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**Research Article**

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# Computer Simulation on Teaching and Learning of Selected Topics in Physics

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**ABSTRACT**

This study was conducted to evaluate the effects of computer simulations and conventional teaching in Physics concept learning on high school students.

The descriptive-experimental design was used in this study. The teacher-made test and evaluation questionnaire were used for gathering data. The data gathered were statistically treated and analyzed using SPSS software.

Findings of the study revealed that there were 40 or 50% male student respondents and 40 or 50% female. The pre-test score of the experimental and control groups did not differ significantly, while pre-test and posttest of the experimental and control groups were found to be significantly different. The evaluation of the teachers and students on lecture with computer simulation and conventional lecture methods did not differ significantly in terms of effectiveness/appropriateness, students' participation/interaction, influence on cognitive skills and influence on content knowledge. There was a significant relationship between the sex and performance of the student respondents who were exposed to lecture with computer simulation method while the performance of the male and female student respondents exposed in conventional lecture method did not differ.

Based on the findings of this research, the use of computer simulation as instructional material in teaching Physics is recommended. This may be used to improve the performance of the students. It may be tried in other schools and respondents. Further studies may be undertaken in other Science subjects to establish the validity of the effectiveness of Lecture with Computer Simulation in teaching-learning process. Developers of instructional materials may improvise other teaching aids that may suit the needs and interest of the students.

**Keywords:** computer simulation, physics, teaching method

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## INTRODUCTION

Specialists on teaching Physics have developed strategies and tools to help increase the desire of students in learning Physics and strengthen their attitudes towards it. This is because students find Physics difficult as they have to compete against different representations such as experiments, formulas and calculations, graphs, and conceptual explanations at the same time. Teachers are also having difficulty in teaching Physics because students have poor foundation in analyzing the situation and in problem solving (Dalagan & Mistades, 2010).

Today, numerous ICT applications are available, aiming to stimulate students' active engagement. One of them is computer simulation which is of special importance in Physics teaching and learning (Jimoyiannis & Komis, 2000).

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, text, images, video clips and interactive laboratory experiences (Bell & Smetana, 2011).

Computer simulations offer a great variety of opportunities for modeling concepts and processes. Simulations provide a bridge between students' prior knowledge and the learning of new physical concepts, helping students develop understanding through an active reformulation of their misconceptions (Jimoyiannis & Komis, 2000).

Researchers in Turkey, New York and Hongkong found out that computer simulations can be effective in developing content knowledge and process skills, as well as in promoting more complicated goals such as inquiry and conceptual change. Gains in student understanding and achievement have been reported in general science process skills and across specific subject areas, including Physics, Chemistry, Biology, and Earth and Space Science (Kulik, 2002).

With this background, the researcher of this study sought to establish the use of computer simulations in Physics education. Physics education is essential in understanding the nature. Although many students do not appreciate this branch of science, it is important to have

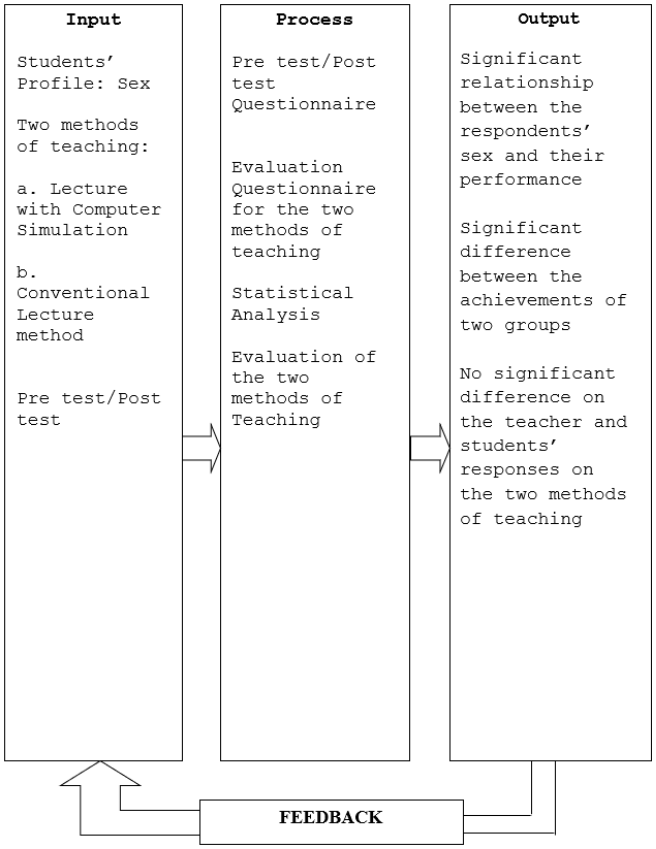


**Figure 1.** Paradigm of the Study

foundation on the energy forces of nature. Thus, it remains an integral part of K – 12 Science, hence this study.

## THEORETICAL FRAMEWORK

Computer simulations have the potential to enhance the way you teach and your students learn. They allow you to bring even the most abstract concepts to life for your students and incorporate otherwise impossible or impractical experiences into your daily instruction. Interaction with computer simulations resulted in measurable achievement gains and indicates that simulations are more effective than traditional methods (Bell & Smetana, n.d).

In the paradigm of the study, the input box shows students' profile in terms of sex, the two methods of teaching – lecture with computer simulation and conventional lecture method, and pre- test/post-test scores of experimental and control group.

In the process box, pre test/post test questionnaire and evaluation questionnaire were administered to evaluate the effects of two teaching methods on teaching and learning in Physics. The experiment was confined to the achievement of the respondents in Science IV (Physics). Pre-test and post-test instruments were used to gauge the degree of correlation on the performance of the control and experimental groups.

The output box determines the significant relationship between the respondents' sex and their performance in Physics, effect of lecture with computer simulations as compared with conventional lecture method on teaching and learning on selected topics in Physics, the level of assessment of the two teaching methods as perceived by the teacher and student respondents.

### Statement of the Problem

This study sought to compare the effects of computer simulations with the conventional teaching Physics concepts among high school students.

Specifically, this study wanted to answer the following questions:

1. How may the nature of the respondents be described in terms of their sex?
2. Is there a significant difference in the achievement of the respondents exposed to computer simulations and conventional teaching in terms of:
   a. Pre-test scores of the control and experimental groups
   b. Post-test of the two groups
   c. Pre-test and post-test of the two groups?
3. How may the methods of teaching be described by the teacher respondents in terms of:
   a. Effectiveness/Appropriateness;
   b. Students' participation/interaction;
   c. Influence on cognitive skills; and
   d. Influence on content knowledge?
4. How may the methods of teaching be described by the student respondents in terms of:
   a. Effectiveness/Appropriateness;
   b. Students' participation/interaction;
   c. Influence on cognitive skills; and
   d. Influence on content knowledge?
5. Is there a significant difference on the teachers' and students' responses on the lecture with computer simulation and conventional lecture method?
6. Is there a significant relationship between the respondents' sex and their performance in terms of:
   a. Lecture with computer simulation method
   b. Conventional lecture method

### Hypotheses

1. There is no significant difference between the achievement of the respondents exposed to lecture with computer simulations and conventional lecture method.
2. There is no significant difference on the teachers' and students' responses on the lecture with computer simulation and conventional lecture method.
3. There is no significant relationship between the respondents' sex and their performance in lecture with computer simulation method and conventional lecture method.

### Significance of the Study

The output of this study would be of value to the following:

**Administrators (particularly head teachers)**, to serve as a basis in improving the professional growth of their teachers and give trainings on the use of computers in teaching-learning process;

**Teachers,** to help them realize the different teaching innovations that can help them in improving the performance of their students and thus, be more efficient with their teaching and to identify what areas they need to improve on;

**Students,** to provide insights on how to persevere in their studies and use technology in meaningful learning,

And lastly, for **future researchers** in which the results of this study may serve as a guide for conducting more studies related to this research.

### Scope and Delimitation of the Study

The study focused on assessing the effects of computer simulations on teaching and learning in Physics at Justino Sevilla High School during the academic year 2014-2015. The topics that were discussed with the senior students were speed, velocity and acceleration. These were chosen in accordance to the findings of Paras (2014) on the difficult lessons in Physics. The program that was used in this study is the application developed by the Physics education research group at University of Colorado at Boulder. This was not validated and tested by the panel of examiners.

### Definition of Terms

The following terms are hereby defined operationally and/ or conceptually as used in the study.

**Animation** is the creation of artificial moving images.

**Computer Simulation** is an imitation of a real concept or process (Salandanan, 2009).

In this study, it serves as a teaching aid in facilitating learning.

**Control group,** in this study, refers to the respondents who will be exposed to conventional lecture method.

**Conventional Lecture Method** is the most common method used in imparting knowledge and information among the students in the secondary and tertiary levels (Zulueta, 2006).

In this study, it refers to the pure lecture method.

**Experimental group**, in this study, refers to the respondents who will be exposed to lecture with computer simulations.

**Graphics** refers to any computer device or program that makes a computer capable of displaying and manipulating pictures.

**Information and Communication Technology (ICT)** is the study of the technology used to handle information and aid communication.

**Multimedia** is a human-computer interaction involving text, graphics, voice and video.

**Physics** is a branch of science that deals with the interaction between matter and energy (Bentillo, 2004).

**Software** refers to the instructions executed by a computer, as opposed to the physical device on which they run.

**Students' Learning** is the performance attained after the study has been made.

**Teaching Method** refers to the teachers' systematic procedure of getting the lesson across to the child (Lardizabal, 1999).

**Video clips** are short videos, often part of a longer recording that can be used on a website.

## LITERATURE REVIEW

Related literature and studies include research findings, published and unpublished theories and principles formulated by experts contained in books, pamphlets, magazines and periodicals which were reviewed to give an adequate background to the problem under study.

### Foreign Literature

One of the new attempts and needs in teaching-learning process is the use of computers in instructional endeavors as they are considered as effective communication and individual learning tools. Computers can be used on their own or along with other instructional tools to ameliorate learning practices (Akgun, 2000).

A number of science educators in the UK suggest that computer simulations offer considerable potential for the enhancement of the teaching of science concepts via, for example, enabling students to modify rules and variables to explore the science of a model, to question and test hypotheses (Enyedy & Goldberg, 2004); offering simultaneous representations of the real and theoretical behaviors of a system (McFarlane & Sakellariou, 2002).

According to Linn (2010) as cited by Honey and Hilton (2011) simulations are hypothesized situations or natural phenomena that allow users to explore the implications of manipulating or modifying parameters within them.

Simulations allow users to observe and interact with representations of processes that would otherwise be invisible. These features make simulations valuable for understanding and predicting the behavior of a variety of phenomena, ranging from financial markets to population growth and food production. Scientists routinely develop and apply simulations to model and understand natural phenomena across a wide range of scales, from subatomic to planetary (Hayward, Homer, & Plass, 2009).

As a teaching/learning aid, computer simulation programs can have many advantages. They provide individualized, self-paced learning with immediate feedback on learner's actions. Compared with laboratory work, they save time and money (particularly if the experiment has to be repeated under different conditions), require less effort to set up and reduce the demand on students by providing automatic measuring facilities and instant feedback. They can simulate invisible or theoretical processes and provide pictorial dynamic representation of abstract models (e.g., kinetic theory of gases). They can simulate dangerous experiments and catastrophes (e.g., the melt-down of nuclear power reactor) and situations which would otherwise be very difficult or impossible to explore. However, it should be noted that simulations cannot replace laboratory experience; rather they should be used to supplement and extend laboratory work (Tao, 2000).

In addition to that, allowing students to use only a simulation does not necessarily result in higher learning outcomes. However, simulations that are accompanied by support lead to effective learning as can be seen from large-scale evaluation studies. Support can of course take the form of a teacher, but can also be found in student partnerships i.e., cooperative or collaborative learning. In simulation programs, supports are often built-in and are known as cognitive tools, or scaffolds. They help students think through the learning processes necessary to understand the simulation (De Jong, 2006).

Effective simulations require several properties to help students understand scientific concepts better and also help them revise their alternative conceptions regarding physical phenomena. If the learner is using the simulation on his or her own it becomes even more important that there is provision to support learning and the simulation has some

features that help better learning of difficult concepts of science (Blake & Scanlon, 2007).

### Local Literature

In today's world, demands on the learner have increased substantially. In the traditional classroom, we view the teacher standing in front of the classroom while students sit and listen. Where once it may have been sufficient to learn rote experiences within given working environments, now the real world demands that individuals use higher-order reasoning skills to solve complex problems. Learners must now be viewed as proactive participants in learning, actively seeking ways to analyze, question, interpret, and understand the ever-changing environment (Carreon, Prieto, & Vega, 2006).

With the diversity of learners, breakthroughs in technology and multiple teacher perspectives, an innovative teaching is one of the answers to the global demands for quality education (Bilbao et al., 2006).

According to Zulueta (2006) in order to insure the delivery of knowledge and information to intended recipients who are the pupils/students, it is important to know the appropriate teaching methodology. Methodology refers to the orderly, logical and systematic procedure in doing something more specifically on the science and art of teaching. The teacher should have a definite and comprehensive plan characterized by a series of related and progressive acts she should perform to accomplish the specific aims of the lesson.

A teacher who is updated on the benefits derived from the use of appropriate technology such as computers, audiovisual devices, electronically operated and various multimedia equipment could enhance her skill in generating new information. Advances in Information and Communication Technology (ICT) have dramatically ushered teachers into a truly interactive mode of teaching and learning (Salandanan, 2005).

One technique to help learners engage in higher order thinking skill is the use of computer simulation in teaching. Computer simulations materials are softwares that are constructivist in nature. This simulation software teaches strategies and rules applied to real-life problems/situations, ask students to make decision on models or scenarios and allow students to manipulate elements of a model and get the experience of the effects of their decision. An example of such software is Simcity in which students are allowed to artificially manage a city given in an imaginary city environment (Lucido, 2007).

### Foreign Studies

Rapid technological advances in the last decade have sparked educational practitioners' interest in utilizing computers as an instructional tool to improve student learning. There is substantial evidence that using technology as an instructional tool enhances student learning and educational outcomes. Demirtas and Gulek (2005) examined the impact of participation in a computer program on student achievement. A total of 259 middle school students were followed via cohorts. His study revealed that computer students showed significantly higher achievement in nearly all measures after one year in the program.

The use of simulations in Physics teaching and learning opens up important research issues. The results presented by Jimoyiannis and Komis (2000) show that computer simulations could be used complementary or alternative to other instructional tools in order to facilitate students' learning.

A meta-analysis was performed by Chen and Liao (2007) to synthesize existing research comparing the effects of computer simulation instruction (CSI) versus traditional instruction (TI) on students' achievement in Taiwan. Twenty-nine studies were located from four sources, and their quantitative data were transformed into Effect Size (ES). The overall grand mean of the study-weighted ES for all 29 studies was 0.54. The results suggest that CSI is more effective than TI and has a more positive effect on students' learning than TI.

This was affirmed by the study of Aldhamit *and* Alrsa'I, (2014) whose findings showed a statistically significant difference of teaching accompanied by a computer simulation program to understanding the concepts of electricity and magnetism.

In the study conducted by Adams et al. (n.d.), three groups of students- those who used real equipment, those who used computer simulations, and those who had no lab experience, were compared in terms of their mastery of Physics concepts and skills with real equipment. Students who used the simulated equipment outperformed their counterparts both on conceptual survey of the domain and in the coordinated tasks of assembling a real circuit and describing how it worked.

Joseph and Kinzie (2008) surveyed 42 middle school students on their game activity preferences. The explorative mode of play was the most appealing for all students but particularly for girls. An example of a game that fosters exploration is Discover Babylon, in which students travel through Mesopotamian time using Math, reading and writing skills.

Similarly, Maloney (2005) showed in an experiment with 224 high school girls that a simulation of a fetal pig dissection was a viable alternative to actual dissection. Further support for the value of exploration in a simulation environment comes from a study by Eliahu and Ronen (2000) of 63 pairs of 15-year-old students. Students permitted the option of exploring an interactive simulation of electrical circuits' demonstrated better knowledge of circuits and increased confidence in their skills than those who did not have this option.

Likewise, Bell and Smetana (2011) revealed that simulations can be as effective, and in many ways more effective, than traditional (i.e., lecture-based, textbook-based and/or physical hands-on) instructional practices in promoting Science content knowledge, developing process skills, and facilitating conceptual change. As with any other educational tool, the effectiveness of computer simulations is dependent upon the ways in which they are used. Computer simulations are most effective when they (a) are used as supplements, (b) incorporate high-quality support structures, (c) encourage student reflection, and (d) promote cognitive dissonance. Used appropriately, computer simulations involve students in inquiry-based, authentic Science explorations. Additionally, as educational technologies continue to evolve, advantages such as flexibility, safety, and efficiency deserve attention.

In the paper of Kotoka and Kriek (2014), they investigated the impact of computer simulations on the performance of 65 grade 11 learners in electromagnetism in a South African high school in the Mpumalanga province. In the analysis of the test questions by topic, the experimental group outperformed the control group consistently. The ability of computer simulations to aid learners' conceptual understanding was confirmed. Although the performance of the

learners was established, the role of the teachers when selecting the most effective instructional designs to enable learners to understand the fundamental ideas in electromagnetism could not be overlooked.

Sahin (2006) found out that students working with simulations exhibited significantly higher scores in the research tasks. His findings strongly support that computer simulations may be used as an alternative instructional tool, in order to help students confront their cognitive constraints and develop functional understanding of Physics. He indicated that although computer simulations cannot replace Science classroom and laboratory activities completely, they offer various advantages both for classroom and distance education. He suggested that the success of computer simulations use in Science education depends on how they are incorporated into the curriculum and how teachers use them.

According to Steinberg (2000), the impact of using computer simulation in a classroom obviously depends on the details of the program and the way in which it is implemented. In order to explore one particular example, he considered a computer simulation on air resistance implemented in an interactive classroom. He compared this environment with one that used interactive learning but did not use a simulation. This resulted in reasonably good student understanding of the subject matter. However, material administered in the same spirit without a simulation yielded nearly identical results on a common exam question. This result suggests that the student success is not simply tied to the simulation.

Abbey, Jonathan and Towler (2006), suggested that increasing resources for supporting simulation use per se may not have a significant impact on the uptake and maintenance of simulations as active learning approach. The results suggested that academics make the decision to use these techniques based upon their professional judgment of benefit and risk, rather than on the resources available. If academics are motivated to use simulations, resource limitations will generally not stop them.

### Local Studies

Computers are used in many ways in teaching Science. Students use computers to acquire and display experimental data, to digitally analyze videotaped phenomena, and to mathematically model systems. Many studies have shown that students who go through active-engagement computer-based activities do better than students who go through traditional instruction.

In the study of Cravino, Sarabando, and Soares (2014), they found out that the total gains were higher when students used the computer simulation, alone or together with "hands-on" activities. However, the total gains obtained depend on the teachers' pedagogy when using the computer simulation to teach the concepts of weight and mass.

This was supported by the research of Lansangan (2011) which revealed that the group exposed to the use of computers outperformed the group who received traditional lecture-discussion method.

This was opposed by the study of Barlis and Fajardo (2013) which revealed that both groups' scores increased significantly from the pretest to the posttest, in both multiple-choice questions and problem solving regardless of methods used. Hence, both traditional and experimental methods, individually, are effective in teaching the students.

### Literature Synthesis

Overall, the researchers showed that interaction with computer simulations resulted in measurable achievement gains and indicates that simulations are equally, if not more, effective than traditional methods.

The literature review suggested that computers may play important roles in the classroom and laboratory Science instruction in either the classroom or in distance learning.

They can be used with instructive or constructive pedagogy. Computer simulations give students the opportunity to observe a real-world experience and interact with it.

Computer simulations are potentially useful for simulating labs that are impractical, expensive, impossible, or too dangerous to run. Simulations can contribute to conceptual change, provide open-ended experiences, and provide tools for scientific inquiry and problem solving.

The literature implied that computer simulations are good supplementary tools for classroom instruction and Science laboratories. There is a growing interest on multimedia supported, highly interactive, collaborative computer simulations because of their potentials to supplement constructivist learning. They offer inquiry environments and cognitive tools to scaffold learning and apply problem-solving skills.

The difference of the present study with the other conducted researches was it evaluates the effects of computer simulation in teaching and learning process. Most of the studies conducted focused on the students learning without considering the teaching method. The topics covered by the different studies were electromagnetism, mass, weight and electricity.

## METHODOLOGY

This chapter includes the research method, instrument used in the gathering of data, the subjects and the sources of data, as well as the method used in analyzing the data.

### Research Method

The method used in this study was a descriptive-experimental design. Descriptive method was used to gather information on the evaluation of teacher and student respondents in two teaching methods –Lecture with computer Simulation Method and Conventional Lecture Method. For the experimental part of the study, the treatment (use of lecture with computer simulations) was applied to the experimental group and the conventional lecture method to the control group.

### Locale of the Study

This study was conducted at Justino Sevilla High School in Arayat, Pampanga. It is the biggest school in the Division of Pampanga. It has a population of more than 3000 students and more than 100 teachers. Sectioning is heterogeneous.

### Sample and Sampling Procedure

Random sampling was employed in choosing the student respondents while purposive sampling was used in identifying the teacher respondents. The teacher respondents were the Science Head teacher, Science Coordinator and Science teacher.

### Respondents of the Study

The respondents of the study were the senior students, Head teacher, Science Coordinator and Science teacher. Student respondents were chosen randomly from two sections and they were divided into two groups. One group was assigned as experimental group while the other was the control group. Since sex was considered as a variable in this study, stratified random sampling was employed to determine the number of male and female students. The student respondents were chosen through picking their names from the list.

### Research Instrument

The researcher used two questionnaires to achieve the objectives of the study. The first questionnaire was a 30- item teacher-made test which was used as pre-test/post-test to determine the prior knowledge of the students and what they have learned after the discussion. The scope of the test included speed, velocity and acceleration. The other instrument was an evaluation questionnaire which was used by the teacher and student respondents (control and experimental group) in evaluating the two methods of teaching.

A table of specification for the test was framed. The chart of the specifications gave the detailed number of test items by content, percentage of items, and number of days each objective will be taken.

### Validation of the Instrument

The pre-test/post-test and evaluation questionnaires were validated by three (3) Physics teachers of Rafael L. Lazatin Memorial High School and four (4) Science teachers at Pampanga State Agricultural University. Pilot testing was done with thirty (30) fourth year students of Vocational Agricultural Curriculum (VAC). The evaluators suggested to make the items parallel specifically the opening statement, make the number of items into five for each topic, and to connect the second phrase. The results of pilot testing and the suggestions of evaluators were considered in editing the questionnaires.

### Data Collection

As soon as the validity and reliability of the instrument were established, pre-test was administered to two sections of fourth year students. Retrieval of pre-test questionnaire was done after the test and the data were tabulated.

Treatment was done after the administration of pre-test. The teacher used lecture with computer simulation to the experimental group, while conventional lecture method was employed with the controlled group.

During the discussion, teacher respondents evaluated the two methods of teaching.

After all the topics were discussed, post test was administered to both groups. The post test questionnaire was retrieved thereafter. The evaluation questionnaire for the two methods of teaching was also distributed to the student respondents.

The researcher served as the teacher of the two groups. The respondents were treated with the same environmental condition.

As soon as the data were analyzed and interpreted with the use of Statistical Package for Science (SPSS) software, appropriate conclusions and recommendations were given.

**Table 1.** Profile of the Student Respondents as to Sex

| Sex | Frequency | Percent |
|---|---|---|
| Male | 40 | 50% |
| Female | 40 | 50% |
| Total | 80 | 100% |

### Statistical Treatment of Data

The data collected were tallied and tabulated according to the information gathered.

**Weighted Mean, Frequency counts** and **Percentage** were used to determine the scores of the respondents in their pre-test and post-test and describe the responses of student and teacher respondents.

**Standard Deviation, ANOVA and Independent t-test** were utilized to compare the effects of two methods of teaching and to check the significance of relationship between the respondents' sex and performance in conventional and computer simulated teaching.

## PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the analysis and interpretation of the obtained data that were statistically treated in the light of specific problems raised.

### Distribution of Respondents as to Sex

**Table 1** presents the data on the number and percentage of the student respondents as to sex. There were 40 or 50% male student respondents and 40 or 50% female. Student respondents were equally distributed.

### Pre-test and Post-test of the Control and Experimental Groups

The achievements of students using the conventional lecture method for the control group and the use of lecture with computer simulation for the experimental group were assessed and compared by looking at the pre-test and post-test results of both groups.

#### *Pre-test of experimental vs. pre-test of control group*

**Table 2** shows the pre-test means of experimental group which is 9.85 and the control group mean is 9.68. This means that there is no significant difference between the pre-test scores of the two groups. This implies that both the experimental and control groups possessed almost the same level of knowledge before the treatment. This result was consistent on the findings of Paras, 2014.

#### *Post-test of experimental group vs. post-test of control group*

**Table 2** reveals the post-test means of the experimental and control groups which are 15.40 and 12.38, respectively. The obtained p-value of .0001 means that there is a highly significant difference with their post-test scores. This entails that the respondents in the experimental group had gained more knowledge than the respondents in the control group. This result supports the findings of Liao et al. (2007), Smetana et al. (2011), and Aldhamit et al. (2014) which revealed that computer simulation instruction has a more positive effect on students' learning than traditional instruction.

**Table 2.** Pre-test and Post-test Scores of the Two Groups

| Variable | Experimental Mean | Control Mean | p-value | Remarks |
|---|---|---|---|---|
| Pre-test | 9.85 | 9.68 | 0.773 | No Significant Difference |
| Post-test | 15.40 | 12.38 | 0.001 | Significant Difference |
| Pre-test vs. Post- test | | | 0.000 | Significant Difference |

**Table 3.** Evaluation of teacher respondents on the two methods of teaching

| Variable | LCSM | | CLM | | p-value |
|---|---|---|---|---|---|
| | Mean | D.R. | Mean | D.R. | |
| Effectiveness/ Appropriateness | 3.28 | Agree | 3.37 | Agree | .742$^{ns}$ |
| Students'/ Participation/Interaction | 3.20 | Agree | 3.33 | Agree | .488$^{ns}$ |
| Influence on Cognitive Skills | 3.32 | Agree | 3.17 | Agree | .519$^{ns}$ |
| Influence on Content Knowledge | 3.40 | Agree | 3.27 | Agree | .592$^{ns}$ |
| Average | 3.30 | Agree | 3.29 | Agree | |

**Legend:**

LCSM – Lecture with Computer Simulation Method
CLM- Conventional Lecture method
D.R. – Descriptive Rating
3.50-4.00- Strongly Agree
2.50-3.49- Agree
1.50-2.49- Disagree
1.00-1.49- Strongly Disagree
ns- not significant

***Pre-test vs. post-test of experimental group and control group***

**Table 2** shows the pre-test mean of the experimental group which is 9.85 and the post-test mean of 15.40. The pre-test mean of the control group is 9.68 and the post-test mean is 12.38. The obtained p-value .0000 means that there is a significant difference between the pre-test and post-test scores of the experimental and control groups. This implies that students under experimental and control groups were able to acquire the needed knowledge on the topics presented after exposing them to the lecture with computer simulation method and conventional lecture method, respectively.

## Teachers Evaluation on the Two Methods of Teaching

Data presented in **Table 3** show the evaluation of teacher respondents of the two methods of teaching. A mean of 3.28 with a descriptive rating of *agree* was obtained by the teacher respondents in terms of effectiveness/appropriateness of the lecture with computer simulation method, while conventional lecture method obtained a mean of 3.37, interpreted as *agree*.

As to students' participation/interaction, they have rated the lecture with computer simulation method as 3.20 and 3.33 for the conventional lecture method. Both are interpreted as *agree*.

In terms of influence in cognitive skills, the lecture with computer simulation obtained a mean of 3.32 while conventional lecture method had a mean of 3.17, both interpreted as *agree*.

The means of lecture with computer simulation method and conventional lecture method were 3.40 and 3.27, respectively. Both have a descriptive rating of *agree*.

**Table 4.** Evaluation of student respondents on the two methods of teaching

| Variable | LCSM | | CLM | | p-value |
|---|---|---|---|---|---|
| | Mean | D.R. | Mean | D.R. | |
| Effectiveness/ Appropriateness | 3.32 | Agree | 3.20 | Agree | .160$^{ns}$ |
| Students' Participation/Interaction | 3.32 | Agree | 3.13 | Agree | .039$^{s}$ |
| Influence on Cognitive Skills | 3.42 | Agree | 3.20 | Agree | .008$^{s}$ |
| Influence on Content Knowledge | 3.35 | Agree | 3.18 | Agree | .053$^{ns}$ |
| Average | 3.35 | Agree | 3.18 | Agree | |

**Legend:**

LCSM – Lecture with Computer Simulation Method
CLM- Conventional Lecture method
D.R. – Descriptive Rating
3.50-4.00- Strongly Agree
2.50-3.49- Agree
1.50-2.49- Disagree
1.00-1.49- Strongly Disagree
s- significant
ns- not significant

Teacher respondents *agreed* that the two methods of teaching are both effective, provoke students' participation and influenced the cognitive skills and content knowledge of the students. This is consistent with the results presented by Jimoyiannis et al. (2000) where he showed that computer simulation could be used complementary or alternative to other instructional tools in order to facilitate students' learning.

## Students Evaluation on the Two Methods of Teaching

**Table 4** presents the evaluation of student respondents of the two methods of teaching. A mean of 3.32 with a descriptive rating of *agree* was obtained by the student respondents in terms of effectiveness/appropriateness of the lecture with computer simulation method, while conventional lecture method obtained a mean of 3.20, interpreted as *agree*.

As to students' participation/interaction, they have rated the lecture with computer simulation method with 3.32 and 3.13 for the conventional lecture method. Both are interpreted as *agree*.

In terms of influence in cognitive skills, the lecture with computer simulation obtained a mean of 3.42 while conventional lecture method had a mean of 3.20, both interpreted as *agree*.

The means of lecture with computer simulation method and conventional lecture method were 3.35 and 3.18, respectively. Both have a descriptive rating of *agree*. Student respondents *agreed* that the two methods of teaching are both effective, provoke students' participation, influenced the cognitive skills and content knowledge of the students. Results show that students prefer learning with computer simulation. This is related to the idea of Kotoka et al. (2014) where he confirmed the ability of computer simulation to aid learners' conceptual understanding.

## Teachers and Students Evaluation on the Two Methods of Teaching

**Table 5** shows the difference between the responses of teacher and student respondents on the two methods of teaching. In terms of effectiveness/appropriateness of lecture with computer simulation, the computed p-value is 0.893 while conventional lecture method has a p-

**Table 5.** Summary on Teachers and Students Evaluation on the two methods of teaching

| Variable | LCSM | | | CLM | | |
|---|---|---|---|---|---|---|
| | Teachers Mean | Students Mean | p-value | Teachers Mean | Students Mean | p-value |
| Effectiveness/ Appropriateness | 3.28 | 3.32 | 0.893$^{ns}$ | 3.37 | 3.20 | 0.406$^{ns}$ |
| Students' Participation/ Interaction | 3.20 | 3.32 | 0.825$^{ns}$ | 3.33 | 3.13 | 0.208$^{ns}$ |
| Influence on Cognitive Skills | 3.32 | 3.42 | 0.119$^{ns}$ | 3.17 | 3.20 | 0.766$^{ns}$ |
| Influence on Content Knowledge | 3.40 | 3.35 | 0.225$^{ns}$ | 3.27 | 3.18 | 0.897$^{ns}$ |

**Legend:**

LCSM – Lecture with computer simulation method
CLM- Conventional Lecture Method
ns- not significant

**Table 6.** Relationship between sex and performance of the two groups

| Variable | Sex | Mean | p-value | Remarks |
|---|---|---|---|---|
| Experimental | Male | 14.35 | 0.032 | Significant relationship |
| | Female | 16.45 | | |
| Control | Male | 12.40 | 0.971 | No significant relationship |
| | Female | 12.35 | | |

value of 0.406. The p-value of the two methods of teaching is greater than the critical value of 0.05 which means that there is no significant difference between the responses of the respondents.

As to students' participation/interaction, the computed p-values were 0.825 and 0.028 which implies that there is no significant difference with their responses.

On the influence on cognitive skills, the computed p-value of lecture with computer simulation was 0.119 and 0.766 for the conventional lecture method. This means that there is no significant difference with the responses of the respondents.

In terms of influence on content knowledge, the computed p-values for the two methods of teaching were 0.225 and 0.897, respectively. This entails that there is no significant difference with the responses of teacher and student respondents.

Overall, there is no significant difference on the teacher and students' responses on the two methods of teaching, thus, the hypothesis is accepted.

Teacher and student respondents *agree* that the two methods of teaching are both effective, provoke students' participation, influenced the cognitive skills and content knowledge of the students. This affirmed the findings of Sahin (2006) which strongly support the use of computer simulations as alternative instructional tool in order to help students confront their cognitive constraints and develop functional understanding of Physics.

### Relationship between Sex and Performance of Two Groups

**Table 6** shows the relationship of student respondents' sex and their performance. The mean score of male students is 14.35 while the mean score of female students is 16.45. The obtained p-value 0.032 means that there is a significant relationship between the sex and performance of the respondents who were exposed to lecture with computer simulation method. Female students performed well than male students. This affirmed the study of Kinzie et al. (2008).

For the control group, the mean scores of the male and female students are 12.40 and 12.35, respectively. The obtained p-value 0.971 means that there is no significant relationship between the sex and performance of the respondents. The scores of the male and female respondents do not differ for the control group.

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary, conclusion and recommendations of the study.

### Summary

This descriptive-experimental study was conducted to generally evaluate the effectiveness of computer simulation in Physics concept learning. The lecture with computer simulation method was used to teach the experimental group. The other group of fourth year students served as the control group and was exposed to conventional lecture method. Pre-test was administered to both groups. After the treatment, both groups were given the post-test. All the student respondents and the three teacher respondents evaluated the methods of teaching used.

Findings revealed the following: a. the student respondents were equally distributed; b. there is a significant difference between the scores of the respondents after the treatment; c. Teacher and student respondents agree that the two methods of teaching are needed and appropriate in teaching Physics; d. There is a significant relationship between the sex and performance of the student respondents in the experimental group while the sex of the control group did not affect their scores.

### Conclusions

Based on the findings of the study, the researcher has drawn the following conclusions.

1. The student respondents in each group were equally distributed in terms of sex.
2. There is no significant difference between the pre-test scores of the experimental and control groups, highly significant difference between the post-test scores of the two groups, and highly significant difference between the pre-test and post-test of the two groups.
3. The teacher respondents agreed to the effectiveness/ appropriateness, students' participation/interaction, influence on cognitive skills, and influence on content knowledge of the two methods.
4. The student respondents agreed to the effectiveness/ appropriateness, students' participation/interaction, influence on cognitive skills, and influence on content knowledge of the two methods.
5. There is no significant difference on the responses of teacher respondents and student respondents on the lecture with computer simulation method and conventional lecture method.
6. There is a significant relationship between the sex of the respondents and their performance in the lecture with computer simulation method, and no significant relationship

between the sex of the respondents and their performance in the conventional lecture method.

### Recommendations

Considering the aforementioned findings and conclusions, the following recommendations are hereby forwarded:

1. Future researchers may consider different number of respondents exposed in conventional lecture method and lecture with computer simulation method.
2. Computer simulation may be used to augment the teaching styles during classroom instructions. It may also be used as an alternative methodology to change the atmosphere in the classroom.
3. Teachers should look for different teaching aids that may cater the different learning styles of the students.
4. Students should be given a copy of the software for review at home to clarify and strengthen their understanding.
5. Further studies may be undertaken in other Science subjects to establish the validity of the effectiveness of Computer Simulation in teaching-learning process.
6. Developers of instructional materials may improvise other teaching aids that may suit the needs and interest of the students.

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