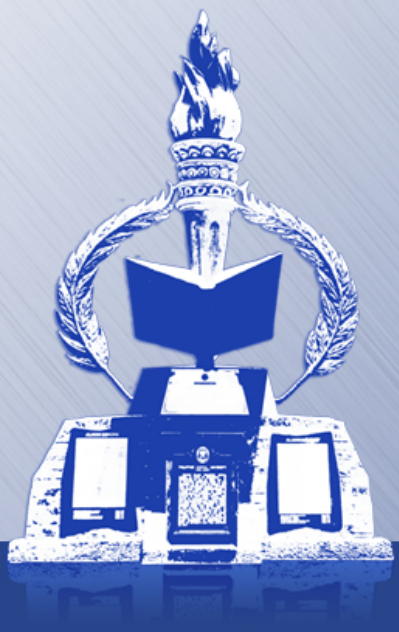
December 2016

Effects of Physics Telecourse on Students' Attitude and Test Performance in Physics

Liza C. Caigoy
Philippine Normal University



EFFECTS OF PHYSICS TELECOURSE ON STUDENTS' ATTITUDE AND TEST PERFORMANCE IN PHYSICS

A Thesis presented to

The Faculty of the College of Graduate Studies and Teacher Education Research

Philippine Normal University

In partial fulfillment of the Requirements for the Degree

Master of Arts in Science Education

With specialization in Science Education

by

LIZA CASTILLO CAIGOY

December 2016

APPROVAL SHEET

This thesis entitled "**EFFECTS OF PHYSICS TELECOURSE ON STUDENTS'ATTITUDE AND TEST PERFORMANCE IN PHYSICS"** prepared and submitted by **LIZA CASTILLO CAIGOY** in partial fulfillment of the requirements for the degree of Master of Arts in Education with specialization in Science Education, is hereby recommended for approval and acceptance.

(SGD.) ANTRIMAN V. ORLEANS, Ph.D
Adviser

Approved in partial fulfillment of the requirements for the degree Master of Arts in Education with specialization in Science Education by the Oral Examination Committee.

(SGD.) ADONIS P. DAVID, Ph.D.
Chairperson

(SGD.) BRANDO C. PALOMAR, MST
Member

(SGD.) REBECCA C. NUEVA ESPAÑA, Ph. D.
Member

Accepted in partial fulfillment of the requirements for the degree **MASTER OF ARTS IN EDUCATION** with specialization in Science Education.

21 December 2016
Date

(SGD.) ZENAIDA Q. REYES, Ph.D.
Dean
College of Graduate Studies and
Teacher Education Research

Acknowledgement

The researcher would like to express her sincere gratitude and appreciation to all the people who shared their valuable time and effort for the completion of this study.

First and foremost, to Dr. Antriman V. Orleans, her research adviser who patiently guided her with his valuable suggestions, most especially on the content and organization of this work, for doing the statistics, for being there and always available to check the details of her data analysis, no amount of thanks can express her gratitude to him.

Sincerest thank also goes to the members of the examining committee namely: Mr. Brando C. Palomar, Dr. Adonis P. David and Dr. Rebecca C. Nueva España, for their critical insights, comments, enlightening suggestions inspired and directed this research.

Her profound gratitude also goes to Dr. Zenaida Reyes, Dean, College of Graduate Studies and Teacher Education Research, for the comments and valuable suggestions that led to the improvement of this work.

Her heartfelt thanks to Dr. Venancio L. Mendiola for final editing and to Mr. Jerry P. Sapon for editing the manuscript in preparation for the colloquium.

Her sincerest thank is also given to Ms. Zeny and Ms. Malou, for their kind assistance and help.

Her appreciation also goes to Mrs. Amparo G. Silvela, the principal of Sagad High School, Mr. Junie C. Serot, the head teacher of science department and all the science teachers, for their understanding and support.

To all those who in one way or another contributed to the successful completion of this study, but not mentioned above, her sincerest thanks and gratitude.

Sincerest appreciation is given to her Nanay, for the love, moral support and constant encouragement.

To her husband Peter, and daughter Aizel Mae for all the support, encouragement and love. Both of them served as inspiration to the researcher in pursuing this long overdue research.

Above all, the researcher thanks God who serves as the Great Provider and the source of wisdom at all times.

L. C. C

DEDICATION

The best things in life come from personal experiences. It is indeed a great pleasure and opportunity to have studied at Philippine Normal University, allowing me to meet different people, especially professors from whom I learned many things. Patience, perseverance and effort marked my stay on the campus plus the additional years, semesters and summers to finish this research.

This piece of work is humbly dedicated to the many people who have made significant contribution to its completion, especially to my late father Ramon Z. Castillo, to Nanay, my siblings and to my husband Peter and daughter Aizel Mae.

L. C. C.

Abstract

Author : Liza C. Caigoy

Title : EFFECTS OF PHYSICS TELECOURSE ON STUDENTS' ATTITUDE AND TEST PERFORMANCE IN PHYSICS

Key Concepts: PhysicsTelecourse, Attitude and Test Performance

Degree : Master of Arts in Education

Specialization: Science Education

Adviser : Dr. AntrimanV. Orleans

This study sought to determine the effects of Physics Telecourse on the attitude and test performance in physics of fourth year students, school year 2014-2015, employing a quasi-experimental two-group research design specifically the counterbalance design. To ensure parallelism, the students in the experimental and comparable groups were matched using their mean grade in physics for the first, second, and third grading periods and attitudes as measured by the Physics Attitude Inventory Test (PAIT). Groups 1 & 2 were then both exposed to Physics Telecourse and traditional method of teaching following the counterbalance design. After the experiment, the data gathered were analyzed and interpreted using the *t*-tests. The study results showed that 1) the test performance in physics measured by the Physics Formative Test of the two groups in the first of the three

segments registered a statistically significant mean difference in favor of the comparable group, results similar to that in the second segment; b) the test performance in physics of the two groups in the last segment provided insignificant mean difference; c) the mean attitude of Group 1, the group exposed once to the Physics Telecourse registered a statistically better attitude than Group 2; d) the mean attitude of students after the experiments is statistically more positive than that before the experiment. Based on these findings, it can be concluded that 1) telecourses like those used in the study cannot be more effective and let alone totally replace competent teacher-facilitated classroom instruction with actual demonstration of student-related activities. In the three physics topics considered in this study, only in one lesson that the use of a telecourse to supplement instructions was found to be as effective as that of a teacher-facilitated instruction; 2) telecourse and teacher-facilitated instruction can improve students' attitude toward the subject; and 3) telecourses can be as effective as teacher-facilitated instruction in enhancing students' attitude toward the subject.

Table of Contents

List of Appendices

Appendix

Page

List of Figures

List of Tables

CHAPTER I
THE PROBLEM AND ITS BACKGROUND

Introduction

Demands for improving teacher quality and for holding teachers accountable for students' learning have increased over recent years. The taxpayers who want to keep lid on school spending and want to know where their money is being spent, want to hold educators responsible for the outcomes of instruction. Moreover, if teachers do make a difference, as many literature claims, then they should be accountable for the outcomes of instruction, whether positive or negative (Ornstein, 1990).

In view of the above demands, school authorities from the higher ups down to the school principals are continuously giving increased professional development

activities in the forms of seminar-workshops, conferences, lectures, conventions, and in-service trainings, here and abroad, to address this important concern. One reason for the holding of these activities equips the teachers with needed trainings to provide their students with necessary scientific skills and knowledge required for economic progress. To this effect, the school must prepare the students to be scientifically, technologically literate and self-sufficient individuals to adapt to the demands of a rapidly changing world. Nowadays, there are different innovations and development in science curriculum, new strategies and techniques that provide students with the true principles of science education. With these students can improve their problem-solving skills, critical thinking skills, and other skills needed in daily life's activities, (Clarete, 1994).

To make science curriculum relevant to students' daily life, several studies have examined the effects of many teaching strategies on student learning. Some of these studies include the works of Reyes (2003), Clarete (1994), Natividad (1995), and Logmao (1997), which had been used to improve instructional methodology and promote greater understanding of science concepts. The current trend in teaching makes use of different technologies that provide learning experiences to awaken students' readiness levels and promise a better, a more comfortable and faster learning phase.

The advancement in technology affects considerably students learning processes and daily activities. For instance, the cell phones, personal digital assistants, internet, digital notebooks, and personal computers are continually changing the way knowledge is being transferred and learned. In this regard, there are innovations in teaching methodologies. Many instructional materials have been developed or invented or even acquired by the school to improve and enhance students' learning in the hope of offering excellent and quality education to the greatest and precious clientele ―the students.

Most of the studies and researches conducted in the field of science have something to do with instructional materials to ensure that students are provided with the required knowledge and skills they need and help them attain higher academic achievement (Manzano, 1996; Guibone, 2001; Agabin, 2003; Yllano, 2009). It is a common view that the achievement of students reflects the kind of instruction that transpires in the classroom. But no matter how competent the teacher is in delivering effective instructional activities, what matters most, as the measure of effective instruction, lies in students' performance in tests.

This study was conducted to determine the effects of physics telecourse on students' attitude and test performance in physics. The researcher holds that determining the effects of physics telecourse on students' attitude and test performance will lead to improve test performance in physics, besides developing their positive attitude toward the subject.

Conceptual Framework

The present study is anchored on the cognitive theory of multimedia learning (CTML) popularized by Mayer (2005). It also referred to as "multimedia principle", which states that an individual learns more deeply from the fusion of words and visuals than from words alone.

In the Philippines, an educational technology that transforms classroom instruction to television program in the country; the Continuing Science Education for Teachers via Television (CONSTEL) was launched in June 24, 1995 in pursuit of improving science education. This technology consists of a telecourse for elementary school science (Science Made Easy), Chemistry (Chemistry in Action), and Physics (Physics in Everyday Life). The program episodes are designed with the Desired

Learning Competencies (DLC) as prescribed by the Department of Education, emphasizing on concepts, skills and strategies in science teaching. The telecourse seeks to improve knowledge, and foster favorable attitude towards the subjects, according to Reyes, (2003).

Despite the claimed promise of improved student achievement and attitude effected by the CONSTEL, the researcher found only one study in CONSTEL chemistry and none in CONSTEL physics. It is therefore, the intent of the investigation to attempt to document the effect of CONSTEL materials on student attitude and test performance.

Recently, the basic education curriculum has been enhanced through K TO 12 program which allows more focus resulting to the mastery of learning. Physics teachers especially science teachers, need instructional materials that will help students learn the true principles of science. Notably, K TO 12 scheme characterizes spiral progression in which subjects are taught from the specific to more complicated concepts through grade levels. To illustrate, Physics telecourse can be used not only to Grade 10 students but also to the lower grade levels in that physics is also taught to these levels. CONSTEL was renamed as Continuing Studies via Technology (CONSTEC) in the belief that this material will be of great help for physics teachers if their positive effects in improving students' attitude towards and test performance in physics is established.

Students' Knowledge

In order to understand fully the world and become responsible individual, students need a firm grasp of science. With the use of multimedia, students are better able to grasp new knowledge and information when they are presented with varied instructional materials. Students who learn from materials containing both text and graphics produced 55% - 121% more accurate solutions to problems. The use of images,

along with words, not only diminishes the overwhelming nature of text but also helps the students to manage cognitive load, which increases retention. Similarly, current multimedia technologies allow students to interact with information in new ways, change content, and even create their own visualizations. In addition, multimedia can stimulate more than one sense at a time and in doing so, may be more-attention-getting and attention-holding which enhances students' learning (Reeves, 1998). This means that multimedia give an infinite interconnection in a different possible combination, sequences and mixture of resources which help shape the higher-order thinking skills of students. With technology, the process of learning brings out interactive responses; students will demonstrate both cognitive and emotional intelligences in accordance to the multimedia stimuli. When knowledge is transferred into a new situation, then learning is complete.

Students are sent to school to acquire knowledge and in the school, there are different learning activities that confront the students during the learning process. Through this learning process, students come to know and internalize knowledge, because it plays a vital role in their learning process.

Knowledge can refer to a theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject). Knowledge acquisition involves complex cognitive processes: perception, communication, and reasoning.

Anderson (1999) published an updated version of Bloom's Taxonomy that takes into account a broader range of factors that impact on teaching and learning. The knowledge dimension has four categories: factual, conceptual, procedural, and metacognitive.

In this study factual knowledge and conceptual knowledge were considered in the preparation of formative test to assess the test performance in science of the fourth year students.

In the revised Bloom's taxonomy, factual knowledge involves isolated bits of information, such as vocabulary definitions and knowledge about specific ideas. While, conceptual knowledge consists of systems information, such as classification and categories.

Students' Attitude

Generally, many students still believe that science is a difficult subject. This preconceived idea makes science teaching a great challenge. To make science appealing, it is the responsibility of the science teachers to provide effective teaching materials in order to bridge the difficulty of the students. If the students do not understand the concepts of a particular lesson, then they are unmotivated to learn more. Thus, their attitude towards the subject becomes negative. With the use of multimedia, science concepts will be considerably understood by the students, gradually making them to develop positive attitude towards science.

Attitude plays a great role in the learning process of the student. His successes and failures depend on his attitude. A student's positive attitude towards the subject serves as a basis in the learning process. Learning the lesson with positive attitude could hasten the acquisition of one's knowledge because it could become a gratifying experience to the learner. Bandura (1989) affirms that a student with favorable attitude is expected to study and learn more than one with unfavorable attitude who would find the subject boring.

According to Gregorio (1976, as cited by Tavios,1987), attitudes towards physics are important to study, because it does not only play a major part in mental organization

and behavior but also has a crucial role in the development of personality. Attitudes exert a stimulating effect upon the rate of learning and teaching and consequently upon the student's progress in school. The efficiency of a student in his day-to-day work is influenced by his attitude as a learner.

Astronomia (1987) considers attitude as a feeling for or against something linked in the emotions, pleasant and unpleasant things such as love, fear and all other variations and complications. It may be thought of as a learned pattern of behavior which predisposes the individual to act in a specific manner, when confronted with a given situation. It varies in quality and intensity on a continuum from strongly positive to neutral to strongly negative.

Effective science teaching can be seen and observed on the kind of students a teacher has, in the way how they think, and on the foundation of knowledge that promotes their success in the world outside school. The learners' attitude and how they perceive information that takes place in the classroom are defined by the affective domain of Bloom's Taxonomy (Ornstein, 1990). This domain on the foundation of knowledge deals with feelings, emotions, interests, attitudes, values and learning appreciations. Observing students directly as they play, talk, and interact with peers is one of the best ways of evaluating their attitudes, as they study, engage in group activities or work independently.

The role of attitude concerning an academic subject is of great importance toward acquiring a deeper knowledge and understanding. Some people ascribe failures in high school due to lack of proper attitudes towards their subjects (Afroilan, 1990, as cited by Balneg 2000). Students' positive attitudes towards their science subjects are important considerations for effective learning, essential in the formation and

development of their intellectual, physical and emotional disposition, scientific attitudes and habits of thinking and solving problems. Right attitudes may enhance self-regard and self-discipline which could minimize their failures in school. Desirable attitudes are usually taken as indicators to predict students' performance and development.

Consequently, Tenedero (2009) assesses the new attitudes of youth toward school. According to him, most of the youth today are willing to go to school, unfortunately, what they really want is not to learn the lesson but the chance given to them by the school. To participate in the different school activities like sports fest, group work and related matters, all involving a positive interaction with their classmates and friends.

Test Performance

In 1999, the Philippines ranked third from the bottom in the Trends in International Mathematics and Science Studies (TIMMS), while in 2003 the country emerged again third from the bottom (Caraballo, 2009). The underachievement of Filipino students in national and international examinations has drawn the attention of policy makers to propose reforms in basic education curriculum (Benito, 2010). Such poor academic performance of Filipino students posed a great challenge to all mathematics and science teachers on how to improve the students' test performance.

Test performance is a form of testing that requires learners to perform a task, regardless of the quality of the tests being used, rather than select an answer from a ready-made list, also known as alternative or authentic testing. It does not reveal student's competence because of personal or circumstantial factors that affect the behavior (Messick, 1994). Neither does it reflect how many hours and days have been spent in studying and how well the student studied through the quarter or semester (Onyper, 2016).

Many factors can affect testing results, regardless of the quality of tests being used, some of which are the emotional, physical, mental, home and school factors. Feedbacks regarding the success or failure in attaining instructional objectives are provided by test results. They also identify the specific learning errors that need to be corrected, as well as reinforce successful performance. For the teacher, it provides information for making instruction and remedial work more effective (Oriondo, 1989).

In the present study, a formative test was used to assess the test performance of the participants using a teacher-made test. Formative test as described by Bloom (as cited by Ornstein, 1990) serves as a major tool for instruction. In his own words:"Too often in the past assessment has been entirely summative in nature, taking place only at the end of a unit, chapter, course, or semester, when it is too late, at least for that particular group of students, to modify either… the teaching or learning… process." Besides, formative assessment should take place not only at the end of instruction (summative assessment), but also at various point of instruction during the teaching-learning process while instruction can still be modified.

At present, students are known as "digital natives," in that they live in a world in which technology is part of their daily life activities. Thus, they expect to use technology in school. Most of today's students depend so much on technology in making their research and homework, an increased dependence comparable to the brain processing information with the use of two channels-visual and auditory. With ability plus technology-based tools, students' learning can be enhanced through multimedia instruction. As an effect, students will be motivated to study more and show positive attitude towards the subject resulting in an increased knowledge on the learned content, which eventually leads to a better test performance.

Taking all these into account, the present researcher holds that determining the effects of physics telecourse on students' attitude and test performance will lead to improve test performance in physics, besides developing their positive attitude toward the subject.

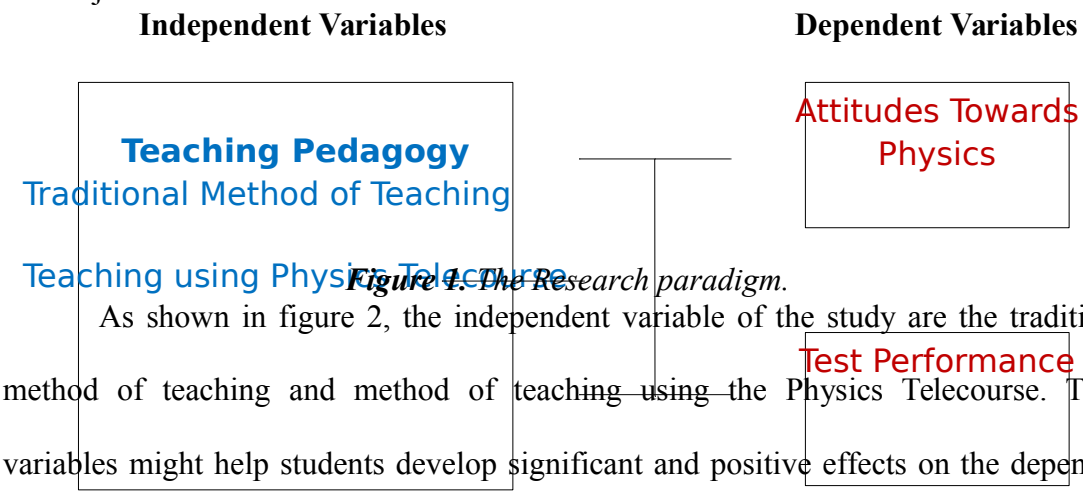


Figure 1. *The Research paradigm.*

As shown in figure 2, the independent variable of the study are the traditional method of teaching and method of teaching using the Physics Telecourse. These variables might help students develop significant and positive effects on the dependent variables: the attitude and test performance.

Statement of the Problem

This study attempted to determine the effects of Physics Telecourse on fourth year students' attitude and test performance in Physics of Sagad High School, school year 2014-2015.

Specifically, it sought to answer the following questions:

1) Is there a significant difference in the test scores of the two groups after the experiment in each formative assessment?
2) Is there a significant difference in the attitude of the two groups after the experiment?
3) Is there a significant difference in the attitude of students before and after the experiment?

Scope and Limitation

Although the study attempted to determine whether instruction using physics telecourse would help improve students' attitude and test performance in Physics, it was study was delimited only to the two sections handled by the researcher in the school year 2014-2015.

Equally, limited to the topics for the fourth grading period only, and they agree with the required learning competencies for the fourth year students. With six video episodes the topics covered include: Episode 28: Waves: Carriers of Energy **(**Types of Waves, Parts of Waves, Properties of Waves), Episode 29: Properties of Waves (Reflection, Refraction, Diffraction and Interference), Episode 30: Sound and Hearing (Sound-Its Production, Transmission and Reception, Properties of Sound Waves, Factors that Affect the Speed of Sound, Characteristics of Sound, and Speed of Sound), Episode 31:Musical Sound, Episode 34: EM Waves **(**Maxwell's Electromagnetic Theory, Production and Propagation of EM Waves and Electromagnetic Spectrum), Episode 35: Telecommunications **(**Telegraph, Telephone and Its Network, Radio Communication and TV Broadcasting). The study lasted for 4 weeks only ---from February to March 2015.

Admittedly, the limitations of the study featured situations beyond the control of the researcher, like the manner of assessing the attitude and test performance of students and the way students responded to the assessments. There might have inaccuracies on the students' perception on the items; after all, not all of them were inaccurate in their perception, or entirely wrong in perceiving the items.

When it comes to the way students responded to the assessment, the mood of the students might have affected their responses. Others might possibly not be very positive at the time of answering the items, as they might have copied the responses of

classmates due to lack of concentration or poor comprehension. Still some probably might not read the items but just checked or chose certain option.

Another perceived limitation of the study is the unequal exposure of the two groups to the experimental set-up in a counter balance research design. The treatment was given twice in Group 2, but only once in Group 1 due to limited time. Should the aforesaid experimental exposure had been equalized, a more consistent result might have resulted.

Significance of the Study

The findings of this study may be of great benefit to the following:

To the principal/school heads. The result of this study will give information on the status of science instruction, especially physics subject to guide them in deciding on what programs to implement for the improvement of physics instruction. In like manner, this might serve as a concrete basis for the improvement of physics laboratory, coupled with a permanent audiovisual room, especially in the public schools. Lastly, this might encourage them to provide trainings and seminars for teachers on how to operate the technologies necessary for teaching.

To the science/physics teachers. The result of this research will be of great help to both experienced and new science teachers to integrate technology in their daily teaching, enough to motivate them to modify/adopt other teaching strategies or instructional materials useful in enhancing the students' attitude and test performance. They might think of using the physics telecourse in their lessons because physics is already taught in the lower grade levels.

To the parents. The result might heighten the parents' awareness on the importance of the Physics Telecourse and other instructional materials in improving the

attitude and test performance of their children, thus, they will be encouraged to spend more time in guiding them and supporting the activities of the school.

***To the students*.** Hopefully, the physics telecourse will motivate and encourage students to study better and help improve their attitude and test performance in physics to lead them to become successful and productive persons later in life.

To the future researchers. This study may provide them with baseline data as they embark on their own study about instructional materials and teaching methods.

Definition of Terms

For purposes of clarity and better understanding, these recurring terms are defined:

***Attitude towards Physics*.** This refers to the favorable behavior shown by the students, as seen in their improved test performance in physics measured using the physics Attitude Inventory Test.

***Physics Formative Test (PFT)*.** This refers to the teacher-made 25 item-multiple choice test covering the topics for the fourth grading period and given after each segment.

***Physics Telecourse*.** This refers to the integrated learning system that employs the use of CD and television, used as an instructional material.

***Test Performance*.** This refers to the scores gained by the students in the formative test after the intervention.

***Traditional Method of Teaching*.** As used in this study, this refers to the usual instruction prescribed to the teachers, also an instruction using lecture method combined with hands-on activities and other manipulative materials.

Chapter II
REVIEW OF THE RELATED LITERATURE

This chapter presents the review of literature and studies conducted related to the topic under study.

Instructional Materials

Probably every child has genius potential in more ways than one. Basically, this is the truth, but some parents who grow up exposed to conventional learning theories and traditional methods of teaching sometimes overlook or ignore this fact. Generally, learning takes place when a large number of senses is stimulated, hence, teachers must use several instructional materials because these stimulate large number of senses.

In addition, Corpuz and Salandanan (2007) mentioned that "the more senses are involved in learning, the more and the better the learning. What is seen and heard are learned more than what are just seen or just heard". One research study confirms this finding: "Humans are intensely visual animals. The eyes contain nearly 70 percent of the body's receptors and send millions of signals along the optic nerves to the visual processing centers of the brain…We take in more information visually than through any of the other senses" (Wolfe, 2001, as cited in Corpuz & Salandanan, 2007). This implies that the use of teaching methodology makes use of more visual aids than mere audio aids. A combination of audio and visual tools however can be far more effective.

The development and acquisition of instructional materials is so important in that they help or assist the teachers in transmitting the knowledge to be learned among learners, in acquiring necessary skills, and developing their positive attitude towards the subject in the entire teaching-learning process (Nwachukwu, 2006 as cited by Nsa, 2013). Instructional materials motivate students, provide different learning activities, reinforce learning, allow for different interests, contribute to the understanding of concepts, encourage participation, and provide experiences that might not otherwise

students have, and changing attitudes and feelings (Ornstein, 1990). The students' success in the skill and knowledge acquisition depends on the suitability and adequacy of instructional materials. Hands-on activities with the use of instructional materials enhance students' understanding and make them experience a particular situation.

Similarly, Agun (1997, as cited by Nwike 2013) describes instructional materials as those which help teachers and students to maximize learning in different areas. While Ajalla (1997, as cited by Nwike et al, 2013), reiterates that in agricultural science, instructional materials are also used to motivate people to learn more, and if used properly, these can capture pupil's imagination.

Teachers can use varied resources to facilitate instruction and promote students' learning. Most of these are found in the environment, meant to assist students' understanding of concepts and situations encountered in daily life's activities. Some schools have learning resource center with instructional materials other than books placed in the library, but most of the time, in the specific learning resource center of the department or grade level. The teacher should pay a visit to such center to look for the available materials useful in the teaching process. It has been said several times that the effective use of instructional materials captures students' attention and interest geared towards the development of positive attitude towards the subject (Corpuz and Salandanan, (2007).

The variety of methodologies and instructional strategies like computer-based and computer assisted learning where intelligent tutoring system can take place must be utilized to bring about effective and responsive instruction (Malunhao, 1998). Their use may be traced back to the history of education, and at present a number of instructional materials are emerging like mushrooms in the rice field during rainy season.

Similarly, Isola (2011) points out these reasons for using instructional materials in implementing any educational program: 1) they complement the teacher in extending wider experience available to learners, 2) enrich learners' experience by supplementing and complementing the verbal explanations of the teacher, and 3) provide the teacher with a variety of learning activities for the students. Moreover, the use of instructional materials clarifies, vitalizes, emphasizes and enhances learning just as they provide spoken or symbolic experiences, even expose learners to concrete experiences. In this way, instructional materials contribute considerably in the teaching-learning process.

Instructional media materials complement teaching through concrete/verbal experience in the learning process, while other forms of instruction merely provide verbal or symbolic experience. In the entire learning process, the contribution of audiovisual materials stands out prominently. The role of instructional media materials today changes the way the world is being thought of and the opportunities for the delivery of effective and efficient education. By and large, teachers' effectiveness can be increased generally through the use of non-print materials. Students benefit considerably from the use of non-print materials, because teaching requires a constant communication between the teacher and student, essentially a communication process between the former and the latter. Educational community, at present recognizes the importance of increasing number of instructional materials as aid to the effective communication between the teacher and the students (Laguilles, 2001).

In the study of Matrio (2000), she found out that one way of achieving quality teaching of folkdances in the elementary school is to produce video materials that will serve as support instructional materials. She also concluded that videotapes are so

effective that they are essential in the teaching-learning process of folkdances. These videotapes direct and guide teachers for effective teaching instructions in terms of mastery of sequence, time consumed and motor skill development.

From the creations of modern technology, come the latest types of instructional materials which are utilized as audiovisual aids in teaching. The use of technology in teaching science assists the learner in understanding the concepts that need to be learned.

Bayos (2013) for her part enumerates the four ways on achieving successfully the integration of technology: 1) transparency and routine use, 2) accessibility and availability, 3) supportive of the curricular goals, and 4) effective in helping the students to reach their goals.

Abimbade, et al (2003, as cited by Kareem, 2015) describe that the use of technology in the classroom is a product of integration and systematic organization of man's ideas, machines, and procedure to achieve the desired goal. Nowadays, computer is one of the most important technological innovations in that it does not only improve the access to learning by all, but also help manifest the application in the delivery of quality knowledge.

Nduati (2009) of Kenya stresses that computers have the ability to store, retrieve and process both the qualitative and quantitative information. He also mentions Moore (1997) who cites that computers, as an instructional tools have a great learning potentials. Furthermore, Nduati also recalls the contribution of Birch, et al. (2000) who ascertains that the active learning in the different places all over the world and in a greater variety of disciplines from literature to other discipline can be done by the use of computers. In this way, different learning methods have emerged and the role of a

teacher has changed gradually from a mere dispenser or transmitter of knowledge to a facilitator of learning.

Similarly, the use of Interactive Multimedia (IMM) in the classroom is considered as a vital innovation in the field of education. It provides much information from words, audio, animation, motion pictures, and other data needed in the teaching process. This type of instructional innovation facilitates learning even appears very attractive to pupils and high school students because they can take an active part in the teaching-learning process. Instructional devices when viewed and heard will provide valuable experiences to both the teacher and students. One becomes updated with the latest discoveries and inventions through radio and television and recently, people are flooded with information through facebook, google, instagram, twitter, messenger and the like. In just one click, information will be provided to everyone.

According to Peck (1998, as cited by Guibone, 2001), multimedia refers to the combination of two or more media types which communicate ideas usually with both sound and visual support, creating a sequence of events effectively.

In multimedia instruction, the learner, as an active participant, is encouraged to build mental representations coherently from the materials being presented, to construct new learning. To Sorden (2005), “cognitive science studies the nature of the brain and how it learns by drawing from research, in a number of areas including psychology, neuroscience, artificial intelligence, computer science, linguistics, philosophy, and biology.”

In addition, Acero, Castro, Javier (2000), in their book, *Principles and Strategies of Teaching*, affirm that “good teaching requires a rich environment of instructional materials and devices. These learning tools challenge the attention of the learner,

stimulate thinking, and facilitate understanding which make learning more meaningful" (p.43). They go on to say—"That is why children need constant opportunity for motion pictures, radio programs, excursions, interviews, service projects, work experience, and the like. Through these, children receive more concrete, interesting, and meaningful experiences."

According to Ornstein (1990), educators should remember that there is an increase supplement of Electronic media, almost replacing printed materials in school and or flooding homes. More important, students and teachers need to understand and apply the processes of these devices, the caveat, though, is that they should not be controlled by these technologies. By and large, the teachers are given broad abilities to invigorate their teaching and instructional procedures, while, students have varied tools to be used in learning and thinking. Admittedly, these will give students more control over their learning and teachers more knowledge and options to guide the process of teaching.

As cited by Geronimo (2004), science education should equip the students with the knowledge and skills to explore; explain and investigate natural phenomena as well as the ability to relate and apply science concepts and processes to real-life situations. The science teacher has a great task of promoting and enhancing students' thinking and understanding. The search for more effective and efficient approaches in teaching has occupied the minds of the academic world. Many were in search of what approach in teaching and learning is effective to cope with the new paradigm in science education.

Recently, classrooms are transforming into something new and exciting. The four walls of the classrooms are now transcending and distances are now spanned by non-traditional delivery systems. The chalkboards of the past are now taken over by

multimedia. Educational television programs are scheduled and are available for use in schools within the area. Television programs like films, never fail to catch the curiosity of the students. Documentaries and cultural programs are best viewed on regular television programs. The appeal of TV varies remarkably from child to child and from age to age. A child's day is seemingly incomplete without TV viewing especially in urban areas even shanties on the river banks and rail road tracks are having modern TV nowadays (Guibone, 2001).

Many researches have shown that video media provides for a) the capture of uncommon and hard-to-duplicate material and phenomena; b) the ability to easily present static and moving material; c) the alteration of visual, auditory , and temporal characteristics of material and phenomena; and d) the option to incorporate animation for added clarity (Journal of Research in Science Teaching, 1997).

Nerbes (1986 as cited by Logmao, 1997) studied the effectiveness of structured and semi-structured laboratory methods using an inquiry approach. In her study, she used two groups (structured and semi-structured) which were composed of 20 boys and 20 girls for each group. Unit tests made by the researcher were given to each group as pretest and post-test at the beginning and end of each unit lesson, respectively. She tested the result using the mean, critical ratio and *t*-tes*t.* After all tests were conducted, based on the results, she concluded that the two methods are effective because of their gain in mean and there is no significantly difference between the two methods. Both the structured and semi- structured laboratory methods using inquiry approach are effective in teaching science.

Narzoles (2013) investigated the effects of multimedia instruction in improving students' learning. Forty eight students were used as subjects of the study using quasi-

experimental design. The post test mean scores of the students revealed that there is significant effect on the academic performance of the experimental group which indicated that better learning was executed by this group as compared with those students taught with traditional method.

Robles (1993) determined the effectiveness of slide sound set in teaching Nuclear Chemistry. Her study premised on the theory that in the absence of scientific laboratory experimentations, the use of slide sound set as a teaching supplement would generate motivation, interest and involvement, develop positive attitude of the learner and strengthen the concepts and make learning more permanent. The effectiveness of the slide sound set was measured experimentally in terms of the achievement and attitude gain of the experimental and control group of students composed of 30 civil engineering freshmen of the Bulacan College of Arts and Trades. The experimental group made use of the slide sound set while the control group was subjected to colorful cartolina visual aids. Employing *t*-test of correlated samples, the experimental group achieved academically better than the control group.

In Clarete's study (1994), she made use of the quasi-experimental pretest and post-test group design involving two groups of students exposed to 2D and 3D visual aids. The subject of the study was 60 students, who were chosen randomly from a population of 100 fourth year students and taught selected concepts in high school physics applicable for one quarter. Two instruments were used in the study, the Physics Achievement Test and the Physics Attitude Inventory Test. Then data were collected and treated using the different statistical tools. The dependent t-test helped determine the difference between the pretest and post-test scores for both the achievement and attitude towards physics, while the two-way ANOVA marked the difference between the types of

visual aids utilized as well as of the mental ability of the students on the physics achievement. The study yielded these findings: 1) There was a difference noted between the pretest and posttest scores in the attitude of students towards physics for students exposed to 2D and 3D visual aids. 2) Equally, there existed a difference between the pretest and posttest scores in physics achievement for students exposed to 2D and 3D visual aids. 4) The students exposed to 2D and 3D visual aids did not show any difference on the physics achievement. 5) The average students performed better with the use of 2D visual aids, in contrast to the below average students who did better with the use of 3D visual aids.

In evaluating the effects of Computer-Assisted Instruction on the Science Achievement and Interest of Grade 7 Students of Xavier School, Natividad (1995) involved 72 students assigned randomly to the experiment and control groups. Each group had 36 students both handled by the researcher. The experimental group was taught using CAI while the control group, the traditional method of teaching. Using the *t-test* of independent samples, she found out no significant differences on the teacher-rating of the two groups. This signifies that the teacher was equally enthusiastic in handling the classes. The findings were based on the following: 1) CAI increased the achievement of students in science as proven in the higher overall post-test mean of the CAI group compared to the traditional group. 2) There was a significant difference in the achievement of students exposed to CAI and those of the traditional method of teaching when students were grouped according to mental ability. Notably, students exposed to CAI performed better than those in the non-CAI group. 3) There was no significant

difference in the level of interest toward science between students exposed to CAI and those taught in the traditional method.

Mayes (1991, as cited by Natividad, 1995) of West Virginian University conducted a study to find out if the use of computer as a tool in guided-lesson learning episodes would enhance the mathematics solving skills of secondary school students. He involved 189 students in a ten-week study. Eighty two students from second year algebra class received problem solving treatment only, while 107 students also from a second year algebra course received both problem solving and computer treatment. The results of the study showed that the low math achievement group performed better in a non-computer problem solving approach. He inferred that these students might have been overwhelmed by the joint problem-solving and computer treatment due to lower initial mathematical knowledge. The middle group benefitted most from the computer treatment whereas the high level math group performed well whether the computer environment was applied or not.

The study of Manzano (1996), revealed that: 1) The experimental group subjected to TV-assisted instruction obtained a pretest mean score of 19.17, which was lower than that of the control group, 19.36. The difference however, was not significant when tested at the 0.05 level. The observed t-value of the pretest of both groups equalled to – 1.4838 with an associated probability of .0734 which was greater than 0.05. 2) The mean in the post-test of the control group = 39.69, higher than the mean score in the pretest, 19.36. The computed *t*-value amounted to -33.44 (df=35) with a probability of . 000 to mean a significant difference between the scores of the pre-test and poet test of the control group. 3) The mean score performances of the experimental group in the pre-test and post-test were 19.17 and 44.25 respectively, with the mean score in the post-test

yielding very much higher than that of the pretest. The computed *t*-value amounted to -43.93 with a probability of .0000 which meant that there was a significant difference between the scores of the pre-test and post-test.

Logmao (1997) also made a study on the effectiveness of programmed instruction using audio-visual technique in teaching physics. To test the effectiveness of the programmed instruction, he used and handled two classes consisting of ninety five (95) sophomore students at the start of the semester SY 1996-1997. One class was randomly assigned as the experimental group and the other as the control group. From these two classes, thirty matched patched pairs were formed using the College Entrance test, tempered by a true experimental design, pretest- post-test Equivalent Group Design. The effectiveness of the program instruction was measured through performance on the achievement test. The uncorrelated *t*-test or *t*- test of independent means was used to determine the comparability of the two groups before the conduct of the study. The same analysis was employed in determining the effectiveness of the programmed instruction. Correlated *t*-test or *t*-test for dependent samples was used to determine the change in the performance of each group after the entire unit was taught. The study revealed that: 1) At 0.05 level of significance, there was a significant difference in the performance of students before and after they were taught the unit using the programmed instruction. 2) The achievement of students using the developed programmed instruction was greater than that of those taught the traditional method of teaching. Based on the findings, Logmao (1995) concluded that 1) the use of programmed instruction using audio-visual technique with supplement is an effective approach in teaching physics. 2) Programmed instruction deserves greater consideration in the field of education to improve teaching-

learning process. 3) The use of programmed instruction seems to considerably enhance students' achievement, promotes better learning and cultivates learners' interest and motivation.

Meanwhile, Alvarez (1998) determined the effectiveness of video-aided instruction to improve the achievement of students in physics in a study using the quasi-experimental Nonequivalent Control Group Design. The *t-tes*t for correlated samples was used to test the significant difference of the achievements between experimental and control groups while the *t-test* for independent samples the difference between the evaluation of videotape lessons by the teachers and students. The following conclusions were deduced based on the analysis of the data gathered: 1) There was no significant difference in the pretest mean scores between the experimental and control groups, while there was a significant difference in the posttest scores between those exposed to video-aided instruction and those taught with the traditional lecture method. 2) Both teachers and students gave favorable opinion to the use of videotape lessons in teaching physics. 3) There was no significant difference between the evaluations of videotape lessons by the teachers.

Equally, De Gulan (1999) found out that: 1) Students in Special Science Classes were exposed to videotapes performed better in achievement, retention and attitude than those unexposed to videotapes. 2) In the Regular Science Classes, the performance of students exposed to the videotapes did not differ significantly from that of non-video students towards science. 3) Students exposed to the videotapes in special Science Classes performed better in achievement, retention and attitude than those to the videotapes in the Regular Science Classes. Related literature explains this phenomenon

by the research finding and observation that practical, intelligent people generally adapt/adjust better to new situations than others.

The continuing quest for updated information and knowledge is now ably assisted by states-of-the-art information and communication technologies ushered in by emerging trends toward modernization. It then behooves the teachers to keep themselves skilled in using new equipment, tools, devices to ensure an unhampered procedure in presenting clear and accurate lesson episodes (Salandanan, 2012).

With the use of videotapes of science lessons/programs, the pupils are motivated to learn their lessons well. Boredom and sleepiness are lessened, if not totally eradicated and the attention span is longer because most of the senses are involved. The videotapes of science can be used repeatedly over the years in teaching the same science lessons. This saves time and effort, giving the teacher more time to work on other science lessons Kenny et al. (1987, as cited by Reyes, 2003).

Epni (2003) of Pakistan investigated the effects of a computer-assisted instruction materials (CAIM), using an experimental design. After the treatment, general achievement in the Physics Achievement Test (PAT) increased by 10% in favor of the experimental group at $p < 0.05$ significant level. Some researchers argued and recommended that achievement increases with the use of computers in science education (Chang 2001). In addition, it is reported that student abilities and skills in scientific investigations are positively affected by computer-assisted instruction (Bayractar, 2001). In contrast, as further cited by Epni (2003), some researchers advocated that the traditional learning method is more useful than CAI (Morrell, 1992; Wainwright, 1989 as cited by Epni et al., 2003).

In Reyes' study (2003), he found out that the CONSTEL chemistry telecourse has helped enhance students' understanding of chemistry concepts, achievement and

attitude towards physics. She stressed, though, that the CONSTEL Chemistry telecourse does not preferentially affect one student ability group.

Likewise, Agabin (2003) in her study enumerated that: 1) The students taught with videotapes instruction performed well as compared to those instructed with conventional method. 2) The use of videotapes instruction is an effective teaching tool in increasing the students' academic performance of the students. She concluded that videotapes instruction was effective as compared to the traditional.

In 2003, a study conducted by Christmann and Badgett (as cited by Shoemaker, 2013), on meta-analysis of computer-aided instruction and its effect on elementary students' achievement. They examined 39 studies which compared the effect of computer-aided instruction and traditional method of teaching. The results showed that the over-all effect size was .342 for computer-aided instruction influencing higher achievement that was relatively small effect size.

Comparably, Reyes' study (2003) yielded that: 1) There is no significant difference between the mean score of the control group, 42.49, and the experimental group, 41.47, since the required t-value at degrees of freedom of 40 at .05 level of significance is 2.021. This meant that the use of videotapes and pictures as instructional materials had equal significant effect on the science achievement of the Grade IV pupils of the Immaculate Conception Academy of Manila. 2) The kind of instructional media used on both sexes were equally effective to both. Based on her findings, these conclusions were drawn: 1) The use of videotapes of science lessons/programs as instructional materials has no significant effect on the science achievement of the Grade IV pupils. 2) The two types of instructional materials used in the control group and the experimental group can be equally effective to both sexes.

Mayer (2005, as cited by Sorden, 2012) reiterates that "meaningful learning from words and pictures happens when the learner engages in five cognitive processes: 1) selecting relevant words for processing in verbal working memory; 2) choosing relevant images for processing in visual working memory; 3) organizing selected words into verbal model; 4) organizing selected images into a pictorial model; and 5) integrating the verbal and pictorial representations with each other and with prior knowledge.

The use of technology in education has dramatically increased over the years. Computers could be used in presenting the day's lesson, solving problems, and providing educational games. Some schools make use of computer-assisted instructional applications such as drill-and-practice programs, simulations and games programs and tutorials. Recently computer literacy has been included as part of the curriculum of many schools. At present, internet allows local and international access to any conceivable topics under the sun.

Maniger and Holden (2009, as cited by Shoemaker, 2013) discovered high levels of integration of technology use in Texas schools with laptops for every middle school student. They reported several positive outcomes of laptop use: first, laptops engage the students, allow teachers to easily accommodate for individual learning, and give their students greater access to a variety of content material. Teachers also reported higher student involvement and deeper understanding of the content when using technology.

Meanwhile, Zulla (2009) initiated to venture strategic intervention material in science teaching to accelerate the students' positive attitudes towards the subject, thereby facilitates understanding science concept. His study aimed to determine the effect of comic strips as teaching aid on the achievement and attitude of students as a basis to propose administrative intervention scheme. The salient findings of his study: 1) The

level of pretest science achievement of students in the experimental and control groups is low with the mean scores of 1.53 and 1.48 respectively. The level of attitude of students in the pretest of experimental and control groups is moderate with the mean scores of 2.70 and 2.95 respectively. 2) The level of posttest science achievement of students in experimental and control groups is high and moderate, respectively as revealed in the mean scores of 3.25 and 2.48. The level of attitude of students is high for experimental group with the mean score of 3.80 and moderate for the control group with the mean score of 3.14. 3) There is no significant difference in the pretest science achievement of students in the experiment and control groups, as revealed in the computed t having a value of 0.513. The probability value of .609 is greater than 0.05. Thus, null hypothesis was accepted. There is no significant difference in the attitude of students in the pretest of experimental and control groups, as revealed in the computed *t*-value of 1.18, with the probability of .402 greater than 0.05.

Yllano's study (2009) investigated the effect of multimedia-based instruction on students' achievement and attitude towards geometry. It utilized a quasi-experimental design using the pretest-posttest equivalent groups and found out following: 1) Attitudes of students were positively gained in the Multimedia-Based Instruction (MBI) compared with Non-Multimedia-Based Instruction (NMBI). 2) There is significant difference in students' achievement between the NMBI and MBI.

Gorra, (2010, as further cited by Shoemaker, 2013) stated that the "digital natives" view technology as an essential part of their everyday life. These authors surveyed college undergraduate students over a period of four years to identify trends in technology preferences among them. Their findings showed that 98% of the students carry some kind of communication device daily and most have devices for listening to

music, viewing videos, and accessing the internet. The students report that they appreciate options in modes of instruction, such as downloading lectures, content or multi-media sources.

In Africa, Adegoke (2011) determined the effect of multimedia instruction on senior secondary school students' cognitive achievement in physics. The participants were composed of 106 boys and 98 girls, a total of 198 coming from four senior secondary schools. Three experimental group were used: 1) animation + on-screen text, 2) animation + narration, and 3) animation + on-screen text + narration, with the control group taught in the conventional lecture method group. The result of the study revealed that students under multimedia instruction performed better than those in the control group which suggested that learning outcomes of the students in physics can be enhanced with multimedia instruction.

In Turkey, Gul and Yesilyurt (2011) studied the effect of computer assisted instruction (CAI) on the attitude and achievement of fourth grade towards science and technology. They utilized quasi-experimental design, with two groups consisted of fifty-five participants. The experimental group was taught using the computer-assisted instruction, while the control group, the constructivist approach prevalent in the country's Education System. The result of the study revealed that the post-test mean scores of the experimental group in the achievement test and attitude scale is higher than the control group.

Shoemaker (2013) of the Liberty University in Pennsylvania investigated the effect of computer-aided instruction on attitude and achievement of fifth grade math students. He used quasi-experimental non-equivalent control group design applied to participants from the intact classrooms and not randomly assigned to treatment or

control. They took a pre-test, midterm test and post-test consisting of different forms of the 4Sight math assessment and went through an attitudinal survey at the beginning, middle, and at end of the study to measure any differences that might be attributed to the use of various technologies. Results were statistically analyzed to determine if any significant differences existed in attitude and achievement after treatment. Shoemaker found out that the participants. However, it influenced positively the attitude of low-achieving students.

Schools need to improve their instructional materials to best prepare today's learners for the global job in the 21st century. Every student should be proficient in reading, writing and arithmetic. One possible answer is to incorporate technology which has been shown to be engaging and effective in increasing the depth of student learning.

Many schools are already using variety of technology as part of the curriculum. To make this effective, essential factors have been identified -- professional development, support and technology resources backed up by studies showing that implementation of technology with these aspects impacts positively on student attitude and achievement in different subject areas, including mathematics (Ozel, Yetkiner, & Caprano, 2008), as cited by Shoemaker (2013).

Similarly, Ifeoma (2013) tried to examine the use of instructional materials and educational performance of students in integrated science. The study used experimental design of pretest and post-test scores with two hundred forty nine (249) participants. The result of the study showed that there is significant difference in the mean scores of the two groups just as the use of instructional materials improved the quality of students' learning. These findings agree with those of Ogunleye (2002) who also observed that when teachers use instructional materials, they become more effective. He also added

that an enriched classroom environment is dependent on the use of instructional materials. While, Esiobu (2005) found out that instructional materials when used to students of different age groups resulted in better performance.

In Nigeria, Nwike et al (2013) studied the effects of use of instructional materials on students' cognitive achievement in agricultural science offered in secondary schools. The study used quasi-experimental design, using a sample composed of 256 JS II students who were randomly sampled from 5 schools of 5 towns with two groups each, the control group and the experimental group. The study used the Agricultural Achievement Test (AAT) with a reliability of 0.82. The control group was taught without instructional materials, while the experimental group with available instructional materials. Mean, standard deviation and z-test were used to analyze the data collected – students taught with instructional materials performed better than those without them. There is no significant difference found in the achievement scores of male and female students. Neither is there significant difference in the mean achievement scores of male and female students. At 0.05 level of significance, however, it was found out that there is significant difference between the achievement scores of those taught with instructional materials than those without to indicate that instructional materials impact positively on students' performance.

In 2014, a group of Kenyan educators investigated the effect of computer-based simulation module on the achievement of students in the magnetic effect of an electric current. They used Solomon-Four Quasi-Experimental design in comparing two control and two experimental groups in the purposive sampling technique. The participants of the study were four schools assigned randomly to the control and experimental groups involving a total of 170 students. The control group was taught using the regular

teaching method, while the experimental group the computer-based simulation module. Experimental Group 1 and control Group 2 were given a pretest before implementing the treatment. After four weeks of teaching, post-test was given to all the groups using the Physics Achievement Test. Data were analyzed using t-test, one-way ANOVA and ANCOVA at significance level of alpha equal to 0.05. The result of the study showed that Computer-Based Simulation module resulted into higher achievement mean scores among the groups that received the treatment. The mean scores were statistically significant in favor of the experimental groups.

Interactive in nature multimedia, --one of the instructional materials which stimulate multiple senses of the audience at a time—enables teachers to control the content and flow of information (Phillips, 1997, as cited by Khan 2015). In Pakistan, the use of multimedia in classroom teaching is very limited due to the high cost of multimedia or computers and other related gadgets; lack of computer-literate and technical staff; and teachers' attitude towards its use. But, Gilakjani (2012) as further cited by Khan (2015) justified the use of computer in the classroom in intensifying students' interest level, enhancing their understanding and increasing their memorizing ability.

Another study in Osun State, Nigeria attempted to evaluate the effects of computer-assisted instruction (CAI) in Biology compared to traditional method of teaching on senior secondary school students' achievement and attitude. Three purposively selected schools were used in randomly selected science class. The participants of the study were composed of one hundred fifty two students. The study used one group pretest-posttest experimental design. Pretest and post-tests scores were used to assess the effect of instruction. To assess students' attitude towards CAI,

Students' Attitude to Computer Instruction Questionnaire (SACAIQ) was used with a reliability equal to .78. Descriptive and inferential statistics helped analyze the data collected. The study revealed that there is significant difference between students' academic achievement and mode of instruction. It was also recommended that in teaching Biology at Secondary Schools to improve students' academic achievement, CAI should be used (Kareem, 2015).

Nsa, et al (2013) conducted a study to find out the effects of instructional materials utilized on the performance of Junior High School students in Practical Agriculture in Ikot Abasi Local Government Area. Quasi-experimental design with a pre/post-test non-randomized control group arrangement was used to two hundred students participated in the study. Students' Achievement Test in Practical Agriculture (SATPA) was developed and used to gather the needed data. Validation of the instrument was done by research experts who obtained a reliability coefficient of 0.80, using K-R 21. To analyze the data gathered, *t*-test and ANCOVA were used. The result of the study revealed that there was a significant difference between the performances of the students taught with instructional materials than those without.

Shah and Khan (2015) observed that the use of multimedia in teaching resulted in a changed teaching-learning process noting a significant difference in the achievement scores of both groups. The presented lessons yielded more effective and better comprehended student performance.

The basic education curriculum has been enhanced through K to 12 program, hence the continuous need to update knowledge and information to motivate students to study better, inspire them to pursue their studies, and prepare them adequately to compete globally later in life. Such upgraded knowledge and information can be easily

learned by the students through the different visual aids/instructional materials, but teachers must learn how to use these varieties of instructional materials to provide the updated information needed by the students so that lessons become more meaningful and relevant to them. Yet admittedly, no matter how effective and competent the teachers are, if the students have not improved in the performance of test, all teachers' efforts are useless.

Students' Attitude

Merriam Webster Dictionary defines attitude as a notable deed, achieved by effort, to execute successfully. Also, it refers to "a mental position with regard to a fact or state, or a feeling or emotion toward a fact or state."

Tavios (1987) held that it is necessary to focus instruction towards awakening the students' interest in physics and to foster their appreciation of the importance of physics as well as the development of a positive attitude on their part toward the subject.

In 1994, Simpson et al defined attitude as "a predisposition to respond positively or negatively to things, people, places, events, or ideas." In like manner Thompson and Mintzes (2002) viewed attitude as the "tendency or state internal to a person toward evaluative responses which is to some degree favorable or unfavorable."

For Kaijian (2007), attitude refers to an idea changed with emotion, which predisposes a class of actions to a particular class of social actions. He identifies three main components of an attitude: first, a cognitive component, an idea which is used by humans in thinking; this category inferred from consistencies in responses to different stimuli. Second, an affective component, referring to emotion which changes the ideas. Third, a behavioral component associated with a disposition to action. However, it is difficult to separate the three components, as they tend to interact and merge with one another.

Bloom (1976, as cited by Terrado, 1995) provides much explanation regarding attitudes and their effects upon school learning. He approximated that of the 50% students' achievement in science, 25% comes affective characteristics, while the other 25% is from quality of instruction. He asserted that attitude towards science is only a portion of much bigger and more powerful attitude system-- which is the attitude towards school.

Students' attitudes are important outcomes of the learning in school. Pupils can be guided to achieve masterly skills and wholesome attitudes, which according to Terrado (1995) compose the factors that go hand in hand in manifesting the learners' scholastic performance. Terrado further affirmed that "learning is conditioned by the attitude of the learner, by the environmental conditions conducive to learning and by the attitude and the skill of the teachers in setting the stage of learning."

In addition, Astronomia (1987) in conducting a study on the attitude of College Students Toward Mathematics found out that the students' attitude towards it is significantly related to their achievement in the subject. Robles (2003) for her study on the relation of attitude and achievement at Central Philippine University, pointed out that students' attitude is significantly related to their achievement.

In the study of Hardwood and McMahon (1997), correlation between student achievement and logical thinking ability revealed that students with high levels of logical ability benefited most from the video-enhanced curriculum. Treatment students also scored significantly higher than control students on the chemistry attitude instrument. These results along with qualitative supportive evidence suggest that integrated video media curriculum intervention can positively affect student chemistry

achievement and attitude both across ability levels and a diverse multicultural population.

A longitudinal study on the influences of attitude toward science, achievement, motivation, science self-concept on achievement in science was conducted by Simpson et al (2006). They found out that effective behavior in science classroom strongly relates to achievement.

In 2001 Molina highlighted the influence of students' attitude on chemistry achievement and revealed that the use of interactive teaching made improvement on students' attitude toward the course. She further concluded that the effect of interactive teaching on the attitude of the students towards chemistry contributed to an enhanced learning in the subject. Students with a high attitude toward the subject as a result of interaction with their teacher and student to student during discussion tend to construct new knowledge, a finding that Rivera and Ganaden (2001) also reported-- a strong and significant correlation between attitudes of students toward science and achievement in science.

Furthermore, Alwis (2003) offers another important insight into the nature of attitudes. He sees attitude as "a latent or non-observable complex but relatively stable behavioral disposition reflecting both direction and intensity."

Reyes (2003) cited that audio-visual aids like video tapes help clarify important concepts and principles. They arouse and sustain the pupils' interests and help minimize monotony and boredom that result in unfavorable attitude toward learning. Audiovisual aids also help make learning more permanent, since they provide visual and audio information of instructional information as much as effectively replace the print-based instruction media such as still pictures, charts and illustration.

Reyes (2003) stressed that with the wide use of television not only in the United States but also here in the Philippines, has become an important source of information, behavior and attitude where children can be exposed to exciting and stimulating source of knowledge, even increase cognitive skills and imaginations. Indeed, television has become a second school curriculum to the point that "Children watch television on average of 24 hours a week or about one-fifth of their waking hours."

Geronimo (2004) pointed out that teachers need to realize the feelings of students toward the subject. Putting emphasis on affective domain is important, but neglected most of the time, since teachers find difficulty in designing approaches or techniques that will help develop positive attitudes among their students.

The attitude today's students is far different some thirty years ago. At present, many factors affect their attitude, the way they study, think, and talk. But then, teachers need to understand students' attitude, to become supportive in their achievement and interest, especially towards science. Attitude influences behavior, it is not an inborn attribute, but it depends mainly on the experiences and situations met by the students. Consequently, one's attitude can be changed depending on the motivational factors within and outside the person (Saparniene 2005, as cited by Shoemaker, 2013).

According to Bennet (2003, as cited by Shah, 2015), students' attitude towards science is developed as the result of experiences in different learning environments in the field of science education. This attitude affects their participation in science-related activities. Moreover, positive attitude towards science is very important for students' achievement. Kamla (2008, as cited by Barado, 2012) concluded that certain factors relate to the attitude of students towards science: method of teaching, teacher's attitude, parents' influence, gender, age, pupils' cognitive styles, interests in career, implications

of science and achievement to society. Osborne (2003) further pointed out that classroom environment is a significant determinant of attitude.

Based on the Social Learning Theory, students learn from observation and imitation (Calderon, 1999, as further cited by Grey, 2004). In the classroom, the students are the best imitators who generally reflect their teachers' attitude and behavior. The things seen and observed from their teachers, in one way or another, affect the students' attitude toward the subject.

There are other kinds of attitudes that are equally important for learning to be successful, attitude toward the teacher, as well as towards the school, other students and oneself. Some studies showed that the teaching method used by the teacher plus his personality greatly affects the students' attitude towards the subject. It is common notion that the teachers' personality as a whole influences the students' attitudes toward the subject (Grey, 2004).

Almoite (2011) held that to facilitate learning, it is vital that educators familiarize themselves with students' attitudes as well as the factors that may influence their academic performance.

Students' attitude towards physics could be influenced by the following: gender, expected achievement, experiences in previous science classes. Significant findings from the study of Craker (2006, as cited by Espiritu (2011) revealed that "attitudes towards science are strongly related to achievement when areas of personal confidence, usefulness of the subject, perception of the subject as a male domain and perception of the teacher's attitude are considered."

In 1983, Magaway made a study on the attitude of pupils toward Filipino subject. Her study revealed that it has no significant relationship to achievement. Accordingly,

children who had positive attitude toward Filipino had high achievement, those with low achievement tended highly to have negative attitude.

Thus, most students don't like science subjects, and other subjects as well. The reason for this maybe traced to the fact that most teachers forget to develop among students the right attitude towards the subject, aside from other things that get students' attention like malling, seeing movie marathon, texting, playing games in the cellular phones, wattpad, peer pressure and many other things. These engagements are more appealing to students, so teachers, in general should be aware of these, and be smart, and creative on how to get students' attention, even at least during class hours. Otherwise, students will not be motivated, neither encouraged to study, resulting in a continuous decline in their academic performance.

Several studies revealed that a significant relationship exists between attitudes and achievement, thus achievement increases because positive attitude toward science is manifested (Schibeci and Riley, 1986, Cook and Mulvihill, 2008, as further cited in Gul and Yesilyurt, 2011).

According to Hannula (2002, as cited in Perez 2013) attitude is not permanent, it changes. The attitude of most students towards the subject depends on their achievement in class, especially the younger ones and those that are not established yet. The attitude changes depending on what kind of day the student has. Positive attitude is manifested for a good day. He further asserted that when attitude is already established or seemed stable, little changes occur depending on situation.

Furthermore, Epni et al, (2003) found out that computer-assisted instruction material had a little change on students' attitude towards science education.

Geronimo (2004) also cited that attitudes influence behavior and hence act as motives. They are developed and often make men learning easier or harder to acquire.

One of the chief obstacles to effective learning lies in the students' negative attitudes towards the subject. Students often acquire attitudes as a result of repeated experiences of a similar type so that repeated unsuccessful and unsatisfying experiences are likely to lead to the development of unfavorable attitude toward the subject.

In Clarete' study (1994), she found out that students exposed to 2D and 3D visual aids did not show any difference in the attitude student towards physics.

Balneg (2000) used a descriptive-normative survey to describe the level of science attitudes of the students. Among other finding his study revealed that: 1) The students had moderately positive attitude towards science and that there is no significant difference in their science attitudes by year level. 2) There is neither significant relationship between science attitude of students and student-related variables such as sex, family, size, occupation of parents, and exposure to mass media. However, involvement in co-curricular activities significantly influences their science attitudes. Similar finding revealed by Kareem (2015) to the effect that there is no significant difference between mode of instruction and students' attitude.

In this connection, Fletcher (1995, as cited by Agabin, 2003) tried to determine if there was a difference between the attitude of the students taught with the traditional classroom instruction and those in computer-assisted instruction. The results were compared and the findings revealed that both methods of instruction were effective in teaching 4th grading spelling, with no significant difference in the results of either method.

Harris study (1998) on the effect of teaching approaches on secondary students' behavior and knowledge regarding education-related concepts yielded that there is no significant difference in students' outcomes related to different teaching approaches.

Unsurprisingly, there were no significant changes in students' behavior, or knowledge as a result of students' exposure to the different teaching approaches.

Barado's research revealed (2012), that students' attitude toward science was negligibly correlated on academic performance, to suggest that there is no significant relationship between students' attitude toward science and academic performance.

According to Festus (2007) performance appears generally to be the fundamental goal behind every life struggle, but positive platform has consequential effects on improving the student worth and can only be achieved through acquisition of positive learning attitudes. His attitudes trigger his behavior. Attitudes are antecedents which serve as inputs or stimuli that trigger the actions.

The findings of Palomares' study (2013) revealed that the students' negative attitudes are the functions of lack of interest, erroneous belief that chemistry is uninteresting and the teacher's poor motivation.

Test Performance

People today are required to take tests throughout their school days and career lives than ever before. With the test in hand, the following techniques will help alleviate stress and enable the individual to perform best: 1) listen to directions; 2) read the test directions; 3) survey the test; 4) budget time wisely; 5) read each question carefully; 6) note or underline key words and terms; 7) read multiple choice options carefully; 8) give each question the fullest attention; and 9) skip ones he doesn't know to go back to them later.

Test has been defined in the Webster Dictionary as "a trial or critical examination," while, performance, according to Gipps (1994), refers to what is actually done under existing circumstances.

Teaching and assessment are inseparable in the learning process. Assessment does not stand outside teaching and learning, but in a dynamic interaction with them (Danili & Reid, 2006).

Developing successful lesson plan depends on the important information provided by the test, but testing results alone cannot fully determine a student's needs. The results of a test can be skewed by factors outside the student's control.

Some factors that can affect test results come in form of: 1) Physical and mental factors which refer to the physical disabilities (hearing loss, visual impairment, etc.), general health condition, the student's attendance record and learning ability levels. 2) Home factors have something to do with the following: interests of parents in their child's education; language used (bilingual/native speaker); stimulation for learning within home which includes books, television, and internet; help on school work at home; and happy home life. 3) School factors include student's interest in school; over or under-age for the grade; appropriate instruction, sufficient time allotted to the subjects; emotionally adjusted (not fearful, compulsive, frustrated, insecure, rejected, etc.); challenging school program; student's study and work habits; setting realistic expectations for the student and teacher-student relationship.

To maximize the performance during the day of testing, Leyden (2015) shared fifteen tips on how to boost test performance: 1) Wake up early. 2) Check the venue and time of test. 3) Have a balanced breakfast. 4) Before leaving, check the things needed in the test, like ID, pencil, etc. 5) Head to the venue with plenty of time. 6) If there are people around panicking, avoid them. 7) Go to the toilet before the test starts. 8) Never forget to write the name in the test. 9) Read all the questions carefully before starting and quickly plan how much time will be spent in each question. 10) Start answering the

easy and familiar questions no need to answer the questions in order. 11) When brain freezes, just start writing to remember important details.12) Dont spend more time on a particular question. 13) Ask the examiner if needed, don't be afraid. 14) When done and still have time, review the answers. 15) Stay calm and show no need to worry, get out of the room quietly.

The following are the emotional and physical factors that affect test performance: 1) panic –self-defeating situation; 2) carelessness; 3) lack of focus; 4) excessive anxiety; 5) cramming; 6) inadequate diet; 7) lack of exercise; 8) low motivation; 9) lack of sleep; and 10) poor attitude.

The importance of aligning teaching methods and assessment tasks is stressed in many publications pertaining to the curriculum (Osborne, 2003). However, over the last decade, the amount of assessment in schools has increased. The assessment workload for teachers has grown dramatically, and the time available to devote to assessing each student has considerably fallen. To reduce workload teachers use objective test.

Maas (2013) tried to determine the effect of music on math test performance. The participants of the study were four algebra II classes, two regular algebra II classes and two accelerated II classes. Latin square design was used to determine the effects of classical, rap, rock and no music. The result of the study revealed that classical music had the most positive effect on the test performance of the students.

In 2006, Danili and Reid conducted a study on the cognitive factors that can potentially affect pupils' test performance. They explored two cognitive styles, 'field dependent/field independent' and 'convergent/divergent', in relation to three formats of assessments (multiple choice, short answer and structural communication grid) in five classroom chemistry tests. The study was conducted in Greece with the participation of Grade 10 pupils, upper secondary school, ages 15-16. The field dependent/independent

characteristic correlated with pupils' performance in all the tests, and in almost all the formats of assessment. By contrast, the convergent/divergent characteristics correlated with pupils' performance in assessment where language was an important factor, but not in algorithmic types of questions or in questions where there is a greater use of symbols and less of words. In relation to convergent/divergent characteristic, the chemistry content and presentation of test is a factor affecting the type of questions being asked. This study suggests that some factors that affect pupils' performance might be the following: a) the content and presentation of the test, b) the format of the test, c) the psychology of the individual.

In Nigeria, Edeh and Vikoo (2013) investigated some factors affecting the performance of secondary school students in chemistry, A Kolokuma/Opokuma Study. It comprised all senior secondary school II students from ten randomly selected schools to make a total of six hundred students. The instrument for data collection was the Students Chemistry Learning Inventory (SCLI) designed by the researcher and chemistry performance test. The study adopted the correlation research design as it sought to establish relationship between two or more variables. The study investigated the extent at which factors like attitude/interest, previous preparation, study style, parental involvement and teacher expectancy influence students' performance in chemistry. The findings of the study could not be conclusive without further analysis of other variables that could influence students' performance in chemistry. Variables such as content validity, physical conditions, school organization, and outside interest could also provide further information on students' performance in chemistry.

Synthesis

The basic education curriculum has been enhanced through K TO 12 program which allows more focus resulting in the mastery of learning. For instances, Physics telecourse can be used not only to Grade 10 students but also to the lower grade levels because physics is also taught to these levels adhering to the spiral curriculum.

The physics telecourse entitled "Physics in Everyday Life"is composed of 40 episodes, and intended primarily for teacher's use but it is the teacher's prerogative to show selected parts of the video to the students, since it integrates values, core life skills and other learning areas.

The present study made use of the physics telecourse. In Reyes (2003), it will be recalled that the use of Chemistry telecourse was found to have significant effect on students' conceptual understanding, achievement and attitude of students' in Chemistry.

Among researchers, the following conducted studies on instructional materials: Clarete (1994), Natividad (1995), Logmao (1997),Alvarez (1998), Guibone, (2001), Chui (2002), Agabin, Reyes, Epni et al (2003), Hardwood et al (2007), Nduati (2009), Espiritu (2011), and Shoemaker (2013). Some on teaching methodologies were done by Molina (2001); (Geronimo) 2004; Espiritu (2011) and Festus (2012) who tried to determine its effects on attitude or other dependent variables under study.

In terms of test performance, the literature (Oriondo, 1989; Gipps, Messick (1994); Ornstein, 1999; Onyper (2016) and studies conducted by Maas, (2013); Danili & Reid, (2006), Edeh & Vikoo, (2013) pointed out that many factors also affect test performance.

The findings of the present study could prove that physics telecourse might affect the test performance and attitude of students toward science.

All the literature and studies reviewed provided pertinent insights and information to the development of the present study.

As aimed by any other researcher, this study tried to seek another way of improving students' attitude and test performance in physics.

Chapter III

METHODOLOGY

This chapter covers and describes the research design, participants of the study, research instruments, data gathering procedure, and data analysis procedure.

The Research Design

The study employed quasi-experimental two-group design research involving counterbalanced design. The group serving as the experimental and the control group is reflected in Figure 2 below.

	Test Session	
	1	2
Subject 1	A	B
Subject 2	B	A

Figure 2. *Classes designated as experimental and control groups*

This design ensures that order effects are balanced across the condition. It also attempts to achieve control by exposing the participants to different orders of the treatment conditions (Foley, 1991). The number of treatment should be equal to the number of groups; in other words, if there are two different groups, there should be two treatments. It is usually used when pretests are not advisable and control groups are not neither available. The experimental and comparable groups are being equated in which the treatments are administered in a reversed manner to both groups.

Participants of the Study

The participants of the study were two intact heterogeneous classes. Before the conduct of the study, statistical analyses (Table 1 & 2) established that the two classes

involved stood parallel and fitting to be called as experimental and comparable group. Using counterbalanced design, the study had both participants taught using the two methods of teaching. The researcher facilitated the classes for the whole duration of the study. (Please, refer to appendix F for the everyday schedule in science class of the two sections under study). After the experiment, their scores in the physics attitude inventory test (PAIT) and the results of the physics formative tests in the three segments were analyzed.

Mean Grade of Group 1 and Group 2 Before the experiment

To establish that the classes utilized for the study were comparable, the quarterly grades in Physics of the students in each class were analyzed statistically before the experiment. Table 1reflects the result of the statistical analyses done.

Table 1.

Independent samples t-test results of Group 1 and 2 on the mean grades before the experiment

Group	Mean	SD	Mean Difference	*t*-value	*p*-value	Interpretation
1	86.54	2.38	0.21	0.309	> 0.05	NS
2	86.75	2.29				

Significant at $\alpha = 0.05$

Using the t-test for independent samples, the research computed and compared mean grades in the first, second and third grading periods. The mean grade of Group 1 is 86.54, while Group 2 has a mean of 86.75. In terms of variation of grades, Group 1 posted a higher standard deviation than that of Group 2 to suggest that the former group is more heterogeneous than the latter group. However, comparing these mean grades

statistically, the mean difference of 0.21 resulted in a computed *t*-value of 0.309 and the *p*-value of greater than 0.05, indicating no significant difference. The insignificant mean grade difference implies that the knowledge of the students in both groups is almost virtually the same and regarded as suitable for study.

Attitude Toward Physics of Group 1 and Group 2 Before the Experiment

Similarly, the attitude of the participants was studied for comparability of the groups. The statistical comparison of the two groups in terms of said variable prior to instruction is presented in Table 1 and Table 2.

Table 2.

Independent samples t-test results of Group 1 and Group 2 on attitude before the experiment.

Group	Mean	SD	Mean Difference	*t*-value	*p*-value	Interpretation
1	3.19	0.26				Not Significant at
2	3.08	0.26	0.11	1.46	> 0.05	α = 0.05

Table 2 shows the results of the attitude of the two groups measured at the beginning of the experiment. The mean and the standard deviation of attitude ratings of students in Group 1 is 3.19 and 0.26, and that of Group 2, 3.08 and 0.26 suggesting that students in Group 1 have slightly better attitude toward Physics at the beginning of the intervention than their counterparts in Group 2. However, the standard deviation values registered are equal, indicating the variation of attitudes toward Physics in both groups stands the same. Using the *t*-test for independent sample, the computed *t*-value is equal

to 1.46, and the corresponding *p*-value greater than 0.05. The latter statistic implies that the mean difference, 0.11, between Groups 1 and 2 is not statistically significant, suggesting that the difference can be attributed to chance. It further suggests that the attitude of the two groups toward Physics, can be considered comparably the same. This phenomenon could probably be attributed to the fact that the two classes were heterogeneously grouped at the beginning of the school year, signifying that both groups were comparable at the beginning of the study in terms of their attitude towards their physics subject. Whatever change in other variables after the experiment, therefore, can hardly be attributed to the difference in the students' attitude.

The results of the statistical analyses (Tables 1 & 2) established that the two classes used in this study are parallel and fitting to be called experimental and comparable groups as far as prior knowledge and attitude toward Physics are concerned. As mentioned earlier, any change in students' characteristics after the experiment cannot be attributed to these variables, but perhaps owing to the intervention made because as presented, the two student groups stands parallel from the start.

Matching of the Participants

To ensure further the comparability of the student groups, manual matching of students were done using their average grade in third grading and attitude towards physics. This matching resulted in reducing the participants of the study to 24 per study groups. Other students still joined the class, but their data were excluded from the statistical analysis to purposely address the problems of this study.

Research Instruments

The following research instruments were used in this study:

1) Physics Attitude Inventory Test (PAIT) adopted from Reyes (2003) to measure the students' attitude toward science. Only two modifications were done-- one

was by replacing the word “chemistry” with the word “Physics”, as suggested by the panelists during the colloquium. Second, the rating scale was also changed into a four-point Likert-type scale consisting of 25 statements on how they feel about the subject with 16 positive statements and 9 negative statements. A statement is classified as positive (+), if it is in favor of physics, and negative (-) if it not in favor of physics. For positive statement: strongly agree (SA) = 4, agree (A) = 3, disagree (D) = 2, and strongly disagree (SD) = 1. The scoring was reversed for negative statement: strongly agree (SA): =1, agree (A) = 2, disagree (D) = 3 and strongly disagree (SD) = 4.

2) Physics Formative Test (PFT) is a teacher-made test to determine the knowledge gained by the students. Prior to this, the topics covered for the fourth grading period were divided into three segments with a corresponding formative test of a 25 item-multiple choice test with four options. The questions were constructed by the researcher herself, based on the PSSLC for the fourth grading period in physics, SY 2014-2015.

Data Gathering Procedure

Two Phases were followed by the researcher in gathering data:

Phase II: Experimental Phase

1) Securing permission from the principal to conduct the study
2) Identifying the experimental and the comparable group for each segment
3) Orienting the participants of the study
4) Administering the pretest on attitude
5) Conducting the study for four weeks
6) Administering and checking of the Physics Formative Test after each segment
7) Administering of Post-test on Attitude
8) Analyzing Statistical Data

In the actual conduct of this study, the researcher followed the class schedule (Appendix H) and used her daily lesson plan (See Appendix G). Figure 2 shows the assignment of the comparable and experimental groups based on the regular class schedule. The classes of the two groups were held in the science learning center, as approved by the head of the science department. The learning center is located in the third floor near the faculty room of the science department had three electric fans. It must be mentioned that after using the tv set, it was always transferred to the learning center, for safety reasons.

	Segment 1	Segment 2	Segment 3
Group 1	Comparable	Experimental	Comparable
Group 2	Experimental	Comparable	Experimental

Figure 3. *Assignment of Group 1 and Group 2 in the three segments.*

Both groups started the lesson with the daily routine, followed by motivation, sometimes review. The groups differed only in the lesson proper. For the group taught with Physics Telecourse, questions were posted on the board before viewing the telecourse, after which students were reminded to write on a sheet of papers important details and concepts while viewing the telecourse. Such viewing was done only during the "activity proper portion" of the lesson plan (See Appendix G). It must be noted that the physics telecourse was not intended to replace the teachers, instead used to help teachers facilitate the lesson.

For the group taught using the traditional method, group work was given to them with hands on activities and were required to answer the activity sheets. They discussed the result of the activities within the group. Then they presented the result of the activity in a creative manner, as emphasized by the science supervisor. After the post activity, the same procedure was followed by both groups, as indicated in the lesson plan.

Data Analysis

The Statistical Package for Social Science (SPSS) Program was utilized in the treatment of data and these statistical tools were used to analyze the data gathered: the mean helped describe the scores of the students in Physics Formative Tests, and in the Physics Attitude Inventory Test, while, the standard deviation yielded how closely the values of a data set are clustered around the mean, the *t*-test for independent sample sought to determine the existence of a significant difference between the scores of the students in the attitudes towards Physics and Physics Formative Tests. To determine the significant difference between the attitude of the two groups before and after the experiment, the *t*-test for dependent samples was used.

Ethical Concerns

Prior to the conduct of study the researcher sought permission from the parents of the participants. It was held during the orientation of parents regarding the conduct of remedial class in preparation for the National Achievement Test. The researcher explained the possible benefit from participating in the research. Orientation of the participants was also conducted wherein they were given the chance to ask questions about the research.

During the conduct of the study, the participants were treated with respect, not pressured, and were given the opportunity to decide to withdraw from participation without deduction from the grades.

Furthermore, special considerations were given to participants who found difficulty in understanding the lesson. All efforts were made to treat the participants fairly and without bias.

Notably, this study utilized counterbalanced design so both groups experienced how to be taught using the physics telecourse and traditional method of instruction.

Chapter IV
PRESENTATION AND INTERPRETATION OF DATA

This chapter presents the findings of the study. The analysis and interpretation of data are also discussed to deliver the effects of Physics Telecourse on students' attitude and test performance in physics.

Effects of Physics Telecourse on the Test Performance of Fourth Year Students

It can be recalled that the two groups were compared before the conduct of the study. Their comparability was determined using the mean grade of the first, second and third grading periods. The mean grade was subjected to independent *t*-test to make sure that they were comparable in terms of their knowledge in physics. The mean grade was also thought of as indicator of their test performance in physics. Table 3 presents the post-test mean scores, mean difference, *t*-value and *p*-value of Groups 1 and 2 in physics formative test 1.

Table 3. *Comparison of group means on Physics Formative Test in segment 1.*

	Mean	SD	Mean Difference	*t*-value	*p*-value	Interpretation
Group 1 (Comparable)	14.25	4.14	3.46	2.80	< 0.05	Significant at α = 0.05
Group 2 (Experimental)	10.79	4.42				

Group 1 showed higher mean score and standard deviation (X = 14.25; SD = 4.14) than Group 2 (X = 10.79; SD = 4.42). These data show that Group 1 performed better and the scores cluster closer to the mean, implying a more homogeneous test result than Group 2. This was confirmed by using the *t*-test for independent samples, the computed *t*-value is equal to 2.80, and the corresponding *p*-value is less than 0.05. These figures suggest that the mean difference 3.46 is statistically significant, a result attributable to the fact that Group 1 (comparable group) was provided with the usual science instruction prescribed to the teachers, an instruction using lecture methods combined with hands-on and multi-sensory activities, including other manipulative materials. The hands-on and multi-sensory activities plus manipulative materials probably have enhanced their learning of the concepts because as the students performed the activities individually or by group, they had a chance to ask questions and collaborate with the other members of the group. At the same time, while doing the different activities or manipulating the given materials, students were able to see the actual results of what they did. Thus, they could contextualize the lesson well and understand the concepts better. During the post discussion students were required to participate and the follow up questions given by the teacher might have encouraged the

students to think critically. Meanwhile, Group 2 (the experimental group) was taught using the Physics telecourse only. Though given guide questions, they were not able to think critically, because the explanations of the concepts were already incorporated with the telecourse. The researcher holds that learning becomes more meaningful when students clearly understand the concepts and see the applications learned in real-life situations. While it may be true that teaching machines like television can take over certain tasks such as transmission of knowledge or testing the children's mastery of the material and immediate correction of their wrong responses (Lardizabal et al, 1991, as cited by Reyes, 2003), but nothing can equal the warm presence of a teacher who has a more vital role to play than television.

In the book of Corpuz and Salandanan (2007), they pointed out that, "Learning is an active process. This means that we have to actively engage the learners in learning activities if we want them to learn what we intend to teach." (p.52)

According to Clarete (1994), as the students performed laboratory activities, they learned concepts which serve as the foundations of subsequent learning experiences. Hands-on in science involves manipulative materials and visual aids enough to awaken these awaken students' interests. After all, the best road to knowledge is doing laboratory activities as reflected in the saying, "What I do, I understand." Direct involvement in the learning experiences is important in concept development. This direct participation of the students should be supported by appropriate materials and visual aids to concretize the abstractions in Science, Garcia (1989). Besides, using instructional materials provide concrete experiences for the students as stressed by Salandanan (2012).

The result of the present study agrees with the finding of Alli (2006) to the effect that students' performance is unaffected by the use of multimedia. From the ratings of the students who were taught using the traditional method of teaching, she found out that students performed well compared to the students who used multimedia. She elaborated that the intensive explanations of the teacher make the students performed better. This cannot be provided by the multimedia, hence, the use of multimedia is not effective, as shown by the data and students' responses who were taught using multimedia. She further mentioned that the responses of the students who were taught using traditional method proved that it is still effective in improving their performance.

Table 4. *Comparison of group means on Physics Formative Test in segment 2.*

	Mean	**SD**	**Mean Difference**	***t*-value**	***p*-value**	**Interpretation**
Group 1 (Experimental)	17.33	3.61	2.01	2.19	< 0.05	Significant at $\alpha = 0.05$
Group 2 (Comparable)	15.25	2.94				

Table 4 provides the result of the physics formative test 2. Notably, Group 1 (the experimental group) had a post-test mean score of 17.33 and a standard deviation of 3.61, while that of Group 2 (the comparable group) 15.25 and 2.94. Comparing these figures using the *t*-test for independent samples, the computed *t*-value resulted to 2.19 and the corresponding *p*-value less than 0.05, signifying that the mean difference 2.01 is

statistically significant. Group 1(the experimental group) performed better in this assessment. A closer look at the results of Physics Formative Tests 1 and 2 of Group 1 would reveal that it got higher mean scores. The researcher believed that it could be attributed to the time schedule in Science of Group 1(the experimental group) which was earlier than that of Group 2. Probably, Group 2 was already exhausted during their Science class, because it being their last subject.

Callan (1999) found out that pupils performed better in the morning, scores significantly get higher and Students appear to have a distinct advantage when tests are given in the morning. However, Barron (1994) revealed that there is overall increase in the mean score for the mastery of reading skills for below grade level students who were instructed in the afternoon, as compared with those in the morning, with long-term memory tasks-like connecting aspects of a story to events in real-life.

By 2004, it was widely understood that afternoon reading classes suited students better, though some researchers noted some spike in the hormones that affect long-term memory just before noon and again between 1pm and 2pm. Test scores have indicated that students perform better with reading tasks toward the end of the school day. Some reading-related study like memorizing, spelling and vocabulary are useful in the morning, with long-term memory tasks- -like connecting aspects of a story to events in real life tend to more successful in the afternoon (Aarons, 2016).

According to Tenedero (2009), the time-of-day preferences of the students should be taken into consideration in scheduling subjects, administering tests and examination, for this factor can greatly affect the learning process of the students. Their productivity and performance could suffer. Therefore, admittedly, there is much to learn about student energy levels. Some students learn or study best during the evening or

early morning. Others perform better in the late morning, while others learn best in the afternoon. It all boils down to students' learning style in particular time of the day.

In the Philippine setting, the time-of-day preference of the students is not taken into consideration in giving class schedule, especially in the public schools. Due to lack of classrooms, some schools are having three shifts to accommodate the increasing number of students. Therefore, students have no chance of choosing their preferred time. It can be recalled that in Segment 2, Group 1 (the experimental group) again got the higher mean scores, than Group 2 (the comparable group). Probably, the majority of Group 1 learned best in the morning, or they are known as "morning people." Group 2 might be a morning people too, but their science class was scheduled in the early afternoon, thus, their performance was considerably affected.

Table 5. *Comparison of group means on Physics Formative Test in segment 3.*

	Mean	**SD**	**Mean Difference**	***t*-value**	***p*-value**	**Interpretation**
Group 1 (Comparable)	17.46	3.58	0.19	0.71	> 0.05	Not Significant at α = 0.05
Group 2 (Experimental)	16.54	5.20				

After analyzing the result of the PFT 3, one sees that Group 1 (the comparable group) obtained a mean score of 17.46, and standard deviation of 3.58, while Group 2 (the experimental group) had a mean score of 16.54 and 5.20. Using the *t*-test for

independent samples, the computed *t*-value is equal to 0.71, and the corresponding *p* greater than 0.05 and a mean difference of 0.92. However, the difference is found not to be statistically significant, a result suggesting that both groups performed equally in test 3. Such results further signify that probably the two methods are both effective in enhancing the students' performance in physics formative test 3.

The result of test 3 agrees with the study conducted by Guibone (2001) on the effect of multimedia assisted instruction on the academic achievement in Science, Mathematics and English of senior students in selected public high school in Manila. He found out that the use of multimedia in instruction did not make any significant difference on the achievement of students in both experimental and control groups. Both methods of teaching are as equally effective, particularly in Mathematics and Science. However, there is a significant difference in achievement in English.

In the study of Reyes (2003) on the effectiveness of videotapes of science lessons/programs as instructional materials on the science achievement of grade IV pupils, she found out that the use of videotapes has no significant effect on the science achievement of grade IV pupils and the type of instructional materials used in the control group and experimental group can be equally effective to be both groups.

The same result was reported by Tjaden and Martin (1995), as cited by Epni et al (2003) to the effect that computer-assisted instructional materials had no significant difference on the achievement test scores of students between the experimental group and control group. It was an interesting result to the authors that the traditional teaching approach was more effective on knowledge level than computer-assisted instructional materials.

In a recent dissertation conducted by Davis (2012, as cited by Shoemaker, 2013), no significant difference was found in fifth grade students' achievement after using instructional technology. Even though the computers were used for academic purposes, the students' learning in mathematics and science as measured by 2010 and 2011 Criterion Referenced Competency Test scores in science and mathematics did not increase significantly more than the scores of those in the control group. The same teacher instructed both groups who controlled for many extraneous factors. One possible explanation for the lack of difference was that students were not motivated by the Web 2.0 technology since it was readily available in the school system in which the study took place.

Another study on the effect of teaching approaches on secondary students' behavior and knowledge regarding education-related concepts was conducted by Harris (1998) in the University of Mexico. She found out that there is no significant difference in students' outcomes related to different teaching approaches. Unsurprisingly, there were no significant changes in students' behavior, or knowledge as a result of students' exposure to the different teaching approaches.

Contrary to the findings above, Espiritu (2011), in her study on the use of learning module design (LMD) in the enhancement of pupil's attitude, skills, and achievement in elementary science 6, revealed that the experimental group obtained higher post-test mean scores in achievement. The experimental group advances in their mean scores in achievement just as there is a significant gain in achievement of the experimental group from pretest to post-test.

Manzano's (1996) study on the effectiveness of DECS TV-assisted instruction in science and health V in Las Piñas concluded that the experimental group obtained a

post-test mean score 44.25, while the control group a mean score of 39.68. The mean difference of 4.56, with a computed *t*-value of 4.77 ($p < 0.05$), suggests that there is a significant difference between the post-test in favor of the experimental group. In addition, TV-assisted instruction is more effective than the conventional method of teaching.

In 1998, Alvarez determined the effectiveness and acceptability of video-aided instruction to improve the achievement of students in physics, using the quasi-experimental Nonequivalent Control Group Design. The *t*-test for correlated sample was used to test the significant difference of the achievements between experimental and control groups. Analysis of the data gathered revealed that there was a significant difference in the post-test scores between those exposed to video-aided instruction and those taught with the traditional method.

The same result was obtained by Robles (2003) in her study on the effectiveness of slide sound set in teaching nuclear chemistry, its effectiveness measured experimentally.

Logmao's (1997) study on the effectiveness of programmed instruction using audio-visual technique in teaching physics in College concluded that it is an effective approach in teaching chemistry and it seems to enhance students' achievement, improve teaching-learning process, promote better learning and cultivate learners' interest and motivation.

Reyes (2003), in her study on the effects CONSTEL chemistry telecourse pointed out that it has helped in enhancing students' understanding of chemistry concepts, achievement and attitude towards the subject. She further found out that the CONSTEL Chemistry telecourse does not preferentially affect one student ability group.

Another research conducted by Agabin (2003) on the effectiveness of videotapes instruction in the academic performance of Science and Technology I at San Mateo National High School yielded that the videotapes instruction was effective, as compared to the traditional method of teaching.

In addition, Natividad (1995) evaluated the effects of computer-aided instruction on the science achievement and interest of Grade 7 students of Xavier school. These were the findings of her study: 1) Computer-assisted instruction increased the achievement of students in science. The over-all post-test mean of the CAI group is higher compared to the traditional group. 2) There was a significant difference on the achievement of students exposed to CAI and they performed better than those in the non-CAI group.

According to Salvador (2011), students' understanding of Physics and the learning strategies employed in the classroom affect students' perception of Physics as well as their achievement (Stodolsky, Salk & Glaessner, 1991). She further stressed that the teaching approach the teacher adopts is one of the factors that may affect student achievement (Mills, 1991). Therefore, the use of appropriate teaching method is critical to the successful teaching and learning of Physics. A teaching strategy may or may not be effective for a group of students. Only teachers with good understanding of the subject matter can organize effectively what is to be taught.

With regard to the result of segment 3, it can be said that some topics can be taught clearly and understood by the students using both physics telecourse and the traditional method of teaching. Most importantly, in the absence of instructional technologies, a teacher should always be ready to guide, to teach and be creative enough

to make her lessons exciting. To make learning more meaningful, it is very important for the teacher to relate lessons in previous experiences and real-life situations, whatever method is used. Equally, it behooves the teacher to emphasize that science is a part of daily- life activities, that science is not a difficult subject, but rather an exciting one. It is still in the hands of the teacher to think of many different strategies and on how to get students' attention and motivate them so that learning takes place.

Effects of Physics Telecourse on Students' Attitude Toward Physics After the Experiment

Table 6 presents the mean attitude scores of Groups 1 and 2. It can be seen that Group 1 had a mean attitude score of 3.39 and standard deviation of 0.26, while, Group 2 obtained a mean attitude score of 3.16 and standard deviation of 0.25.

Table 6. *Comparison of group means on attitude after the experiment.*

Group	Mean	SD	Mean Difference	*t*-value	*p*-value	Interpretation
1	3.39	0.29				Significant at
2	3.16	0.25	0.23	3.01	< 0.05	$\alpha = 0.05$

Using the t-test for independent samples, the obtained *t*-value was 3.01 with a *p*-value less than 0.05, signifying that the mean difference, 0.23 is statistically significant, in favor of Group 1 no matter how both groups received the same treatment. The result might indicate that physics telecourse and traditional method of teaching had greater effect on the attitudes of Group 1 students. This could be attributed to the possibility that

the two groups might have unequal abilities even before the experiment was conducted. Those are the pre-existing abilities not captured by the mean grade of the students in the three grading periods.

In the study of Reyes (2003) on the effects of Chemistry CONSTEL telecourse on student conceptual understanding, and attitude towards chemistry, she found out that there is no significant difference in the attitude towards Chemistry between students exposed to the two methods of teaching. Furthermore, Chemistry CONSTEL Telecourse perhaps can neither enhance students' attitude with respect to how they study Chemistry or how students from both groups give importance to submitting assignments, projects and the like. But most had enhanced students' attitude towards chemistry more specifically in terms of how they enjoy chemistry activities and give utmost value to the practical applications of concepts to everyday life shown in the telecourse, hence their appreciation to science has changed favorably.

In Ocon's (1995) investigation of the effects of integrated cooperative learning and journal writing on mathematics achievement and attitude among high school sophomores, it stressed that the attitude of the control group improved when the respondents are subjected to the traditional-lecture method. This conclusion implies that the traditional method of teaching is also effective.

In the study of Salvador (2011) on communicative strategies, student performance, and attitude towards physics, she found out that the attitude of both groups towards physics significantly improved after the treatment. However, their mean post-test attitude ratings show no significant difference, which suggest that the strategies had no significant impact on students' attitude.

Similarly, Morell (1992) and Wainwright (1989) as cited by Epni et al (2003) argued that the use of computers negatively influences the students' attitudes and achievement in the teaching learning process. Together with the findings of Shaw and Marlow (1999) that computer-assisted instructional materials do not show a positive effect on students' attitude (also cited by Epni et al, 2003).

Harris (1998, as cited by Grey, 2004) also held that there is no significant change in students' attitudes, behavior or knowledge as a result of students' exposure to different teaching approaches. Attitudes are formed as a result of some kind of learning experience to the effect that if the student experienced an enjoyable time in the subject, then, the learner must have a favorable attitude toward the subject.

However, the aforesaid result contradicts with that of Salvador (2011), though both groups showed a reasonably positive attitude towards physics, the experimental group had higher mean rating than the control group, a difference on mean attitude scores of 9.88 and significant at α 0.05, which means that the experimental group differs significantly in attitude before the conduct of the study.

According to Kaijian (2007), attitude is conceived as an outcome of education is important because it may provide a complementary or even alternative and more lasting effect than examination achievement. Thus, a positive attitude towards a subject may be a more ending outcome than knowledge gained in passing the examination.

Corpuz and Salandanan (2007) emphasized that teachers should add meaning to what students learn. They see meaning in what they learn when the teachers show the interconnectedness of the lessons to their everyday concern. Emotional touch should be added to learning, without it, the subject matter will remain cold, detached, if not lifeless. Also, Wolfe (2001, as further cited in Corpuz and Salandanan, 2007) states that

"our own experience validates that we remember for a longer time events that elicit emotion in us" (p.55).

Difference on attitude of the participants before and after the experiment

Table 7 shows the mean attitude scores of the participants before and after the experiment. The mean and standard deviation of students' attitude before the experiment is 3.13 and 0.26. After the experiment, the mean and standard deviation is equal to 3.39 and 0.29.

Table 7. *Comparison of the group means on attitude before and after the experiment*

Time	Mean	SD	Mean Difference	*t*-value	*p*-value	Interpretation
Before	3.13	0.26	0.26	3.85	< 0.05	Significant at $\alpha = 0.05$
After	3.39	0.29				

The mean rating after the experiment suggests that the participants have improved their attitude toward science, a result confirmed by using *t*-test for dependent samples. The computed *t*-value resulted to 3.85 and the corresponding *p*-value less 0.05, signifying that the mean difference of 0.26 stands statistically significant.

The present study found out that there is significant difference in the attitude of the students before and after the experiment. This significant difference in their attitude after the experiment cannot be attributed to any of the method much less to only one method, because both groups were exposed to physics telecourse and traditional method of teaching due to counterbalanced design. Both methods of teaching improved students' attitude toward physics.

As cited by Epni et al (2003), the studies conducted by Wainwright (1989) and Morell (1992) argued that the use of computer negatively influences students' attitude. Harris (1998, as cited by Grey (2004) also found out that there is neither significant change in students' attitudes, behavior or knowledge as a result of students' exposure to different teaching approaches, while Shaw and Maslow (1999) confirmed that computer-assisted instructional materials do not show a positive effect on students' attitude. Furthermore, the findings of Salvador (2011) suggested that the strategies had no significant impact on students' attitude.

Ocon (1995) who investigated the effects of integrated cooperative learning and journal writing on mathematics achievement and attitude among high school sophomores stressed that the attitude of the control group improved when the respondents are subjected to the traditional-lecture method. This implies that the traditional method of teaching is also effective. The findings of aforementioned studies somehow support the findings of the present study.

Implications

One of the most important objectives of teaching is to provide the students with appropriate and effective instructions. Many educators are conducting endless researches and studies as to what instructions are effective and appropriate for the current generation of students, (especially in the Philippine system of education where K TO 12 curriculum is at nascent stage). The reason for these is to improve students' performance and develop positive attitude towards science.

In the Philippine public secondary school system, teachers are bombarded with seminars, seminar-workshops, in-service trainings, and many other related academic

activities in order to help the teachers on how to use the different teaching strategies and approaches.

The result of the present study suggests that physics telecourse and the traditional method of teaching are both effective in improving the students' test performance. This finding implies that despite too many approaches and strategies that can be used by the teacher in teaching science subject, the traditional method of teaching is still as effective, as the physics telecourse in improving the test performance of the students. The result of the study also implies that both methods also enhanced students' attitude toward science.

To a public school teacher, the results of the study seem to suggest that any method of teaching affects students' performance and attitude. At the end of the day, to use a cliche,' the outcomes of the study still largely depend on the kind of teacher the student has.

Chapter V
SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary and Findings

This study sought to determine the effects of physics telecourse on the attitude and test performance in physics of the fourth year students.

The study employed quasi-experimental research involving counterbalance design and conducted in two intact, heterogeneous groups during the fourth quarter. The participants of the study were the fourth year students handled by the researcher in the school year 2014-2015 at Sagad High School, Pasig City. The treatment covered the topics for the fourth grading period.

Two instruments were used in this study: the Physics Attitude Inventory Test (PAIT), and the Physics Formative Tests. To determine the initial comparability of the two groups before the conduct of the experiment, the *t*-test for independent samples was -used. To find out the significant effects of the intervention, post data were analyzed using *t*-test for independent samples. To determine the significant difference on the attitude of the participants before and after the experiment, the *t*-test for dependent samples was used.

The findings of the study based on the effects of physics telecourse on test performance follow: a) It was found out that in segment 1, a mean difference of 3.46 is statistically significant. b) In the second segment, the mean difference 2.01 was statistically significant. c) In the last segment of the physics formative test, Group 1 (the comparable group), and Group 2 (experimental group) found out that the mean difference of 0.92 yielded was insignificant. Both groups performed equally in physics formative test 3. On the effects of physics telecourse on students' attitude towards physics after the experiment, Group 1 had a mean attitude score of 3.39 and standard deviation of 0.29. Group2 obtained a mean attitude score of 3.16 and standard deviation of 0.25. Using the *t*-test for independent samples, the obtained *t*-value was 3.01 with a *p*-value less than 0.05, signifying that the mean difference, 0.23 is statistically significant. The significant difference favors Group 1. On the difference on attitude of the participants before and after the experiment, -test for dependent samples, the computed *t*-value resulted to 3.85 and the corresponding *p*-value is less 0.05, signifying that the mean difference of 0.26 is statistically significant.

Conclusions

In view of the above findings, the study concludes that:

1 Telecourses like those used in the study cannot be more effective let alone totally replaced competent teacher-facilitated classroom instruction with actual demonstration of student-related activities. In the three physics topics considered in this study, only in one lesson that the use of a telecourse to supplement instructions was found to be as effective as that of a teacher-facilitated instruction.
2 Telecourse and teacher-facilitated instruction can considerably improve students' attitude toward the subject.
3 Telecourses can be as effective as teacher-facilitated instruction in enhancing students' attitude toward the subject.

Recommendations

In light of the findings and conclusions arrived at in this study, the researcher has the following recommendations:

1) Repeat the same study during an academic quarter (second/third quarter) when students are not busy with other school activities.
2) Conduct the same study to lower grade levels, (Grade 7, 8, and 9) to verify if physics telecourse will have significant effects on their attitude and test performance.
3) Time element should be considered in conducting this study, shorter period of time might not be enough to elicit the needed data. Try to conduct the study for at least two quarters.
4) Consider other factors that might affect the result of the study (e.g students' study habits, learning styles).

References

Aarons, Andrews (2016). Does the time of day affect how students focus on their reading? Demand Media, Hearts Seattle Media, LLC. Retrieved from: http://www.education.seattlepi.com/time-day-affect-students-focus-reading-2209.html

Abimbade, A. A., Aremu, A. & Adedoja, G. O. (2003). Providing information and communication technology (ICT) environment for teaching and learning in nigerian education system in O. Ayodele-Bamisaye, I. A. Nwazucke and A. Ockhedran. *Education this millenium: innovations in theory and practice.* Ibadan, Macmillan, Nigeria Publishers Ltd. 172-188.

Acero, Victorina O, Javier, Evelyn S., & Castro, Herminia O. (2000). *Principles and strategies of teaching.* Rex Bookstore.

Adegoke, Benson A. (2011). Effect of multimedia instruction on senior secondary school students' achievement in physics. *European Journal of Educational Studies*. 3(3), 537. Ozean Publication. Retrieved from: www.ozelacademy.com/(11)ejes%20169%20%adesina20%20gel.tar%202220mart%202011%20paid.pdf

Afroilan, Tito G. (1990). *Attitudes and interest in science of the university of the northern Philippines college students: their relationships to performance in physics and chemistry.* (Unpublished master's thesis). University of Northern Philippines, Vigan, Ilocos Sur.

Agabin, Adoracion C**.** **(**2003). *The effectiveness of videotapes instruction in the academic performance of science and technology I at San Mateo National High School.* (Unpublished master's thesis) Eulogio "Amang" Rodriguez Institute of Science and Technology, Manila.

Agun, I. (1992). Importance of audiovisual instruction. *West African Journal of Education 20 (2).*

Ajalla, A. A. (1997). Availability of educational of pre-vocational agricultural science in secondary schools in Anambra State. *Journal of Research in Learning and Teaching 1 (1).*

Alli, Maria Eden D. (2006). *Effects of multi-media on the academic performance and level of interest in social studies 1 of foreign Filipino freshman at Colegio de San* Agustin, Makati. (Unpublished master's thesis). Technological University of the Philippines, Manila.

Almoite, Anacleto G. (2011). *Attitude and academic achievement in biology of PMA* c*lass 2014.* (Unpublished master's thesis). University of the Cordilleras, Benguet.

Anderson, Lorin (1999). Bloom's taxonomy: A new look at old standby. Retrieved from: https://www.oxfordbibliographies.com/view/document/obo/xml

Alvarez, Rosita C. (1998). *Effectiveness and acceptability of video-aided instruction in Teaching Physics* (Unpublished master's thesis). Technological University of the Philippines, Manila.

Alwis, W. D., and Senathiraja, R. (2003). The impact of socio–cultural background of the entrepreneur on management and business practices of selected small and medium scale businesses in Sri Lanka. In 9th International conference on Sri Lanka p. 28-30.

Astronomia, Aida L. (1987). *Attitude of college students towards mathematics in the Northern Iloilo* (Unpublished master's thesis). Polytechnic State College, Iloilo City.

Anderson, S. J. & Noyes, J. M. (1999). Evaluation of the internet as a learning tool. *Journal of computer assisted learning15, 1*. Retrieved from onlinelibrary.wiley.com/doi/10.1046/j.1365-2729.1999.t01-1-15.1078.x/full

Balneg, Crisostomo T. (2000). *The science attitude of students of Gaddani National high school, division of Abra*. (Unpublished master's thesis) University of Northern Philippines, Vigan, Ilocos Sur.

Bandura, Albert. (1989). Regulation of cognitive processes throughperceived self-efficacy. *Developmental Psychology* 1989 25, 5, 729-735, U.S.A: McGraw-Hill Books Co, Inc., Retrieved from: https://www.uky.edu~eushe2/Bandura/Bandura 1989 DP.html

Barado, Mharit N. (2012). *Psychological learning environments and students' attitudes toward science and their relationship to academic performance in science among public secondary students*. (Unpublished master's thesis) Notre Dame Univesity, Cotabato.

Barron, B.G. et al. (1994). Effects of time of day instruction on reading achievement of below grade readers. Reading Improvement, 31(1), 59-60.

Bayos, Maria Luisa I. (2013).*Mathematics teachers' attitudes toward and practices in the integration of computer technologies in teaching* (Unpublished master's thesis). Philippine Normal University, Manila.

Bayractar, S. (2001). A meta-analysis of the effectiveness of computer-assisted instruction in science education. Journal of research on technology in education, 34(2).

Bennet, J. (2003). *Teaching and learning science*. New York, N.Y.: Continuum.

Benito, N. V. (2010). The national achievement test: an overview. Retrieved from: http://www.affordablelearning.com/content/dam/corporate/global/palf/pdf_files/National_Achievement_Test_Dr%20Benito.pdf.

Birch, M. A. & Gonzales, G. M, (2000). Evaluating the instructional efficacy of computer-mediated interactive multimedia: Comparing three elementary statistics tutorial modules. *Journal of Educational Computing Research, 22, 411-436.*

Bloom, B. S., Hastings, J. T. & Madaras, G. F. (1976). Handbook on formative and summative evaluation of student learning. U.S.A., McGraw-Hill Book Co., 1976.

Calderon, Jose F. (1999). Foundations of education. Rex printing Company., Inc, QC.

Callan, R. J. (1999). Effects on matching and mismatching students' time-of-day preferences. *Journal of Educational Research, 92(5), 295-299.*

Caraballo, Angelica Katherine (2009). Analyzing the status of mathematics and science *Education. Growth Revolution magazine*. Retrieved from: https.www//:www.goggle. com.ph

Chang, C. Y. (2001). Comparing the impacts of a problem-based computer-assisted instruction and the direct interaction teaching method on student science achievement. Journal of science education and teachnology, 10(2).

Christmann, E. P., & Badgett, J. L. (2003). A meta-analytic comparison of the effects of computer-assisted instruction on elementary students' academic achievement. *Information Technology in Childhood Education Annual, 2003(1), 91-104.*

Clarete, Josefina. (1994).*The effects of using two-dimensional and three-dimensional visual aids on achievement and attitude of high school students in physics* (Unpublished master's thesis). Philippine Normal University, Manila.

Cook, M. & Mulvihill, T. M. (2008). Examining U.S. college students' attitude towards science: Learning from non-science majors. Educational Research and Review, 3(1): 38-47.

Corpuz, Brenda B. & Salandanan, Gloria G. (2007). *Principles of teaching.* Lorimar Publishing Inc., Quezon City.

Counterbalancing. (Untitled document). Retrieved from **http://onlinestatbook.com/lms/researchdesign/causation.html**

Counterbalancing. (Untitled document).Retrieved from **www.psych.stanford.edu/lera/290/lecture/.html**

Craker, D. E (2006). Attitudes toward science of pupils enrolled in introductory level science courses. *UW-La Crosse UW-L Journal of Undergraduate Research, 9, 1-6.*

Danili, E. & Reid, N. (2006) Cognitive factors that can potentially affect pupils' test performance. Centre for Science Education, University of Glasgow, Glasgow G12 8QQ, UK. Retrieved from http://www.rsc.org/

Davis, K. (2012). The effects of technology instruction on the academic achievement of 5th grade students. (Doctoral dissertation). Retrieved from http://digitalcommons.liberty.edu/doctoral/556.

De Gulan, Ma. Victoria R. (1999). *Effects of the use of videotapes on biology students' achievement, retention and attitude towards science.* (Unpublished Master's Thesis). University of the Philippines, Diliman, Quezon City.

Department of Education (2013). Science Curriculum for K TO 12. Pasig: Department of Education.

Department of Education (2015). DepEd Order No. 8, s. 2015. "Policy Guidelines on classroom assessment for the K to 12 basic education program". Pasig: Department of Education.

Epni, Salih , Ta, Erol, & Ko, Sacit (2003). *The effects of computer-assisted material on students cognitive levels, misconceptions and attitudes towards science*. (Karadeniz Technical University, Trabzon, Turkey). Retrieved from http://www.tlu.ee/~kapata.haridustechnoologiaTLU/misconceptionscience.pdf

Espiritu, Criselda B. (2011).*The use of learning module design (LMD) in the enhancement of pupil's attitudes, skills and achievement in elementary science 6* (Unpublished Master's Thesis). Philippine Normal University, Manila.

Edeh, Imomotimi & Vikoo, B. (2013). Some factors affecting the performance of secondary school students in chemistry, a kolokuma/opokuma study. *Journal of Education and Practice*, 4, 7. Retrieved from: www.iiste.org/Journal/index.php/JEP/articleviewFile/5262/5271

Esiobu , G.O. (2005). Genre issues in science and technology education development. In: science and technology education for development, Uwowi, U.M.O. (Ed.). NERDC Press, Lagos, pp: 137-156.

Festus, C. & Ekpete, O. A. (2012). Improving students' performance and attitude towards chemistry through problem-based-solving techniques (PBST). *International Journal of Academic Research in Progressive Education and Development. 1, 1* Retrieved from www. hrmars.com.admin.pics/608.pdf

Fletcher-Flinn, C. M., & Gravatt, B. (1995). The efficacy of computer assisted instruction (CAI): A meta-analysis. Journal of Educational and Computing Research, 12, 219–242.

Foley, Hugh J. (1991).Counterbalancing. Retrieved from http://srmo.sagepub.com/view/the- sage-encyclopedia-of-social-science research-methods/n180.xml

Garcia, Placida. (1989). "Enriching and enlivening science learning." The Educator's Diary, pp.42-44.

Geronimo, Maria Elena D. (2004). *The effects of constructivist approach on the achievement and attitude of grade five science students.* (Unpublished master's thesis). Philippine Normal University, Manila.

Gilakjani, A. P. (2012). The significant role of multimedia in motivating EFL learners' interest in English language learning. I. J. Modern Education and Computer Science, 4, 57-66. Retrived from http://www.mecs-press.org/

Gipps, C. (1994). Beyond Testing; towards a theory of educational assessment. London, Routledge Falmer.

Gorra, A. Finlay, J., Devlin, M., Lavery, J.,Neagle, R., Sheridan-Ross, J. & Boule, R. (2010). Learning with technology: What do students want? *Proceedings of the European Conference on E- Learning, 126-133.*

Gregorio, Herman. (1976). Principles and methods of teaching. Philippines: R.P. Garcia publishing company.

Grey, Evelyn J. (2004). *Attitude and academic achievement in Philippine history among education students at the West Visayas State University* (Unpublished master's thesis). University of San Agustin, Iloilo City.

Guibone, Donato G. 2001. *The effects of multimedia assisted instruction on the academic achievement in science, mathematics and English of senior students in selected* p*ublic high schools, manila* (Unpublished doctoral dissertation). Technological University of the Philippines, Manila.

Gul, Seyda, & Yesilyurt, Selami (2011). The effect of computer-assisted instruction on fourth grade primary students' achievements and attitudes towards science and technology lesson. *e-international journal of education research*. 2, (1), 30-43. Retrieved from https://etd.lib.metu.edu.tr

Hannula, M (2002). Attitudes towards mathematics: emotions, expectations, and values. University of turku, department of teacher education.

Hardwood, William S. & McMahon, Maureen M. (1997). Effects of integrated video media on student achievement and attitudes in high school chemistry. *Journal of Research in Science Teaching.* 3, 6 (1997). Retrieved from http://onlinelibrary.wiley.com/doi/10.1002(SICI)1098.

Harris, Debra D. (1998). The effects of teaching approaches in secondary students' attitude, behavior and knowledge regarding education related concepts. University of Mexico, Dissertation abstract International p.3456A.

Ifeoma, Mbah Modesta (2013). Use of instructional materials and educational performance of students in integrated science (A case study of unity schools in Jalingo, Taraba state, Nigeria). *Journal of Research and Method in Education (IOSR-JRME).* 3, 4. Retrieved from http//www.iosrjournals.org

Isola, Olawale M. (2011). Instructional materials and students' academic achievement in physics: some policy implications. *Journal of Humanities and Social Sciences.* 2, 1. Retrieved from http//www.journalsbank.com/ejhss

Journal of Research in Science Teaching, 34, 6, August 1997.

Kaijian, M. (2007). Attitudes toward science: a review of the literature and its implications. Retrieved from http://www.opas.ous.edu/.

Kamla, B. (2008). Attitudes and achievement orientation of students towards learning science and math. Retrieved from http://www.myais.fsktm.edu.my/9238.

Kareem, Adedemola A. (2015). Effects of computer- assisted instruction on students' academic achievement and attitude in biology in Osun state, Nigeria. *Journal of Emerging Trends in Educational Research and Policy*. Retrieved from www.jeteraps.scholarlinkresearch.com

Kenny, T. J., Hebel, J. R., Sexton, M. J., & Fox, N. L. (1987). Developmental screening using parent report. *Journal of Developmental and Behavioral Pediatrics, 8*, 8–11.

Khan, Muhammad & Shah, Iqbal (2015). Impact of multimedia-aided teaching on students' academic achievement and attitude at elementary level. Allama Iqbal Open University, Islamabad, Pakistan. *US-china Education Review A*. (May 2015), 5, 5, 349-360. doi: 10. 17265/2161-623X/2015.05.006

Laguilles, Elvira C. (2001). *The development of instructional media materials: the case of Pasig catholic college* (Unpublished master's thesis). Centro Escolar University, Manila.

Lardizabal, A. S., Bustos, A. S., Bucu, L. C., and Tangco, M. G. (1991). *Principles and methods of teaching*, 3rd ed., Phoenix Building House, Inc., Quezon City.

Leyden, Andrea (2013). The day of exam: 15 tips to boost your exam performance. Examtime. Retrieved from https://www.examtime.com

Logmao, Dario L. (1997). *Effectiveness of programmed instruction using audiovisual technique in teaching* p*hysics* (Unpublished master's thesis). Philippine Normal University, Manila.

Maas, Sarah Elizabeth (2013). *The effect of background music on math test performance of high school students.* Oakland University. Oakland. Retrieved from https://www.our

Magaway, Azucena. **(**1983). *Attitudes of pupils toward Filipino* (Unpublished master's thesis*)*. Bukidnon State College, Bukidnon.

Malunhao, Rodrigo L**.** (1998).*Teaching methodologies, instructional media technologies utilized by faculty members in EARIST, and a proposed training program of the development and application of multimedia instruction*. Eulogio "Amang" Rodriguez Institute of Science and Technology, Manila.

Maniger, R. M., & Holden, M. (2009). Put the textbooks away: Preparation and support for a middle school one-to-one laptop initiative. *American Secondary Education, 38(1), 5-33.*

Manzano, Teresita D. (1996). *Effectiveness of DECS TV-assisted instruction in Science and Health V in Las* P*iñas District II* (Unpublished master's thesis). Technological University of the Philippines¸ Manila.

Matrio, Genalin B**.** (2000). *Supplementary video materials in folkdances for public elementary school teachers*. Eulogio "Amang" Rodriguez Institute of Science and Technology, Manila.

Mayer, R. (2005). Cognitive Theory of Mayer. *Cambridge Handbook on Psychology*. Retrieved from: https://kaneb.nd.edu/assets/155013/mayer cogtheory multimedialearning.pdf.

Mayes, Robert. (1992). The effects of using software tools in mathematics problem solving in secondary school. School Science and Mathematics, 92, 5, pp.243-245.

Messick S. (1984). The psychology of educational measurement. *Journal of Educational Measurement, 21, 215-238*

Mills, H. R. (1991). Teaching and Training: A handbook for instructors (3rd ed). London: Macmillan Publishers.

Molina, Gloria V. (2001).*Interactive teaching in chemistry effects on students' achievement and attitudes.* University of Northern Philippines, Vigan City.

Moore, D. S. (1997). *New pedagogy and new content: the case of statistics*. International statistical review, 65 (2), 52-63.

Morrel, D. (1992). The effects of computer-assisted instruction on student achievement in high school biology. School science and mathematics, 92, 177-181.

Narzoles, Danebeth Tristeza G. (2013). The effect of multi-media instruction on student learning. *Journal ofEducation and Practice,* 4(5). Retrieved from pakacademesearch.com/pdf-files/edu/413/126.

Natividad, Jane**. (**1995). *The effects of CAI on the science achievement and interest of grade 7 students of Xavier School.* (Unpublished master's thesis). Philippine Normal University, Manila.

Nduati, Charagu, S. (2009). *Effect of computer-assisted learning on secondary school students' achievement in chemistry in Murang A South Sub-County*,

Nerbes, Marlyn F. (1986). *The effectiveness of structured and semi-structured laboratory methods using an inquiry approach in teaching integrated science*. (Unpublished master's thesis). Bicol University.

Nsa, S. O et al (2013). Instructional materials utilization and students' performance in practical agriculture. *Journal of Educational Research and Reviews.* 1, 4, 49-54. Retrieved from **www.sciencewebpublishing.net/jerr/archive/2013**

Nwachukwu, C. E. (2006). Designing appropriate methodology in vocational and technical education for Nigeria, Nsukka, University, Trust Publishers.

Nwike, Matthew & Onyejegbu Catherine (2013). Effects of use of instructional materials on students' cognitive achievement in agricultural science. *Journal of Educational and Social Research.*doi:105901/jesr.2013.v3n5p103.

Ocon, Arlene T. (1995)**.***The effect of integrated cooperative learning and journal writing on mathematics achievement and attitude among high school* s*ophomores.* Philippine Normal University, Manila.

Ogunleye, B.O. (2002). Towards the optimal utilization and management of resources for the effective teaching and learning of physics in schools. Proceedings of the 41st Annual Conference of the Science Teachers' Association of Nigeria, (STAN'00), University of Lagos, Nigeria, pp.: 215-220.

Onyper, Serge (2016). How chewing gum can boost your test performance? St. Lawrence University, N.Y. Retrieved from https://www.brainscape.com/blog

Oriondo, Leonora L & Antonio, Eleonor D. (1989). *Evaluating educational outcomes.* Rex Printing Company, Quezon City.

Ornstein, Allan C. **(**1990). *Strategies for effective teaching.* Harper Collins Publishers, Inc. New York.

Osborne, J. (2004). Managing students' attitude toward science through problem-solving instructional strategy. Retrieved from http://www.krepublishers.com

Osborne, J. & Simon, S. (2003). Attitudes towards science: a review of literature and its implication. International Journal of Science Education. 25,9. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/0950069032000032199

Ozel, S., Ebrar Yetkiner, Z., & Capraro, R. M. (2008). Technology in K-12 mathematics classrooms. School Science & Mathematics, 108(2), 80-85.

Palomares, Ma. Dulce A. (2013). *Support strategies, observed teachers' characteristics, students' achievement and attitude towards chemistry.* Philippine Normal University, Manila.

Peck, Dave. (1998). *Multimedia: Hands-on instruction*. Albany, New York: Delmar Publisher, International Thompson Publishing Company.

Perez, Michelle S. (2013).*Attitudes of students towards mathematics*. Philippine Normal University, Manila.

Phillips, R. (1997). *The developer's handbook to interactive multimedia: A practical guide for educational applications*. London: Kogan Page.

Reeves, T. (1998). *The impact of media and technology in schools*. A research report prepared for the Bertelsmann Foundation.

Reyes, Eredani D. (2003). *CONSTEL chemistry telecourse and student conceptual understanding, achievement and attitudes* (Unpublished master's thesis). University of the Philippines, Diliman, Quezon City.

Reyes, Isabelita DR. (2003). *The effectiveness of videotapes of science lessons/programs as instructional materials on the science achievement of the grade IV pupils (*Unpublished master's thesis). Philippine Normal University, Manila.

Rivera T. C. & Ganaden M.F. (2001). Classroom psychosocial environment. International Online J. Sci. and Math. Educ. Available from the Web site: http://www.upd.edu.ph/~ismed/online/articles/psycho/lit.htm

Robles, Purificacion. (2003). .*Attitude toward and achievement in chemistry of the first year college students*. (Unpublished master's thesis). University of San Agustin, CPU, Iloilo City.

Salandanan, Gloria G. (1985). *The teaching of science*, 2nd revised edition. Phoenix Publishing House, Inc., Quezon City.

Salandanan, Gloria G. (2012). *Methods of teaching*. Lorimar Publishing Inc., Quezon City.

Salvador, Sheryl Ablog. (2011). *Communicative strategies and student performance and attitude towards physics*. (Unpublished master's thesis). University of the Philippines, Diliman, Quezon City.

Saparniene, D., Merkys's G., & Saparnis, G. (2005). Students' attitudes towards computer: statistical types and their relationship with computer literacy. University College (Dublin, Ireland)

Sevilla et al. (1992). *Research method*. Rex Bookstore.

Schibeci, R.A. and Riley, J.P. (1986). Influence of students' background and perceptions on science attitudes and achievement. Journal of Research in Science Teaching, 23(3): 177-187.

Shah, I., & Khan, M. (2015). Impact of multimedia-aided teaching on students' academic achievement and attitude at elementary level. US-China Education Review, 5(5), 349-360.

Shaw, G., & Marlow, N. (1999). The role of student learning styles, gender, attitudes and perceptions on information and communication technology assisted learning. Computer & Education, 33, 223–234.

Shoemaker, Traci L. (2013). *Effects of computer-aided instruction on attitude and achievement of fifth grade math students*. (Doctoral dissertation & Projects, Liberty University, Lynchburg, VA). Retrieved from http://digital commons.liberty.edu/doctoral/746

Simpson, R. D. and Oliver, J. S. (2006). Influence of attitude toward science achievement, motivation, science self-concept and achievement in science. A

longitudinal study. *Science Education.* Retrieved from: http://onlinelibrary.wiley.com/doi/10.1002/sce.3730720204/abstract

Sorden, Stephen D. (2012). The cognitive theory of multimedia learning [Abstract]. Mohave Community College, Northern Arizona University. Retrieved from https://www.sorden.com/portfolio/sorden_draft_multimedia2012.pdf

Stodolsky, Salk & Glaessner (1991). Student views about learning math and social science. *American educational research journal, spring 1991, 28, 1, 89-116.* Retrieved from: https://www.jstor.org/stable/1162880?seq=#page scantabcontents

Tavios, Blanche P. **(**1987). *Factors related to the attitudes towards physics among fourth year high students in Torres High School: an exploratory study.* Philippine Normal College, Manila.

Tenedero, Henry S. (2009). *Cooking up a creative genius*. Center for Learning and Teaching Styles, Phils., Inc.

Tenedero, Henry S. (2009). *Super teacher excellent in teaching.* Center for Learning and Teaching Styles, Phils., Inc.

Terrado, Lourdes P. (1995). *Cognitive styles in learning and their relations to attitude* and achievement in science YS-7 learners in Angelicum School, Quezon City.

Thompson, J.J. Mintzes. (2002). Cognitive structure and affective domain: on knowing and feeling biology. International Journal of Science Education, 24 (6), pp.645-660.

Tjaden, B. J & Martin, C. D. (1995). Learning effects of computer-assisted instruction on college students. *Computer education, 24 (4), 221-302.*

Wainwright, C. L. (1989). The effectiveness of a computer-assisted instruction package in high school chemistry. Journal of research in science teaching, 26, 275-290.

Wolfe, Patricia. (2001). Brain matters: translating research into action: Alexandria, VA: Association for Supervision and Curriculum Development.

Yllano, Amada C. (2009). *The effect of multimedia- based instructions on students' achievement and attitude* (Unpublished master's thesis). Adventist University of the Philippines, Silang, Cavite.

Zulla, Eduardo D. (2009). *The effect of comic strips as science teaching aid on the achievement and attitude of students: basis for administrative intervention scheme.* University of Southern Philippines, Davao City.

Appendix A

List of Physics Telecourse Episodes used in the Study

Test 1:

a) Episode 28 (Waves)
b) Episode 29 (Properties of Waves)

Test 2:

a) Episode 30 (Sound and Hearing)
b) Episode 31 (Musical Sound)

Test 3:

a) Episode 34 (EM Waves)
b) Episode 35 (Telecommunications)

Appendix B

Physics Attitude Inventory Test (PAIT)

Name: _____ Section: _____

Directions: Below are twenty –five (25) sentences about Physics. Check the column that corresponds to your answer.

4- Strongly Agree 3- Agree 2- Disagree 1- Strongly Disagree

PAIT	4	3	2	1
1) Physics is fun and fascinating.				
2) I am interested in knowing more about Physics.				
3) Working as a physicist would be satisfying.				
4) I like my Physics subject.				
5) I do not see the value in studying Physics.				
6) I am eager to know more about Physics during my free time.				
7) I always look forward to attending my Physics class.				
8) Physics helps me think.				
9) Regardless of my teacher, I enjoy my Physics class.				
10) Physics is very important in the scientific age in which we live.				
11) Mankind benefits much from Physics.				
12) Scientific work does not interest me.				
13) I enjoy performing experiments in physics class.				
14) Physics is unnecessary to society.				
15) Physics more than any other field of inquiry can lead the way to a better world in the future.				
16) Physics makes me aware of things around me.				
17) I do not care whether or not I finish the physics activity scheduled for the day.				
18. I like to study my other subjects better than Physics.				
19) During my physics class, I eagerly wait for the bell announcing the end of the period.				
20) Modern technologies brought about by science have only made life more difficult.				

21) When I hear the word Physics, I have a feeling of dislike.				
22) Physics is my most feared subject.				
23) I am never late in my Physics class.				
24) I feel I am being forced to study Physics.				
25) I make it a point to do my Physics homework.				

Appendix C

Sample Test Items of the Physics Formative Test 1
SAGAD HIGH SCHOOL

Name:_____ Section: _____

MULTIPLE CHOICE:

Directions: Read each statement carefully and encircle the letter of the correct answer.

1) Waves are created when a source of energy causes a medium to _____.

a)move b) compress c) expand d) vibrate

2) Which wave is purely longitudinal?

a) sound waves in air

b) light waves traveling through a vacuum

c) radio waves traveling through air

d) surface waves in a shallow pan of water

3) Which of the following statements about wave is NOT true?

a) A wave can have both transverse and longitudinal components.

b) A wave carries energy from one place to another.

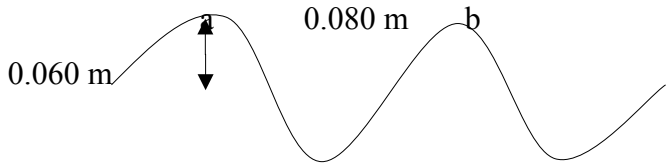
c) A wave always needs a medium in order to be propagated.

d) A wave is a traveling disturbance.

4) An ocean wave has a length of ten meters. A wave passes a fixed location every two seconds. What is the speed of the wave?

a) 5 m/s b) 0.2 m/s c) 20 m/s d) 10.2 m/s

5) What is the amplitude of the wave in the diagram below?



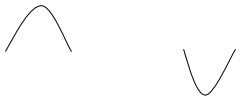
a) 0.0 m b) 0.04 m c) 0.05 m d) 0.060 m

6) What is 0.080 m in the diagram in no. 14?

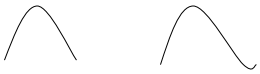
a) frequency b) wavelength c) period d) amplitude

7) Which of the following illustrates destructive interference?

a)



b)



c)

d)

8) What property of wave is shown in the diagram below?

A B

C D

a) Refraction b) Reflection c) Interference d) Diffraction

9) A spoon partly submerged in water appears to be bent at a point where it enters the water surface when viewed obliquely. Which of the following statements explains this observation?

a) Light does not travel in a straight line.

b) Refraction of light as it enters another medium.

c) Diffraction of light by the surface of water.

d) Dispersion of light on entering water

10) When a piece of stone is dropped into a pond, the waves spread and encounter a log floating in the water. The water waves bend around the log. What property of wave is being illustrated?

a) reflection b) refraction c) diffraction d) interference

Appendix D

Sample Test Items in the Physics Formative Test 2

SAGAD HIGH SCHOOL

Name: _____Section: _____

MULTIPLE CHOICE.

Directions: Read each statement carefully and encircle the letter of the correct answer.

1) Which of the following statements best describes a sound?

I. Sound is produced by vibrating objects only.

II. Sound requires a medium for its transmission.

III. Sound is a longitudinal wave.

a) I only b) I and II c) II and III d) I, II and III

2) Sound waves **do not** travel through _____.

a) solids b) fluids c) a vacuum d) objects at rest

3) A cat can hear sound frequencies up to 70,000 Hz, but bats send and receive ultrahigh frequency squeaks up to 120,000 Hz. Which hears sound of shorter wavelengths?

a) the cats b) bats c) both d) neither

4) Which part of the ear is responsible for increasing its sensitivity to sound waves?

a) eardrum b) pinna c) cochlea d) auditory nerve

5) The speed of sound is different in gas, liquid and solid. Which of the following gives the order of speed from slowest to fastest?

a) air, steel, water c) air, water, steel

b) steel, air, water d) steel, water, air

6) What is the speed of sound in air at 30^{o} C?

a) 394m/s b) 349m/s c) 493m/s d) 439m/s

7) The longitudinal waves shown below have the same speed. Which corresponds to the highest pitch?

I. ||||| |||| | |||||| ||||||

II. || | | | | | | | | ||| |||

III. | | | | | | || | | | | | |

IV. | | | |||| | | | | | |||

a) I b) II c) III d) IV

8) Of the following procedures, which will lower the pitch of a guitar string?

I. Lengthen the string

II. Use a lighter string

III. Decrease the tension in the string

a) I only b) II only c) I and II d) I and III

9) A guitar string is plucked and set into vibration. The vibrating string disturbs the surrounding air, resulting in a sound wave. Which entry in the table below is correct?

	Wave in the string	sound wave in air
a) The wave is transverse.	yes	no
b) The wave speed increases as the temperature rises.	no	yes
c) The wave is longitudinal.	yes	yes

d) The wave is transmitted by particle vibrations no yes

10) Which of the following is **not** a way of reducing noise pollution?

a) report excessive noise c) sound proof walls

b) wear protective device d) clean the surroundings

Appendix E

Sample Test Items in Physics Formative Test 3

SAGAD HIGH SCHOOL

Name: _____ Section**:** _____

MULTIPLE CHOICE:

Directions**:** Read each statement carefully and encircle the letter of the correct answer.

1) Which of the following statements concerning electromagnetic waves is false?

a) Electromagnetic waves are longitudinal waves.

b) Electromagnetic waves transfer energy through space.

c) The existence of electromagnetic waves was predicted by James Clerk Maxwell.

d) Electromagnetic waves do not require a physical medium for propagation.

2) In a vacuum, the speed of electromagnetic wave _____.

a) depends on its frequency c) depends on its electric and magnetic field

b) depends on its wavelength d) is a universal constant

3) Which of the following is the same for all types of electromagnetic waves?

a) velocity b) frequency c) wavelength d) energy

4) The type of electromagnetic wave that stimulates the production of vitamin D in the skin is known as _____.

a) infrared b) visible light c) ultraviolet d) radio waves

5) Which is the correct order, beginning with shortest wavelength and extending to the longest wavelength, following colors in the visible spectrum?

a) red, yellow, blue, green, violet c) red, yellow, green, blue, violet

b) violet, blue, yellow, red, green d) violet, blue, green, yellow, red

6) A broadcasting method that changes the amplitude of the carrier wave to carry the pattern of the sound is known as

a) frequency modulation c) amplitude modulation

b) energy modulation d) radio station

7) Which statement is correct?

a) Microwaves are used for satellite communications because they are refracted by the atmosphere.

b) Radio waves are used for satellite communications because they are refracted by the atmosphere.

c) Microwaves are used for satellite communications because they are not refracted by the atmosphere.

d) Radio waves are used for satellite communications because they are not refracted by the atmosphere.

8) In radio communication, sound waves are fed to the radio stations' microphones and heard through a radio to _____.

a) increase the intensity of sound

b) convert electrical signals to sound waves

c) select the frequency received

d) strengthen the weak signals

9) The mouthpiece of a telephone is a transmitter which is actually a _____.

a) loudspeaker b) amplifier c) microphone d) demodulator

10) Which of the following communication devices was the first to send messages using electricity?

a) telephone b) telegraph c) radio d) television

Appendix F

Sample Lesson Plans

Topic: Reflection

References: You and the Natural World Series, pp. 334-335
TSS for HS Physics, pp. 12, 15-16, 18
Science and Tech IV, pp. 36-41

Materials: mirror, graphing paper, ruler, protractor, flashlight/laser, TV set, CD (Episode 29-Properties of Waves)

Skills: observing, analyzing

I. Objectives:

Provided with the necessary materials, the students should be able to:

1) describe how waves are reflected;
2) state the Law of Reflection;
3) differentiate regular reflection from diffused reflection;
4) identify daily life situations showing reflection; and
5) appreciate the importance of reflection in our daily life.

II. Strategies:

A) Daily Routine:

B) Motivation:

How many times do you look at your face in the mirror in one day? How are you able to see your image?

C) Lesson proper:

Comparable Group	Experimental Group
1) Pre-activity: 1.1 Giving instructions 2) Activity proper: 2.1 Performance of the activity (see the attached activity 2) 3) Post activity: 3.1 Group presentation of the result of the activity 3.2 Discussion: a) How many media are there in the demonstration? b) What is the medium? c) Describe the wave as it reaches the fixed end. d) How is the angle of incidence related to the angle of reflection? What law states their relationship?	1) Pre-viewing activity: 1.1 Giving of instructions and guide questions (posted on the board) a) How many media are there in the demonstration? b) What is the medium? c) Describe the wave as it reaches the fixed end. d) How is the angle of incidence related to the angle of reflection? What law states their relationship? 2) Video viewing 3) Post Viewing: Discussion on the given guide questions

D. Generalization:

1) Waves are reflected after hitting a barrier.

2) Law of Reflection states that the angle of incidence is equal to the angle of reflection.

3) The two types of reflection are: Regular Reflection and Diffused Reflection. In regular reflection, clear image is seen, light reflects in one direction, and occurs in a smooth surface. While in diffused reflection, no clear image is seen, light reflects in different direction and occurs in rough surface.

4) Seeing one's image in a mirror is one important application of regular reflection. For diffused reflection, it enables one to see the object, scatters the light in different directions like when reading a book or newspaper.

E. Application:

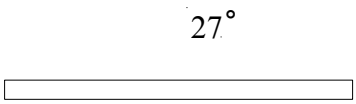
1) In what other phenomenon/event/activity in everyday life can we experience reflection?

2) Is reflection relevant to our daily life? Cite examples/defend your answer.

III. Assessment:

Multiple Choice. Write the letter of the correct answer.

1) What happens to sunlight when it hits a plane mirror?
   a) It diffracts. c) It bends.
   b) It reflects. d) It interferes.
2) How many media are involved in reflection?
   a) 1 b) 2 c) 3 d) 4
3) If the angle of reflection is 27°, what is its corresponding angle of incidence?



a) 27° c) 47°
b) 37° d) 57°

4) A light ray strikes a curved mirror at angle of incidence 40°. What is the angle of reflection?
   a) 20° b) 40° c) 60° d) 80°
5) Which of the following materials does not reflect light?
   a) clear plastic sheet c) mirror
   b) tree d) pages of books

IV. Assignment:

A. Motive Question:
   Why is an open field concert always held at night?

B. Guide Questions:
   1) Describe refraction.
   2) Identify daily life situations showing refraction.
   3) Bring the ff. materials by group:
      transparent glass, slinky spring (small and big)

C. References: Physics IV, pp. 52-57, any physics book

Name: _____ Date: _____
Section: _____ Teacher: _____

Activity Title
"Do I Reflect"?

Objectives:

1) To describe reflection.
2) To compare angle of incidence with the angle of reflection.
3) To state the Law of Reflection.

Materials:

mirror, graphing paper, ruler, protractor, flashlight/laser

Procedure:

1) Position the mirror at about 7 cm from the top of a graphing paper such that the reflecting surface rests on a grid line. Mark this line.
2) Mark grid line perpendicular to the mirror. Choose a line at the middle. Call this normal line.
3) Switch on the light source in such a way that the light rays hit the surface of the mirror exactly at the normal line. What do you observe?
4) Orient the source such that the ray hits the mirror at an angle at the point where the normal line meets the mirror surface (position 1). You will see two rays. One ray comes from the source as it hits the mirror. This is the incident ray; the other which bounces off the mirror is the reflected ray.
5) Mark with a pencil two points on each of the rays.
6) Remove the light source and trace each ray observed by joining the points using a pencil and a ruler.

7) Measure the angles formed between the incident ray and the normal line (angle of incidence) and the reflected ray and the normal (angle of reflection) with a protractor. Record your data in the table below.
8) Vary the position of the light source three times and repeat steps 4-7, so that you will have three sets of data.

Position	Angle of Incidence	Angle of Reflection
1		
2		
3		

Guide Questions:
1) Define the following terms:
   a) Normal line
   b) Incident ray
   c) Reflected ray
   d) Angle of incidence
   e) Angle of reflection
2) Relate angle of incidence with angle of reflection.
3) State the Law of Reflection.

Topic: Sound and Hearing (Its Production, Transmission and Reception)
References: You and the Natural World Series, pp. 346-347.
Hands on and Minds On Activities, pp.171-172.
Physics, pp. 368-369.
Science-HS.Com pp.247-248.
Materials: see activity sheets, TV set, CD (Episode 30-Sound and Hearing)

I. Objectives:

At the end of the lesson, the students are expected to:
1) describe how sound is produced;
2) explain how sound is propagated;
3) analyze how sound is heard; and
4) appreciate the importance of sound.

II. Strategies:

A. Daily Routine
B. Review: Parts of the ear
C. Motivation:

Touch the middle of your front neck portion and say ---AAAHH. What do you feel? Did you hear something? Is what you feel related to what you hear?

D. Lesson proper:

Comparable Group	Experimental Group
1. Pre-activity: 1.1) Giving Instructions 2. Activity proper:	1. Pre-viewing activity: 1.1 Giving of instructions and guide questions (to be posted on the

2.1. Performance of activity (see the attached activity sheet) 3. Post-activity: 3.1. Group presentation of the result of the activity 3.2. Discussion: a) How is sound produced and transmitted? b) What causes the vocal chords to vibrate? c) How do we hear sound?	board) a) How is sound produced and transmitted? b) What causes the vocal chords to vibrate? c) How do we hear sound?

E. Generalization:

1) Sound is produced by vibration. In humans, the vibration of the vocal chords produces sound. It is caused by the passing of air, which was forced out by the lungs, which passes through the trachea.
2) To transmit sound, a medium is required. The continuous compression and rarefaction of the particles of the medium is necessary for the sound to be transmitted.
3) In humans, the sound is caught by the outer ear and then reaches the eardrum. The hammer, anvil and stirrup amplify the sound, which will reach the oval window, a membrane in the inner ear. Then to the cochlea, and pass through the organ of corti which translates sound into electric impulses decoded by the brain.

F. Application:

The principle of ultrasound is used in medicine and industries, to detect cracks in metals, measure the ocean depth, or to provide information about tissues that aid in diagnosing ailments or even detecting a human fetus.

III. Assessment:

By group present what you have learned today in a creative way, be it in the form of songs, poem, skit or drawing.

IV. Assignment:

1) What are the factors that affect the speed of sound?
2) Give the equation in determining the speed of sound.

References:

Natural World Series, pp. 346-349.
HS.com, pp. 249-250.

Name: _____ Date: _____
Section: _____ Teacher: _____

Activity Title
"Can you sense me"?

Objectives:
1) To describe how sound is produced.
2) To explain how the ear receives sound.

Materials: improvised drum with rice grain on top, tuning fork, basin of water, rubber pad, ruler, slinky, spoon and fork, photocopy of the inner ear, scotch tape and scissors

Activities:

Learning Station # 1. Improvised drum with rice grain on top

Students will tap on the drum. What happens to the rice grains? What do you hear?

Learning Station # 2. Tuning fork in water.

Gently strike the tuning fork on the rubber pad and then place it in the basin of water. Describe what you observe. What do you hear?

Learning Station # 3. Ruler on the edge of the table.

Hold one end of the rubber firmly against the top of the table. Snap the other end. What do you observe? What do you hear?

Learning Station # 4. Playing with the slinky.

Time	Sections
7:00 - 8:00	Section U
***8:15 - 9:15**	**Group 1 (Section V)**
9:15 - 10-15	Section W
10:15 - 11:15	Section X
***12:30 - 1:30**	**Group 2 (Section Y)**

a) Ask your classmate to hold one end of the slinky, you hold the other end. Stretch the slinky. Then give it a sharp push towards your friend. What do you notice?

b) Pull and push the slinky alternately. What do you observe?

c) Mark a dot on the slinky and repeat steps (a) and (b). Describe the motion of the dot.

Learning Station # 5. Accordion Ears.

a) Cut the pieces of paper along the black lines.

b) Tape the pieces together to make one strip as seen in fig.1.

c) Fold the paper like an accordion along the dotted lines so that the outer ear is at the top as seen in fig. 2.

d) Label the middle ear, cochlea. What structures vibrate in response to sound waves? Which part transmits sound signals to the brain?

Appendix G

Schedule of Classes

*Participants of the study

Appendix H
Letter of Request to Conduct Study

February 21, 2015

FLORENCIA R. MEMBREBE
Principal II
Sagad High School
E. Angeles St., Sagad, Pasig City

Madam:
Greetings!
At present, I am working on my thesis entitled ***"The Effects of Physics Telecourse on the Attitude and Achievement in Physics of Fourth Year Students".***

In this connection, I would like to ask permission from your good office to allow me to conduct the study in fourth year, specifically to sections V and Y.

Rest assured that all lessons will follow the teaching competencies prescribed by the Department of Education for the fourth grading period.

Your favorable action in this request will be highly appreciated.
Thank you very much.

Respectfully yours,
(SGD.) LIZA C. CAIGOY
Researcher

Appendix I
Letter of Approval to Conduct a Study

February 26, 2014

LIZA C. CAIGOY
Sagad High School
Pasig City

Mrs. Caigoy,

Please be informed that your request to conduct your study in fourth year, sections
Diamond and Amethyst is approved provided that no classes will be disrupted in the process.

(SGD.) FLORENCIA R. MEMBREBE
Principal II

Appendix J
Letter of Request to Use the Attitude Inventory Test

23 January 2015

MS. EREDANI P. REYES
St. Mary's University HS Dept.

Dear Madam:

Good day!
I am Liza C. Caigoy, a graduate student from the Philippine Normal University (PNU), currently working on my thesis ***"The Effects of Physics Telecourse on the Attitude and Achievement in Physics of Fourth Year Students".***

In connection with this, may I ask permission to use the instrument that you have used in your study entitled "***Effects of Chemistry CONSTEL telecourse on Student Conceptual Understanding,Achievement, and Attitude Towards Chemistry".*** However, modification will be done to suit the purpose of the study.

Thank you very much and more power.

Respectfully yours,

(SGD.) LIZA C. CAIGOY
Researcher

Vitae

I. Personal Data:

Name:	Liza Castillo Caigoy
Date of Birth:	February 25, 1969
Place of Birth:	Bicas-Bicas, Buenavista, Marinduque
Civil Status:	Married
Name of Spouse:	Pedro S. Caigoy
Child:	Aizel Mae C. Caigoy

II. Educational Background:

Primary:	Bicas-Bicas Elementary School 1976-1980
Elementary:	Buenavista Central Elementary School 1980-1982
Secondary:	Buenavista Barangay High School 1982-1986
Tertiary:	Manuel L. Quezon University Bachelor of Secondary Education (BSEd) Major: General Science 1986-1990
Post Graduate:	Philippine Normal University 1994-1997 2005-2006 2013-2016 Master of Arts in Education
Specialization:	Science Education

III. Occupational Background:

Teacher I:	Marikina High School	1991-1992

Teacher I:	Rizal High School	1992-2001
Teacher II:	Rizal High School	2001-2009
Master Teacher I:	Sagad High School	2009-2015
Master Teacher II:	Sagad High School	2015-present

Descriptives

[DataSet] D: /Academics/Students'Thesis/Caigoy-Done/Data 7-22-15 c.sav

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A_grade	24	81	92	86.54	2.377
A_attitude_befor	24	2.76	3.68	3.1850	.25512
A_attitude_after	24	2.96	3.88	3.3917	.29084
A_test_1	24	6	25	14.25	4.142
A_test_2	24	10	24	17.33	3.608
A_test_3	24	10	25	17.46	3.575
B_grade	24	81	92	86.75	2.289
B_attitude_befor	24	2.64	3.56	3.0767	.25974
B_attitude_after	24	2.72	3.68	3.1583	.24501
B_test_1	24	3	23	10.79	4.423
B_test_2	24	11	23	15.25	2.938
B_test_3	24	10	34	16.54	5.200
Valid N (listwise)	24				

T-test Groups=Grouping (1 2)
/Missing=Analysis
/Variables=Grade
/Criteria=CI (.95).

T-Test
[Dataset2]

Group Statistics

Grouping		N	Mean	Std.Deviation	Std. Error Mean
Grade	Group 1	24	86.54	2.377	.485
	Group 2	24	86.75	2.289	.467

Independent Sample Test

	Levene's Test for Equality of Variances		t-test for Equality Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Grade								
Equal variances assumed	.043	.837	-.309	46	.759	-.208	.674	-1.564
Equal variances not assumed			-.309	45.934	.759	-.208	.674	-1.564

Independent Sample Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
Grade	Equal variances assumed	1.148
	Equal variances not assumed	1.148

```
T-test GROUPS=Grouping (1 2)
/Missing Analysis
/Variables=Attitude_Before
/CRITERIA=CI (.95).
```

T-Test

Group Statistics

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Attitude_Before	Group 1	24	3.1850	.25512	.05208
	Group 2	24	3.0767	.25974	.05302

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.
Attitude_Before							
Equal variances assumed	.005	.943	1.458	46	.152	.10833	.07432
Equal variances not assumed			1.458	45.985	.152	.10833	.7432

Independent Samples Test

	t-test for Equality of Means	
	95% Confidence Interval of the Difference	
	Lower	Upper

Attitude_Before		
Equal variances assumed	-.04126	.25793
Equal variances not assumed	-.4126	.25793

T-test Groups= Grouping (1 2)

/Missing=Analysis
/Variables=Test_1
/Criteria=CI (.95)

T_Test

Group Statistics

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Test_1	Group 1	24	14.25	4.142	.845
	Group 2	24	10.79	4.423	.903

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Test_1								
Equal variances assumed	.207	.651	2.796	46	.008	3.458	1.237	.969
Equal variances not assumed			2.796	45.802	.008	3.458	1.237	.968

Independent Samples Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
Test_1	Equal variances assumed	5.948
	Equal variances not assumed	5.948

T-test Groups=Grouping (1, 2)
/Missing=Analysis
/Variables=test_2
Criteria=CI (.95).

T- Test

Group Statistics

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Test_2	Group 1	24	17.33	3.608	.736
	Group 2	24	15.25	2.938	.600

Independent Samples Test

	Levene's Test for Equality of Variances	t-test for Equality Means

	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Test_2								
Equal variances assumed	.425	.518	2.194	46	.033	2.083	.950	.172
Equal variances not assumed			2.194	44.187	.034	2.083	.950	.170

Independent Samples Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
Test_2	Equal variances assumed	3.995
	Equal variances not assumed	3.997

T-test Groups=Grouping (1, 2)
/Missing=Analysis
/Variables=Test_3
Criteria=CI (.95).

T-test

Group Statistics

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Test_3	Group 1	24	17.46	3.575	.730
	Group 2	24	16.54	5.200	1.061

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Test_3								
Equal variances assumed	1.573	.216	.712	46	.480	.917	1.288	-1.676
Equal variances not assumed			.712	40.771	.481	.917	1.288	-1.685

Independent Samples Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
Test_3	Equal variances assumed	3.510
	Equal variances not assumed	3.519

T-test Groups= Grouping (1, 2)
/Missing=Analysis
/Variables=Attitude_after
/Criteria=CI (.95).

T-Test

Group Statistics

	Grouping	N	Mean	Std. Deviation	Std. Error Mean
Attitude_After	Group 1	24	3.3917	.29084	.59337
	Group 2	24	3.1583	.24501	.05001

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Test_After								
Equal variances assumed	1.922	.172	3.006	46	.004	.917	.23333	.07763
Equal variances not assumed			3.006 .	44.711	.004	.917	2.3333	.07763

Independent Samples Test

	t-test for Equality of Means	
	95% Confidence Interval of the Difference	
	Lower	Upper
Attitude_after		
Equal variances assumed	.07708	.38959
Equal variances not assumed	07696	.38971

NEW FILE.

DATASET NAME DataSet3 Window=FRONT.
UNIANOVA Attitude By Time Grouping
/METHOD=SSTYPE (3)
/INTERCEPT=INCLUDE
/EMMEANS=TABLES (OVERALL)
/EMMEANS=TABLES (time) COMPARE ADJ (LSD)
/EMMEANS=TABLES (Grouping) COMPSRE ADJ (LSD)
/EMMEANS=TABLES (time*Grouping)

/PRINT=DESCRIPTIVE
/CRITERIA=ALPHA (.05)
/DESIGN=Time Grouping Time*Grouping.

Univariate Analysis of Variance

[DataSet 3]

Between-Subjects Factors

		Value Label	N
Time	1	Before	48
	2	After	24
Grouping	1	Group 1	48
	2	Group2	24

Descriptive Statistics

Dependent Variable: Attitude

Time	Grouping	Mean	Std. Deviation	N
Before	Group 1	3.1850	.25512	24
	Group 2	3.0767	.25974	24
	Total	3.1308	.26051	48
After	Group 1	3.3917	.29084	24
	Total	3.3917	.29084	24
Total	Group 1	3.2883	.29009	48
	Group 2	3.0767	.25974	24
	Total	3.2178	.29607	72

Tests of Between-Subjects Effects

Dependent Variable: Attitude

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.229[a]	2	.615	8.492	.001
Intercept	693.088	1	693.088	9575.59	.000
Time	.513	1	.513	9	.010
Grouping	.141	1	.141	7.081	.168
Time*Grouping	.000	0		1.946	
Error	4.994	69	.072		

Total	751.718	72			
Corrected Total	6.224	71			

a. R Squared=.198 A (Adjusted R Squared=.174)

Estimated Marginal Means

1. Grand Mean

Dependent Variable: Attitude

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
3.21[a]	.032	3.155	3.281

2. Time

Estimates

Dependent Variable: Attitude

Time	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Before	3.131	.039	3.053	3.208
After	3.392[a]	.055	3.282	3.501

a. Based on modified population marginal mean.

Pairwise Comparisons

Dependent Variable: Attitude

(I) Time	(J) Time	Mean Diff. (I-J)	Std. Error	Sig [d]	95% Confidence Interval for Difference[d]	
					Lower	Upper
Before	After	-.261[*b]	.067	.000	-.395	-.127
Before	After	-.261[*c]	.067	.000	.127	.395

Based on estimated marginal means

*The mean difference is significant at the .05 level.
b. An estimate of the modified population marginal mean (J).
c. An estimate of the modified population marginal mean (I).
d. Adjustment for multiple comparisons: Least Significant difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: Attitude

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	1.089	1	1.089	15.039	.000
Error	4.994	69	.072		

The F tests the effect of time. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

3. Grouping

Estimates

Dependent Variable: Attitude

Grouping	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Group 1	3.288	.039	3.211	3.366
Group 2	3.077[a]	.055	2.967	3.186

a. Based on modified population marginal mean.

Pairwise Comparisons

Dependent Variable: Attitude

(I) Grouping	(J)Grouping	Mean Diff. (I-J)	Std. Error	Sig [d]	95% Confidence Interval for Difference[d]	
					Lower	Upper
Group 1	Group 2	-.212*[b]	.067	.002	.077	.346
Before	After	-.212*[c]	.067	.002	-.346	-.077

Based on estimated marginal means
*The mean difference is significant at the .05 level.

b. An estimate of the modified population marginal mean (J).
c. An estimate of the modified population marginal mean (I).
d. Adjustment for multiple comparisons: Least Significant difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable: Attitude

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.717	1	.717	9.904	.002
Error	4.994	69	.072		

The F tests the effect of grouping. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

4. Time* Grouping

Dependent Variable: Attitude

Time	Grouping	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Before	Group 1	3.185	.055	3.075	3.295
	Group 2	3.077	.055	2.967	3.186
After	Group 1	3.392	.055	3.282	3.501
	Group 2	[a]			

a. This level combination of factors is not observed, thus the corresponding population marginal mean is not estimable.

T-Tests Groups=Time (1, 2)
/Missing=Analysis
/Variables=Attitude
/Criteria=CI (.95).

T-Test

Group Statistics

	Time	N	Mean	Std. Deviation	Std. Error Mean
Attitude	Before	48	3.1308	.26051	.03760
	After	24	3.3917	.29084	.05937

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence.. Lower
Attitude								
Equal variances assumed	.823	.367	-3.852	70	.000	-.26083	.06771	-.39588
Equal variances not assumed			-3.712	41.8571	.001	-.26083	.07027	.40266

Independent Sample Test

		t-test for Equality of Means
		95% Confidence Interval of the Difference
		Upper
Attitude	Equal variances assumed	-.12579
	Equal variances not assumed	-11900