Countless experiments have been done and several hypotheses have been put forward to explain the differentiation, migration, growth and division of cells in early stage and embryonic development. Through developmental models and computer simulations it is hoped that teaching and learning can compliment conventional techniques and gain a better understanding of how these mechanisms interact with each other and influence cellular development (Vincent, 2009).

Computer simulations make these types of interactive, authentic, meaningful learning opportunities possible. Learners can observe, explore, recreate, and receive immediate feedback about real objects, phenomena, and processes that would otherwise be too complex, time-consuming, or dangerous (Tarekegn, 2009). Broadly defined, computer simulations are computer-generated dynamic models that present theoretical or simplified models of real-world components, phenomena, or processes. They can include animations, visualizations, and interactive laboratory experiences. In a simulated environment, time changes can be sped up or slowed down; abstract concepts can be made concrete and tacit behaviors visible (Akpan, 2000). Teachers can focus students' attention learning objectives

when real-world environments are simplified, causality of events is clearly explained, and unnecessary cognitive tasks are reduced through stimulation.

1.2   Statement of Problem

Through teaching experience, researcher have more clear understanding that most of the student whom are studying cell division topic having problem of understanding especially in the phases of process mitosis (Segel, 1984). The events during Mitosis process students could not understand because they unable to visualise the different phases together the sequence of process which taking place.

These supported by Malaysian government various steps to facilitate greater integration of information and communication technology (ICT) to enhance the effectiveness of education. This was outlined in the country's ICT Master Plan, finalized in 2001. The long-term vision of the plan, Vision 2020, for sustained, productivity-driven growth, possible only with a technologically literate, critically thinking workforce, prepared to participate fully in the global economy of the 21' century.

Beside that, Malaysian governments' also provides schools with ICT tools and manages change towards integrating ICT into teaching and learning. Therefore, students will be introducing with live visuals containing the particular topics which they unable to

understand clearly. Moreover, Malaysia Government also encourages students to pursue science education at the upper secondary level to meet the demand of the labor force in the industrialized economy. In this respect, the Ministry of Education has formulated a policy aimed at making 60 percent of enrolment. Unfortunately,   the present enrolment only achieved at 28 percent for upper secondary science stream (Faridah, Shah 2010).

Those students learning with conventional method, not able to achieved with unexpected results. Whereby, these students did not utilize all the experimenting possibilities that were available. For this reason, in a number of studies, additional instructional measures are suggested to help learners overcome the problems. The group of students receiving a simulation in addition to a tutorial, scored higher on a test compare to conventional group (Gokhale, 1996).

Although laboratory application in students' learning has a very important place in biology education, in use, it has some limits and problems, especially in developing countries. Some of the main problems faced in school can be summarized as follows:

- In carrying out experiments

- Arranging with equipment, the laboratory activities are expensive.

- For planning and application, it is much time consuming.

- Checking students' performance during the activities can be difficult in over-crowded classes.

- Lack of laboratory or equipment, or insufficient lab conditions which limits the teacher to perform a simple lab activity.

At this point, teaching using simulations are effective as real equipments in enhancing conceptual understanding and mastery of manipulating real equipments. Therefore, replacing real equipment labs with computer demonstration vital in our economical constraints to fulfill costly real lab equipment in the urban as well as the rural schools.

1.3 Research Purpose

The purpose of this research is to study the significant differences between the use of simulations in 5E teaching approach as a way of teaching and learning biology. Using simulation will be enhancing the students' understanding for topics of Mitosis. Furthermore, this identifies the research aims at differences in achievement between learners who were taught using two different instructional methods.

1.4 Research Objective

The aims of this study, is to study the effect of simulation on students' achievement in the topic of mitosis in cell division. Through simulation teaching, students can discover how one cell with limited direct information can develop into a complex organism. The effect using simulation will be measured by conducting a post test.

Through developmental models and integration of simulations it is hoped that the student would gain a better understanding of how the process of mitosis in cell division occur. Visualization of cell division without microscopic procedure can results in the understanding of learners to constructs the actual process that allow them to think about, describe, and explain the real structures of the cell.

1.5   Research Questions

The research questions are as follows:

1).   Is there a significant difference in academic achievement between students in the experimental group and the control group?

2).   Is there a significant difference in academic achievement between students in higher achiever and lower achiever in experimental group?

3).   Is there a significant difference in academic achievement between student in higher achiever and lower achiever in control group?

4).   Is there a significant difference in academic achievement between   student in higher achiever experimental group and higher achiever in control group?

5).   Is there a significant difference in academic achievement between

students in lower achiever experimental group and lower achiever in

control group?

1.6   Research Hypothesis

The objective of the study to measure the impact of Computer Simulation for the topic of

process Mitosis on academic achievement is based on testing the null hypothesis (Ho) and

alternative hypothesis (Ha) of the following:

Ho 1:   There was no significant difference in academic achievement between the

experimental group and the control group.

Ho 2:   There was no significant difference in academic achievement between

higher achiever and lower achiever in experimental group.

Ho 3:   There was no difference in academic achievement between higher

achiever and lower achiever in control group.

Ho 4:   There is no significant difference in academic achievement between

higher achiever experimental group and higher achiever in control group.

Ho 5:   There is no significant difference in academic achievement between

lower   achiever experimental group and lower achiever in control group.

1.7   Significant of The Research

In the view of achieving the significant of the research, computer simulation should be integrated into teaching and learning biology. In addition, simulation programs makes the concepts and processes more concrete and causes to achieve the objective of students, educator and policy maker.

1.7.1   Significant of The Research To The Student

Researchers hope this study will also help to alert students to strive to improve the mastery of topic cell division for answering questions in SPM. The studies show that computer based learning by way of simulation programs makes the concepts and processes more concrete and causes the students to understand more easily the relationship between them and as a result of this, a more permanent learning is achieved. The non-print, interactive, multi-sensory, 3-dimensional, and in some cases hands-on nature of these tools can be highly engaging for students. These tools make certain types of content unusually accessible and enable students to work with that content in a way not normally possible. Therefore, computer simulations and virtual reality are programmed and digitized, it would be realistic for a teacher to offer students a selection of different environments and simulations with different content.

1.7.2 Significant of The Research To The Teachers

This study emphasizes only a topic in form Four Biology syllabus involving the concept of process mitosis modification and its application. The findings of this study will later be a guideline in looking at what the basics should be emphasized by the teachers, so that students have a strong foundation in Biology form four syllabus. The introduction of virtual reality and computer simulations into the classroom will greatly improve teachers' ability to offer choices of content and tools because their nature is so vastly different from those typically made available in the classroom.

In particular, it is hoped the study could enhance teaching techniques and learning for the subheadings under review. In addition, teachers can also find out the weaknesses of students in solving problems that can be easily resolved this relevant topic. Another way to motivate students is to provide rewards. But no one kind of reward will motivate every student so teachers are encouraged to offer a choice of rewards. Computer simulations and virtual reality can help mix things up. It is not difficult to generate recreational forms of these materials that could be offered to students as an extrinsic reward for a job well done. In terms of intrinsic rewards, these materials are also valuable in terms of their ability to build students' sense of accomplishment by providing feedback and knowledge of results. Students also benefit when teachers offer a choice of learning context. Factors like the degree of structure or support, the speed of the work, the level and timing of feedback, and the degree of game-like elements, are important to different students in different ways. With computer simulations and virtual reality teachers can

vary some of these features and offer students enough choices that they can find a personally effective learning context.

1.7.3   Significant of The Research To Policy Makers

The key role of education is to empower students with skills and attitudes that are essential to their success in our future knowledge society. In view of that, new ways of thinking and solving problems in supportive classroom learning environments require well-developed motivation, self-regulation strategies and metacognitive capacities to engage students successfully.

A central aim of education is to ensure students, essential information skills, appropriate to the knowledge society, and to nurture modes of learning, or learning styles, such as visual, auditory and to maximize the learning potential of individual students. To achieve this aim, the use of Information and Communication Technology (ICT) is important.

It is easy to believe that ICT has a positive influence on learning and teachers are convinced ICT offers better learning opportunities than 'conventional' approaches. The commitment of the schools is evidence of the positive thinking about ICT and its potential

to improve student attainment. For many students the novelty of the equipment is a motivational factor in their learning. The attention should, be focused on whether the ICT is engaging the student and enhancing the learning.

For SPM examination, this study hopes to assist students' manage to answer the questions which related to cell division topic. It can provide a form of academic quality courses and also hope the parties involved can improve teaching and learning in further strengthening students with the fundamentals of the biology before moving to further.

1.8   Research Limitation

This study has certain limitations. This study focuses only on a relatively small scope in teaching and learning biology for form four students and applications involving the process cell division in biology. Whereby, biology achievement test conducted is limited to this topic. Test sample consist of all objectives questions and students are only from form four science stream. Therefore, the result obtained could not generalized to the whole population of students non- biology subjects. Besides that, result of this research also cannot be generalized to other subjects. The findings might be different if the study were conducted on biology student in different school or in different subject.

1.8.1   Operational Definition of Research Variables

1.8.1.1   Computer Simulation Learning

Computer Simulation Learning use in the classroom, consisting of five categories:

(Thomas and Boysen Taxonomy).

- experiencing

- informing

- reinforcing

- integrating

- utilizing

For this research, researcher use video clips from Youtube. This simulation consists of cell division topics which divided into Interphase and Process Mitosis. During this simulation teaching the student should be able to understand those process occur in different phases such as interphase, prophase, metaphase, anaphase and telophase which they could not visualized with their present understanding of the topic of conventional teaching.

1.8.1.2   Conventional Teaching Approach

Conventional teaching is a common teaching in which teacher communicate, while the students shows less involvement. It is teachers centered whereby student pays less attention when teacher is using black or white board as a teaching aid.

1.8.1.3 Academic Achievement

Academic achievement refers to the success of the study and measured by tests administered by the subject instructor. It also refers to the marks obtained in the test