ENGINEERING STUDENTS' CONCEPTUAL UNDERSTANDING OF FORCE AND MOTION AND PERSONAL BELIEFS

A Thesis
Presented to
the Faculty of the Graduate Studies
Samar State University
Catbalogan City

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts in Teaching (MAT)
Major in **Physics**

NICOLAS O. BOCO, JR.
February, 2016

APPROVAL SHEET

This thesis entitled **"ENGINEERING STUDENTS' CONCEPTUAL UNDERSTANDING OF FORCE AND MOTION AND PERSONAL BELIEFS"** has been prepared and submitted by **NICOLAS O. BOCO, JR.**, who having passed the comprehensive examination, is hereby recommended for oral examination.

ENGR. ESTEBAN A. MALINDOG, JR. Ph. D.
Graduate School Faculty, SSU
Adviser

Approved by the Committee on Oral Examination on March 5, 2016 with a rating of **PASSED.**

MARILYN D. CARDOSO, Ph. D.
Dean, College of Graduate Studies/
Vice President for Academic Affairs, SSU
Chairman

RONALD L. ORALE, Ph. D.
Director, Research and Extension Services, SSU
Member

LANIE M. PACADALJEN, Ph. D.
Secretary to the Dean, CGS-SSU
Member

CARMEN R. LIM, M.A.T.
Education Program Supervisor-Science,
DepEd, Catbalogan City Division
Member

Accepted and approved in partial fulfillment of the requirements for the Degree, **Master of Arts in Teaching (MAT)** major in **Physics.**

March 5, 2016
Date of Oral Examination

VICTORIA M. TAFALLA, Ph. D.
Dean, College of Graduate Studies, SSU

ACKNOWLEDGEMENT

First and foremost, I thank the **Almighty God** for giving me the courage and the determination, as well as guidance in conducting this research study, despite all odds and difficulties.

I would like to express my heartfelt gratitude to my adviser, **Dr. ESTEBAN A. MALINDOG, JR.**, for his assistance and support throughout this intellectual journey, and especially for his confidence in my ability. He served as my inspiration since I was a student of him.

I would like also to thank **Dr. MARILYN D. CARDOSO**, for serving as chairman; **Dr. RONALD L. ORALE**, **Dr. LANIE M. PACADALJEN**, and **Dr. CARMEN R. LIM** for serving as members of the defense committee. Their comments and suggestions were beneficial in the refinement of the manuscript. I learned a lot of insights about research during the deliberation.

I have to thank my **parents** for their love and support throughout my studies. The same goes to my **wife** and my **daughter** for being patient while I was away during the data collection period. They deserve my wholehearted thanks.

To my laboratory assistant **Julito Roma**, thank you for the patience in checking and encoding the accomplished questionnaires.

To the **personnel and students** of the three selected universities, thank you for your cooperation.

Again THANK YOU!

Nico

DEDICATION

This thesis is just the beginning of my educational journey to reach the stars and chase my dreams to obtain a doctoral degree. So, I am dedicating this humble piece of achievement to:

NICOLAS S. BOCO, JR., my father;

ADELA O. BOCO, my mother;

FRANCIS O. BOCO, my bother;

MA. KRIZZA MAE C. BOCO my wife;

and

KHZIA NICOLE C. BOCO, my daughter.

NICOLAS O. BOCO, Jr.

ABSTRACT

This study determined the conceptual understanding of force and emotion and personal belief of second year civil engineering and electrical engineering students in selected state universities in Eastern Visayas during school year 2015-2016. This study employed descriptive-correlational research design. Out of 200 student-respondents, 137 or 68.5 percent had a "low" level of conceptual understanding corresponding to a percentage score of 21-40. Fifty seven or 28.5 percent had a "very low" level of understanding with percentage scores between 41-60. Their overall level of conceptual understanding of student-respondents of force and motion was 24 interpreted as "low" conceptual understanding with standard deviation of 8. Of the 200 student-respondents, 154 or 77.0 percent were "highly rational", followed by 46 or 23.0 percent who were "moderately rational" in their superstitious beliefs. As a whole, the student-respondents were "highly rational" as revealed by a mean value of 1.27 with a standard deviation of 0.33. Student-respondents' belief towards learning Physics was significantly related to their age; and school; but not with sex; course; religion; family size and average monthly family income. As a whole, student-respondents were highly rational in their superstitious beliefs. Physics professors should improve their content knowledge about force and motion through pursuing graduate degree in Physics.

TABLE OF CONTENTS

Chapter 1

THE PROBLEM AND ITS SETTING

Introduction

The school is an important institution. It plays a vital role in promoting and equipping every student, the knowledge and skills necessary to live productively, comfortably and harmoniously in this 21st century that is becoming scientifically and technologically driven. According to Lawson and Askell-Williams (2007:19), the task of the school is to design curricula that will help students become scientifically and technologically literate, that at the end of schooling, students can demonstrate or apply at the desired proficiency any knowledge they have learned in school.

The above characteristics of scientifically and functionally literate citizens are molded through Section of Article XIV of the 1987 Constitution of the Philippines which says:

> "Section 10. Science and technology are essential for national development and progress. The State shall give priority to research and development, invention, innovation, and their utilization; and to science and technology, education, training and services period. It shall support indigenous, appropriate, and self-reliant scientific and technological capabilities, and their application to the country's productive systems and national life."

On the other hand, the ambition of every country to have all its citizens scientifically and functionally literate was formalized in 1990 during the World

Declaration on Education for All (EFA) in Jomtiem, Thailand. As a response, the Philippines crafted and implemented the 10-year EFA Philippine Plan of Action covering 1991-2000 (UNESCO-Philippines, 2014:8). During the 2000 World Education Forum in Dakar the country committed that the 10-year EFA Philippine Plan of Action will be realized by 2015.

The year 2015 has ended but no country report is available regarding the status of science literacy among secondary and tertiary students. No such study or survey was conducted either by the Department of Education and the Commission on Higher Education, may be because the government was focused on the implementation of the K to 12 Curriculum. It is therefore timely that this study will be conducted.

A scientifically literate and progressive society has its citizens competent in the engineering field, specialist doctors, and technologists. Included are ordinary citizens who can effectively participate in decisions and debates of science and technology issues that concern the country. These individuals are not develop in just a day or overnight, but are built up with sound scientific knowledge (OPMSAC, 2011:10).

There is no doubt that the role of science and physics in particular, in modern society is changing. It is very different from yesterday. Increasingly the challenges faced by society - be it at the global level such as dealing with climate change or at the local level such as the problems of an ageing population, of environmental degradation, or of enhancing economic productivity through science and innovation – all depend on science.

In physics education, studies have shown that students have difficulties learning basic physics concept like force and motion (Darling, 2012:50-53). These concepts have been referred to as abstract concepts which are difficult to learn by students ranging from primary school to university including physics teachers and engineering students (Martín-Blas, Seidelb, and Serrano-Fernándeza, 2010:15; Azman, Alia, and Mohtar, 2013:21).

Force is the central concept of Newtonian mechanics. Newton's laws are important because they have easily visible applications in the daily lives of people. For example, O'Shea (2004:335-341) demonstrated the action of Newton's second law by describing the forces involved during snowboard jumping. There is the famous stunt with which most people are familiar, where a full table setting is placed on a table with a tablecloth, and a skillful practitioner manages to whisk the cloth out from under the dishes without upsetting the glasses and other objects (Science Clarified, 2015:12).

However, when conducting research on conceptual understanding, it is **also important to learn how students' conceptual understanding is shaped by** personal factors like beliefs and teacher competence. Superstitious beliefs determine one's personal conception of a science concept. It has been suggested that high school students' superstitious beliefs influence their study strategies and were related to their conceptual development (Chu, Treagust, and

Chandrasegaran, 2008:111-125). Could this be true to engineering students who are matured enough compared to high school students?

So, the nationwide campaign for scientific literary in the 21st century will not become a reality unless problems in learning physics in general and force and motion in particular are properly addressed. This has already been evidenced in the 2003 Trends in International Mathematics and Science Study (TIMSS) Testing where the Philippines placed second from the bottom (Gonzalez, 2004:2). In a separate interview, Dr. Reynaldo B. Vea, Mapua Institute of Technology president and Congressional Commission on Science and Technology and Engineering (COMSTE) Education committee chairman said that in the competitiveness level, the Philippines slid down from 47 in 2001 to 77 in 2007 out of 117 countries that were evaluated (Carballo, 2009:3).

Similarly, Northwestern Samar State University, Samar State University and Eastern Visayas State University posted an average passing rate of 49.54 percent in the 2014 Civil Engineering licensure examination which is slightly higher than the national passing rate of 46.41 percent. For year 2015, the average passing rate was 28.26 percent which is lower than the national passing rate 36.50 percent. In electrical engineering, for year 2014 the average passing rate was 25.88 percent which is almost twice lower than the national passing rate of 46.91 percent. In 2015, the average passing rate was 48.34 percent which is again lower than the national passing rate of 56.5 percent. This scenario could only mean one thing - students have not learned the basic concepts of the subjects covered in the board examinations including concepts in Physics.

Based on the above arguments, the aim of the present study is to determine engineering students' conceptual understanding of force and motion and their beliefs toward learning physics so that appropriate intervention will be designed. The Royal Academy of Engineering has emphasized the need for innovation in its Educating Engineers for the 21st Century report to ensure that graduates are equipped to meet future challenges (RAE, 2012:6). Teachers have a formative role to play in embodying current industrial practice in respect of innovation within university teaching. Innovation should be taught to ensure that engineering students and professional engineers are able to fulfil their contribution to the innovation economy. To be an effective innovator, good conceptual understanding in Physics is required in order to master the subject.

Statement of the Problem

This study determined the conceptual understanding of force and motion and personal belief of second year civil engineering and electrical engineering students in selected state universities in Eastern Visayas during school year 2015-2016.

Specifically, the study sought answers to the following questions:

1. What is the profile of the student-respondents in terms of the following variates:

1.1 age and sex;

1.2 course;

1.3 school;

1.4 religion, and

1.5 average family monthly income?

2. What is the level of conceptual understanding of the student-respondents of force and motion?

3. What is the level of misconception of the teacher-respondents of force and motion?

4. Is there a significant relationship between student-respondents' conceptual understanding of force and motion and their profile variates?

5. Is there a significant difference in conceptual understanding of force and motion according to:

5.1 course, and

5.2 school?

6. Is there a significant relationship between the conceptual understanding of student-respondents and their teachers' misconception of force and motion?

7. What is the level of student-respondents' personal beliefs along:

7.1 beliefs towards learning Physics, and

7.2 superstitious beliefs?

8. Is there a significant relationship between student-respondents' profile variates and personal beliefs along:

8.1 beliefs towards learning Physics, and

8.2 superstitious beliefs?

9. Is there a significant relationship between student-respondents' conceptual understanding of force and motion and personal beliefs along:

9.1 beliefs towards learning Physics, and

9.2 superstitious beliefs?

Hypotheses

Based on the specific questions posted in this study, the following hypotheses were tested.

1. There is no significant relationship between student-respondents' conceptual understanding of force and motion and their profile variates.

2. There is no significant difference in conceptual understanding of force and motion according to:

2.1 course, and

2.2 school.

3. There is no significant relationship between the conceptual understanding of student-respondents and their teachers' misconception of force and motion.

4. There is no significant relationship between student-respondents' profile variates and personal beliefs along:

   4.1 beliefs towards learning Physics, and

   4.2 superstitious beliefs.

5. There is no significant relationship between student-respondents' conceptual understanding of force and motion and personal beliefs along:

   5.1 beliefs towards learning Physics, and

   5.2 superstitious beliefs.

Theoretical Framework

The study is anchored on the Theory of Constructivism. The theory sets the foundation for many instructional methods in science. As summarized by Gunstone (2011:9-21) there are two main pillars of constructivism: (1) knowledge is not passively received but is actively built by students, which can differ from person to person and (2) there is no one correct view of the world, only what is perceived as real by each person as he constructs his meaning of the world through his own experiences.

Knowledge of human affairs couched in personal terms seems more important and more intimately appealing than knowledge of physical things conveyed in impersonal terms. Only by taking a hand in the making of knowledge, by transferring guess and opinion into belief authorized by inquiry, does one ever get knowledge of the method of knowing.

The realization of the learner as a "constructer" of knowledge and not an empty container to be filled with facts is what differentiates constructivism from other educational theories. In the rush to have a nation of better prepared scientists, the focus was on a more student-centered approach for teaching science. This developed alongside Piaget's ideas of intellectual development (Handy, 2008:353).

As children proceed through the sensorimotor, preoperational, concrete, and formal operational stages, mental processes are engaged in which old and new experiences merge to form new ideas. The formal terms Piaget gives to these processes are assimilation and accommodation (Karl, 2010:285).

Science has been taught too much as an accumulation of ready-made material with which students are to be made familiar, not enough as a method of thinking. Too often school science is studied as a disembodied set of facts and principles independent of the knower (White, 2008:51-57). A key component of constructivist thinking is that students have numerous personal experiences before they are formally educated, which shape how they perceive the world around them. With this principle in mind, it is not the intent of a constructivist educator to change a child's beliefs, but to modify beliefs so they more closely follow the accepted scientific understanding (Colburb, 2010:9-12).

The present study is also supported by the Attribution Theory (Weiner, 2011:2532-2533). The attribution theory attempts to assign causality to the outcome of any situation. Essentially, an individual attempts to explain a given situation by identifying the scenario itself in addition to the reasoning behind the outcome. For example, if a student is to take an examination and he knew that he has not studied, the student will try to find a reason to pass the examination like wearing a particular shirt color or bringing something to the classroom during the examination.

When the results are announced and he passed the examination, the student will try to attribute his passing the examination to the color of the shirt he wore or the thing that he brought with him during the examination and this would then create superstitious belief on the student by attributing the passing scenario to the particular shirt color and that the color of the shirt is a lucky color. The thought that a given action can bring good luck or bad luck when there are no rational or generally acceptable grounds for such a thought forms a superstitious belief on the student.

Human beings tend to learn also from observing the events around them (Beck and Forstmeier, 2007:35-46). According to them, any person that is capable of learning through observation is susceptible to becoming superstitious. When learning a superstitious belief, students compare the odds that any outcome is random to the odds that the outcome was more than chance. Students naturally assess situations similar to statistical analysis. For example, according to the authors, if a performer has a successful outcome and attributes this outcome to something unrelated to the performance, this would then create the superstition.

The study is also supported by the Social Learning Theory of Bandura (Sincero, 2011). Social learning theory focuses on the learning that occurs within a social context. It considers that individuals learn from one another, including such concepts as observational learning, imitation, and modeling.

According to social learning theory, learning, like any other behavior, is developed by imitating the practices including beliefs of people around an individual. In such situation, an individual's personal beliefs are formed through ones interaction with other persons around him or her. As an individual develops his or her own behavior through imitation, beliefs may also be imitated by the individual. An individual's belief systems then influence the ability of the individual to learn.

In other words, clearly establishing one's beliefs about something such as learning could directly influence study habits. For instance, the beliefs of students would influence how they would feel towards a subject like physics. Because of personal beliefs students would filter some of the information of the discussion of teachers during lectures. This would result to incomplete integration of the whole information into the cognitive structure of the students causing misconception.

Conceptual Framework

Figure 1 shows the conceptual framework of the study illustrating, among other things, the research environment, the respondents of the study and the major variables involved in the study.

The box at the base of the paradigm reflects the respondents and research environment of the study who are second year engineering and technology students from Samar State University, Northwestern Samar State University and Eastern Visayas State University of school year 2015-2016.

The next upper box encloses three smaller boxes representing the research variables. The box at the right represents student-respondents profile variates such as age, sex, course, school, religion, academic performance in Physics, academic performance in Math, and parents' educational attainment. The two boxes at the left represent students' level of conceptual understanding of force and motion and beliefs toward learning Physics. The three boxes are connected by two-way arrows which serve as indication that correlational analysis will be performed between these variables.

This big frame is then connected to a smaller box representing the results and findings of the study. This same box is connected by a broken arrow to the base of the schema indicating the feedback mechanism where the results of the study will be disseminated to the community. It is again connected to a smaller top most box representing the goal of the study which is improved conceptual

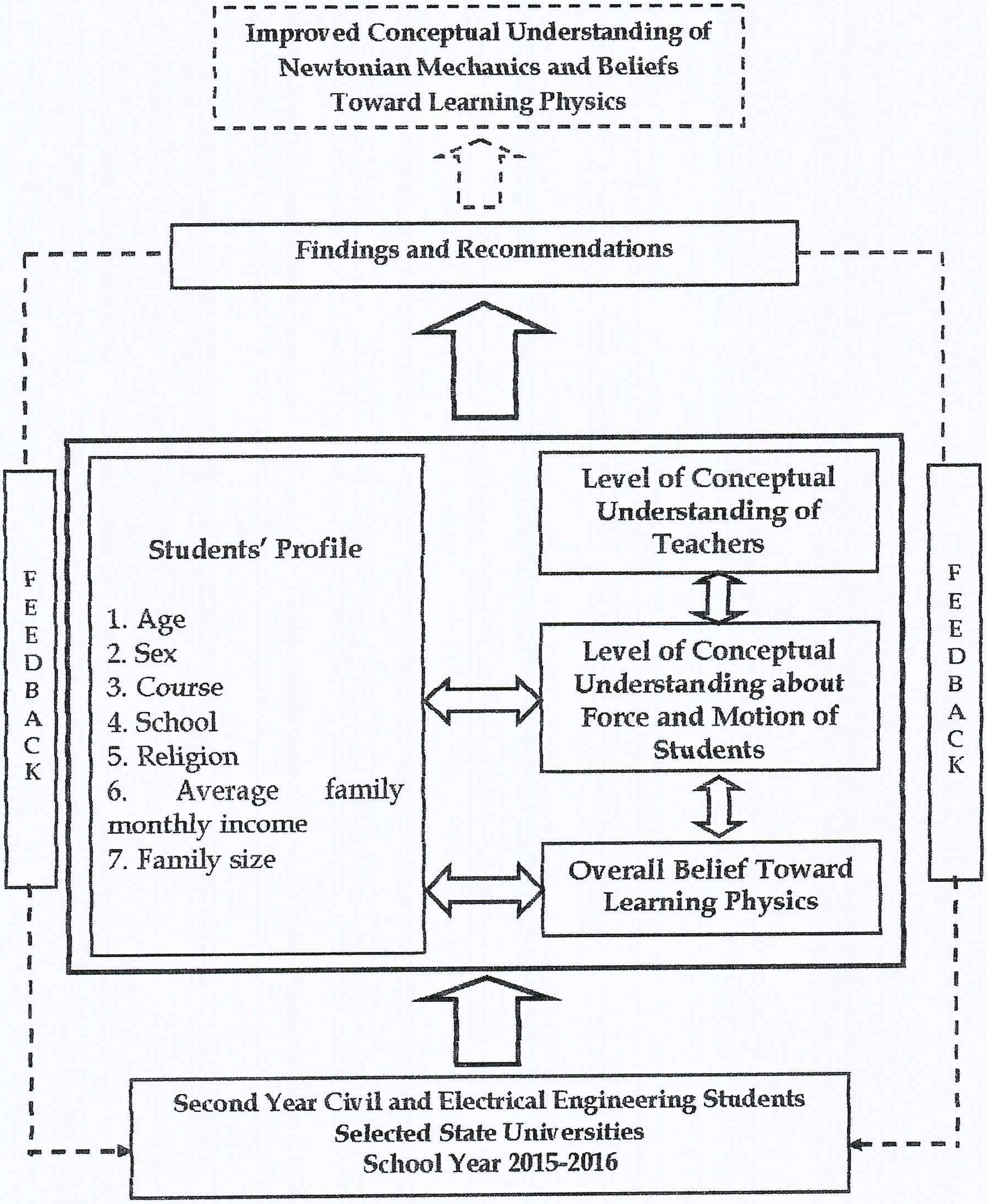


Figure 1. Conceptual Framework of the Study

understanding about force and motion, and positive beliefs toward learning Physics concepts.

Significance of the Study

The researcher believes that the result of this study would be beneficial to the students, teachers, parents, school administrators and future researchers.

Students. The results of the study would inform them regarding their conceptual understanding of physics concepts and how concepts are constructed and the belief factor in constructing the scientific conception of Newtonian mechanics about force and motion.

Teachers. The result of this study would inform them that teaching physics concepts for conceptual understanding is not just handing a loose collection of facts to students but involves careful observations and appropriate assessment and feedback of students' understanding of physics concepts taught.

Parents. From this study, parents would be informed regarding the academic performance of their children and somehow would serve as encouragement on their part to monitor their children's academic performance like knowing their grades after every major grading period – midterm and final examination results.

School administrators. The findings that will be generated in this study would be helpful to them as it may serves as the basis for close monitoring the quality of students' learning outcomes and that teachers are doing their best to help students attain the required proficiency level. Further, the results could serve as basis in coming up with intervention programs for the improvement of physics education.

Future researchers. The findings of this study would serve as additional information for those interested in investigating deeply into other factors affecting retention.

Scope and Delimitation

The study was designed to determine the conceptual understanding about force and motion of second year engineering students from the three identified state universities - Samar State University, Catbalogan City, Samar, Eastern Visayas State University, Tacloban City, Leyte and Northwestern Samar State Unuersity, Calbayog City, Samar.

The concepts of force and motion were selected primarily because force and motion are the most frequently discussed physics concepts in physics subjects, and secondly because the concepts are required subject matter in engineering curricula (Eryilmaz, 2002:1001-1015). Historically, the concepts of force and motion have produced misunderstandings in students of all ages, due to the content's difficulty and ineffective teaching methods that do not adequately illuminate the concepts (Halloun, 1998:239-263; and Kikas, 2004:432-448). By determining students' conceptual understanding would reveal their misconceptions about force and motion.

Based on the above arguments, the aim of the present study is to determine engineering students' conceptual understanding of force and motion and their beliefs toward learning physics so that appropriate intervention will be designed. The Royal Academy of Engineering has emphasized the need for innovation in its *Educating Engineers for the 21st Century* report to ensure that graduates are equipped to meet future challenges (RAE, 2012:6). Teachers have a formative role to play in embodying current industrial practice in respect of innovation within university teaching. Innovation should be taught to ensure that engineering students and professional engineers are able to fulfil their contribution to the innovation economy. To be an effective innovator, good conceptual understanding in Physics is required in order to master the subject.

It also treated beliefs toward learning Physics and force and motion concepts for two reasons. On the other hand, beliefs towards learning physics was included in this study since beliefs affects learning. According to Santrock (2011:250), there is always a tendency for people to hold to an idea or concept even in the face of contradictory evidence. People have a difficult time letting go of an idea once they have embraced it. This is the reason why misconceptions in science are persistent and resistant to change.

The respondents were engineering students who often have robust misconceptions that can persist throughout their educational career and may hinder their ability to learn new materials (Flynn, Davidson, and Dotger, 2014:3).

This study was conducted during the school year 2015-2016.

Definition of Terms

The following terms were defined conceptually and/or operationally for easy reference and understanding of the study.

Belief. It refers to an acceptance that a statement is true or that something exists (Santrock, 2011:114). As used in this study, it refers to assumptions or convictions or ideas about force and motion held to be true by student-respondents that may affect their learning.

Conceptual understanding. It refers to comprehension of science concepts, operations, and relations (Berthold and Renkl, 2009:70-87). In this study, it refers to student's ability to reason in settings involving the careful application of concepts of force and motion, definitions in physics, relations, or representations just like what scientists do.

Force. It refers to a push or a pull upon an object resulting from the object's interaction with another object (Young, Freedman, and Lewis Ford, 2012:215). In this study, it is any interaction that, when unopposed, will change the motion of an object as supported by Newton's laws of motion.

Level of conceptual understanding. This refers to the degree of knowledge learned by both students and teachers of force and motion as measured by the Force Concept Inventory and researcher-made questionnaire.

Misconception. This term refers to those beliefs students have about science concepts that contradict accepted scientific conception also known as alternative conception (Eryilmaz, 2012:1001-1015). For the purpose of this study, these are ideas about force and motion that are contradictory to or inconsistent with the Newtonian idea of force and motion as measured by the Force Concept Inventory (FCI) test.

Motion. It refers to the movement of a body or object which is observed by attaching a frame of reference to an observer and measuring the change in position of the body relative to that frame (Giancoli, 2014:305-339). As used in this study, it refers to a change in position of an object with respect to time. Motion is typically described in terms of displacement, distance, velocity, acceleration, time and speed.

Newtonian mechanics. It refers to the system of mechanics that relies on Newton's laws of motion concerning the relations between forces acting and motions occurring (Giancoli, 2014:11). In this study, it is a the branch of mechanics that is based on Newton's laws of motion and that is applicable to systems that are so large that Planck's constant can be regarded as negligibly small.

Personal belief. It refers to a person's acceptance that something is true or exists (Santrock, 2011:114). In this study, it is a compound phrase for beliefs toward learning physics and superstitious beliefs.

Superstitious belief. Refers to believing to a phenomenon that there has no experimental evidence for them, estimating a mystery by another mystery; believing that the world is directed by chance; offering the thoughts, desires and intentions with reference to their original nature; and belief in the supernatural, miracle, magic and divination (Inglehart, 2008:250). As used in this study, it refers to student-respondents' acceptance regarding the truthfulness about luck, construction of houses and buildings, and about weather condition as measured by the research questionnaire.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents concepts and ideas regarding the research problem reviewed from different sources.

Related Literature

Developing literacy in science for all students has become an essential goal within international school science education in the past few decades (Feinstein, 2011:79-104). Along this line, many educational efforts dealing with science education have been exerted on determining the factors affecting the achievement in science and especially in physics from elementary through graduate schools.

Student achievement is not simply a matter of what happens in school. Although schools can and do make a significant difference, some researchers identified numerous factors that affect student success. In physics, there exist too many studies conducted on different type of factors believed to be effective on achievement. According to study of Yen (2009:180-192), gender has a significant effect on students' physics achievement, in favour of boys. Another finding of the study was that students from high socioeconomic status background generally tend to get higher scores from physics than those from low socioeconomic background.

Results of the study of Doran (2009:72-77) supports the belief that teachers' efforts to make lessons interesting and relevant to student needs are effective. This suggests that to improve achievement in physics, schools should recruit and assign teachers who have the preparation needed or certification as a teacher of physics. Moreover, the international comparisons showed that students who study physics over several years have higher performance and that physics can be studied and learned at a younger age with no significant difficulties.

One of the factors affecting students' learning in physics is their existing knowledge prior to instruction. Henson and Henson (2003:86-98) pointed out that the students' prior knowledge or pre-conception provides an indication of the alternative conceptions as well as the scientific conceptions. The results show a significantly larger improvement in the acquisition of scientific conceptions as a result of the instructional strategy and materials, which explicitly dealt with student alternative conceptions.

Moreover, results of Eryılmaz (2012:1001-1015) showed that the correlation between students' misconceptions and achievement in physics is statistically significant. That is, the fewer the students' misconceptions are, the higher the students' achievements are. It was also found that the conceptual change discussion was significantly effective in improving students' physics achievement in force and motion.

Researchers pointed out that there appear a significant correlation between students' beliefs towards physics and physics achievement scores. Sancar (2009:530-533) concluded that the physics achievement scores of the students who have higher attitude scores will also be high. Moreover, science literacy depends on such factors as improving physics learning, increasing positive attitudes and beliefs towards physics, teaching methods, classroom environment, homework and projects, choice of teachers and encouraging to bring gender equity and awareness to every aspect of schooling.

Research findings indicate that novice learners hold a wide range of beliefs on basic concepts in science, and beliefs learners hold of the natural world tend to be naive, unstudied, and intuitive (AAUEF, 2010:8). Building models reflective of how students learn, what students learn, and what they need to learn next in order to grow useful knowledge structures could open doors to new worlds of learning.

Over the years, members of the physics teaching community have begun to conduct systematic observations and research on students' learning and understanding of physical concepts, models and lines of reasoning. Physics education research has revealed that students already have a number of ideas about how physical systems behave even before they start to study physics (Aguirre, 2008:212-216).

It is well established that, during their experiences in everyday life, children develop their own ideas that they use to make sense of the natural phenomena they experience in the world around them. But in many cases these ideas are either incorrect or differ from the scientific accepted ones. To the science educator, these ideas, preconceptions, or alternative conceptions are important because they significantly interfere with learning (McDermott, 2008:24-32).

Many studies were carried out in many different subjects in physics, especially in mechanics. Since late 1970s' many investigators met at the same point of decision that, students' preconceptions about force and motion has a great influence on performance in introductory mechanics (Clement, 1982:66-71). The studies concerning physics students' reasoning about the concept of force and motion have indicated that students exhibit misconceptions which can interfere with learning and which are surprisingly resistant to be changed.

In addition to the above mentioned studies, many other research studies are being carried out for the investigation and remediation of these misconceptions regarding force and motion. Briefly most of the studies accomplished in this area are concerned with detecting and dispelling misconceptions of students related to introductory mechanics - force and motion.

Students come to the class with a well-established system of common sense beliefs about how the physical world works. In this respect, the research into student misconceptions and their reasoning in mechanics has been the subject of many investigations and studies. Many physics education research has established that common sense beliefs about force and motion are incompatible with scientific concepts in most respects.

Halloun and Hestenes (2005:1043-1048) pointed out that student over a wide range of age and educational background have misconceptions about many concepts in mechanics. Besides, they have identified that not only ordinary students but also honor students and even physics teachers in fact highly misunderstand some concepts of mechanics.

Halloun, Hake, Mosca, and Hestenes(1995) designed a 29 item test (FCI) to probe students' beliefs about Newtonian mechanics focused on force and motion. This test has been given to more than 1500 high-school students and more than 500 university students. The results indicated that students' initial knowledge had a large effect on their performance in physics, and conventional instruction produced comparatively small improvement in their basic knowledge, as well as the small gain was independent of the professor or the teacher.

It has been suggested that students' epistemological beliefs about physics influence their study strategies and were related to their conceptual development (Chu,Treagust, and Chandrasegaran, 2008:111-125). Expectations are beliefs about the learning process and the structure of knowledge. These beliefs have shown to affect how students learn and what they want to learn. Helping students attain more expert-like beliefs can foster their learning.

The phrase expectation was used to represent students' prior conceptions, attitudes, beliefs, and assumptions about what sorts of things they will learn, what skills will be required, and what they will be expected to do in addition to their view of the nature of scientific information in a physics classroom. The study by Redish, Saul, and Steinberg (2008:2) has focused on students' expectations about their understanding of the process of learning physics and the structure of physics knowledge.

Epistemological beliefs are defined as the systems of implicit assumptions and beliefs that students have about the nature of knowledge and its acquisition (Paulsen and Feldman, 2005:731-763). Epistemological beliefs involve learners' theories about knowing, the nature of knowledge, and knowledge acquisition. Kortemeyer (2007:1-8) described epistemological beliefs about Physics and Physics learning as the beliefs which concern on what constitutes knowledge in Physics and how knowledge in Physics is developed.

Hofer and Pintrich (2002:88-140) suggested that epistemological beliefs affect Physics understanding through their indirect effect on learning, text comprehension, and meta-comprehension strategies. They have also suggested that epistemological beliefs can influence academic achievement indirectly, by affecting goal orientation. In other words, epistemological beliefs can give rise to certain types of learning goals, such as mastery, performance, and completion goals, which in turn, can function as guides for cognitive and metacognitive strategy use.

According to Gray, Adams, Wieman, Perkins (2008:1-10), students' beliefs about Physics, about the structure of Physics knowledge, the connection between Physics and the real world, how to approach problem solving and how to learn Physics, play a substantial role in a student's ability to learn Physics. Therefore, study on epistemological beliefs and attitudes of students towards learning Physics is needed to tap into the students' mind frame to probe their beliefs and perception towards Physics and learning the subject.

Rohana and Shaharom (2008:1-10) reported that generally students failed to master the conceptual understanding of force in Newtonian force concept in Physics and they were poor in giving correct answers to problems which related to force and motion. The study showed that the students are weak in understanding and applying the concept of force in problem solving and generally are poor decision makers when come to deal with force concept problems.

Teachers in science courses may have implicit expectations about what students should learn and how-to learn it. Chin (2007:151-157) refers to these goals as the hidden curriculum. It has been shown that students come to physics classes with a variety of epistemological beliefs and expectations about physics and physics learning.

As Mistades (2007:100-1066) reported that some students consider physics as weakly connected pieces of information to be learned separately, whereas others see physics as a coherent set of ideas to be learned together. Some students perceive learning physics as memorizing formulas and problem solving algorithms, while others think that learning involves developing a deeper conceptual understanding. Some students believe that physics is not connected to the real world, while others believe that ideas learned in physics are relevant and useful in a wide variety of real contexts. These preconceptions may inhibit students' learning of the required material in their physics course.

Researchers who investigated students' epistemological beliefs and expectations and their role in physics learning have effects on how they study, how they learn, and what they want to learn. Study by Carey (2005:514-529) has indicated that many pre-college students have misconceptions both about science and about what they should be doing in a science class. Other studies at the pre-college level determined some critical factors that comprise the relevant elements of student's system of beliefs.

For example, Singer (2006:761-784) studied students in middle schools and determined that they could categorize students as having beliefs about science that were either dynamic (science is understandable, interpretive, and integrated) or static (science knowledge is memorization-intensive, fixed, and not relevant toothier everyday lives). In describing high school students 'assumptions about mathematics learning, Schoen(2005:12) concluded that student's beliefs shape their behaviour in ways that have extremely powerful (and often negative) consequences. He further suggested that the more consistent the students 'and instructors' views about learning physics were, the better these students performed in the course.

Research on students' epistemological beliefs is important since they affect motivation and influence students' selection of learning strategies. Beliefs are also found to be related to the ability to reason on applied tasks, how students solve physics problems, conceptual learning gain in introductory physics courses, and conceptual understanding in middle school and university levels (Hofer and Pintrich, 2007:88-140).

Since research has found relationships between students' beliefs and their performance on the course, studies have focused on this area during the last decade. It emphasized the importance of expectations in how students make sense of their world and their learning. If inappropriate expectations play a role in students' common difficulties with introductory calculus-based physics, they need to be tracked and documented in order to help students improve their expectations which may in turn increase their success and enrolment in introductory physics classes.

On the other hand, superstitious beliefs had been around since man began walking upright on two legs (Park, 2008:9). The effect that superstition has had on the lives of people, even now in the so-called technologically-aware 21st century, is profound. Indeed, superstitions from person to person, nation to nation has seeped itself into their very psyche.

The true origin of superstition is to be found in early humans' effort to explain nature and his own existence; in the desire to propitiate fate and invite fortune, in the wish to avoid evils he could not understand and in the unavoidable attempt to pry into the future (Kashia, 2009:21-26). From these sources alone must have sprung that system of crude notions and practices still obtaining among savage nations; and although in more advanced nations the crude system gave place to attractive mythology, the moving power was still the same; human interpretation of the world was equal to their ability to understand its mysteries no more, no less.

George (2008:11) also accounted for the origin of superstition. According to him, early humans looked to the sky and invented stories explaining the nature of gods and monsters, heroes and heroines, warriors and poets. They created myths, stories and legends to account for the workings of these mysterious, brilliant points of light. Stories and explanations were extended and imposed upon everyday occurrences like the rising and setting of the sun, moon phases, tides, and weather patterns. To every issue, people tend to look at it from different perspectives as people hold diverse opinions about superstition. As some scholars are apostle's faint-superstition campaign, so also are many advocates of superstitious beliefs.

Albert (2010:101-108) submitted that in general terms, women are more superstitious than men. At least many women than men seek help for anxiety problems. Altogether, personality variables are not a strong factor in developing superstition, there is some evidence that if one is more anxious than the average person one is slightly more likely to be superstitious. Intelligence seems to have little to do with whether or not we subscribe to superstitions. Most of the superstitious people engage in are perfectly fine, and are not pathological. Psychologically, people are influenced with what goes on their minds and surrounding.

The world is undoubtedly proliferated with various religions and beliefs. Among the prominent religions in the world today are Christianity, Islam and traditional religion. All these religions hold different views about superstitious beliefs. These religious groups have different ways and modes of worship. This is in accordance with Philippines constitution, which states that everyone has right to practice his or her own religion - freedom of worship. All the religions hold different views about superstitious beliefs. Since superstition does not exist on its own but rather it is being practiced by people, then it may be difficult to mark out the boundaries of superstition. There are a lot of superstitions handed down from one generation to another with a view of teaching certain moral values.

Religion in this regard, is a polar opposite. Beliefs are dictated and taken on faith (Maher, 2006:101-123).Belief revision is not encouraged. Indeed, religion has difficulty changing its dogma when pressured. Take for example, Christianity's recent struggles to keep up with the rapidly changing times. Changes in the Christian belief system have had to been made with regards to the equality of women, homosexuality, another social changes in modern cultures. Belief systems, which are based around faith change painfully and slowly.

Education is regarded as one of the social institutions of the society. Sinelli (2010:12) explained education as the process by which society deliberately transmit its cultural heritage through schools, colleges, universities and other institutions. This means that the content of the curriculum in schools must be loaded with cultural elements of the society. Consequently, knowledge, which is produced in the school system, should be firmly grounded in the culture of the given society.

This means that no two societies can have identical educational system. Since educational system is supposed to be a reflection of the society's culture, needs and aspirations, the nature of the knowledge available in any given society should be sought in the nature of a society's institutions and culture (Troban, 2006:75-99). This is because knowledge is disseminated and acquired so that members of the society can improve themselves and operate the social institutions of the society. This implies that the culture of a given society reflects the types of knowledge produced in the society.

A study by Jegede and Okebukola (1991:37-47) found that Nigerian University students with a high-level of belief in African traditional cosmology, superstitions and taboos, made significantly fewer correct responses on a process skills test in comparison with those with a low level of belief. They also found significant interaction between gender and main effects of achievement and African traditional cosmology. They recommended that, curriculum and instruction for learners of science in non-Western societies must begin with and reflect the world-views the learners already possess.

A Philippine study (Riley II, 2001:53-63) examined the relationship among science process skills, logical thinking abilities and indigenous beliefs. Fifty students were randomly sampled from each year of a four-year high school in metro Manila and given instruments measuring the three outcome variables. The results indicated an inverse relationship between student achievement on the inquiry skill test and scores on the belief instrument.

The same inverse relationship existed between scores on the logical thinking test and on the belief instrument. In both cases students who scored high on the science and logical thinking measures tended to score lower on the measure of indigenous beliefs. The correlations were significant at the .001 level. However when gender results were analyzed separately there were no significant correlations among the females tested. High scoring females on the logical thinking test and on the science process test were as likely to have high scores on the measure of indigenous beliefs as females who scored low on the science and logical reasoning measures.

One explanation offered for this gender difference-cantered on the female role in the oral history traditions of Philippine indigenous beliefs. Taken together these studies suggest that overall, students who achieve high on science related measures tend to hold a more tentative view of traditional beliefs. However this does not hold true for all students and may vary by gender. The cultural background of the learner may have a greater effect on education than does subject content, especially in some aspects of science education (Martini, 2008).

Related Studies

The following are relevant studies reviewed by the researcher that helped him in planning and structuring the study.

Undie, Duruamaku, and Agba (2015) embarked on a study entitled "Superstitious Beliefs and Academic Performance of Pupils in Early Childhood Science". The study was designed to investigate the influence of superstitious beliefs on academic performance of pupils in early childhood science. The research design was ex-post factor. A random sample of 400 pupils was used.

Data for the study we recollected through a forty item three-point Liker-scale type questionnaire on Superstitious Beliefs and Science Achievement Test. The data were analyzed using Analysis Of Variance (ANOVA) and tested at $p< 0.05$ level of significance. A post hoc pair-wise comparison was made using LSD to compare main and interaction effects. Results showed that academic performance of early childhood pupils was significantly decreased by superstitious beliefs in the four basic categories of "Good luck", "Bad luck", "Impending danger" and "Perceived effect". Social study curriculum in early childhood schools was recommended to be broadened to teach concepts in superstitions which may reduce pupils beliefs and enhance the teaching of science.

The above study is similar to the present simply because the two studies focused on superstitious beliefs and its effects to academic performance of learners. The presents differed from the mentioned study in terms of research locale and respondents. The above study if a foreign study and involved elementary pupils unlike the present is a local one and involved college students.

Crouch (2014) did a study entitled "On the Effect of Virtual Reality on Student Understanding of and Interest in Physics". The study investigated the effect that video game Portal 2 had on students understanding of Newton's Laws and their attitudes towards learning science during two-week afterschool program at a science museum. Using a pre/post-test and survey design, along with instructor observations, the results showed a statistically relevant increase in understanding of Newton's Laws but did not measure a relevant change in attitude scores. The data and observations suggest that future research should pay attention to non-educational aspects of video games, be careful about the amount of time students spend in the game, and encourage positive relationships with game developers.

The above study is related to the present study since both studies involved Newtonian mechanics which involves the concepts on force and motion. However, the two studies differ in research design, research environment, and respondents. The above study was experimental in nature, a foreign study, and involved students that have knowledge in videogames. On the other hand, the present study is descriptive-correlation, a local study and will involve engineering and technology students.

Similarly, Abdal-Razzaq (2014) conducted a study entitled "To What Extent Do Engineering Students Master and Retain an Understanding of Newtonian Mechanics throughout Their University Life". The research was to assess the conceptual understanding of towards learning Physics courses for master and undergraduate students among the first year and final year. The study examined 272 engineering undergraduates and 10 master students for one year session. The results indicated no statistically significant difference between correct answer and year; age; grades in Physics 1, General Chemistry 1, and

Calculus; and degree program. The results further showed that the Mean score for masters students is (M=30.3 percent), while the Mean score for undergraduate students is (M=26.6 percent) using the Force Concept Inventory (FCI) test. However, the results indicated that poor conceptual understanding due to misconceptions detected among students.

Just like the above study of Abdal-Razzaq, the present study is focused on determining the conceptual understanding of engineering students of force and motion, both studies are descriptive correlational, and will use the same research instrument. The difference between the two studies are in terms of other variables like the involvement masteral students while none in the present study but instead will also involve technology students; and the period of the study which in the case of the previous took one year of data collection while the present study about two weeks of data collection.

Stecklein (2014) investigated the "Effects of Interactive Technology, Teacher Scaffolding and Feedback on University Students' Conceptual Development in Motion and Force Concepts". Primarily, the aim of the study was to determine the effects of the utilization of interactive technologies like tablet PCs and Dy Know Interactive Software, in a technologically enhanced, university-level, introductory physics course. Results of this qualitative case study of three university students indicate that (1) the use of interactive technology positively affects both student learning within force and motion and self-reported beliefs about physics, (2) ad hoc use of instructional technologies may not sufficient for effective learning in introductory physics, (3) student learners dictate the leveraging of technology in any classroom, and(4) that purposeful teacher structuring of classroom activities with technologies are essential for student construction of knowledge. This includes designing activities to elicit attention and make knowledge visible for low-level content, **while augmenting student interactions and modelling procedural steps for** higher-level content.

A study entitled "The Effects of Peer Instruction on Ninth Grade Students' Conceptual Understanding of Forces and Motion" was conducted by Harvey (2013) with the aim of testing whether the use of peer instruction, specifically concept questions embedded within a PowerPoint that allows for students to interact throughout the lecture, affects learner outcomes in a classroom setting. The outcomes from classes taught using peer instruction were compared to classes taught with traditional, lecture-based teaching strategies. Students in five different sections of a 9th grade Physical Science class were given pre-tests and post-tests to determine their learning gains on the topics of motion and forces. Overall, the peer instruction technique showed a significant positive effect on learning gains compared to traditional teaching methods. In each of the sections of students examined individually, peer instruction was as or more effective than traditional lecturing in improving student learning.

The above study is similar to present study since both studies delved on force and motion. However, they differ in terms of purpose. The study of Harvey was experimental in nature since it after determine the effectiveness of peer instruction in teaching force and motion concepts which contrary to the present which is descriptive in nature - determining the level of conceptual understanding about force and motion including beliefs towards learning physics.

Underwood (2012) studied "Do Learning Logs Have an Impact on the Conceptual Mastery of Force and Motion?" aimed at investigating the impact Learning Logs haven student conceptual mastery of force, motion, and kinematics. The study included a sample of 554 ninth grade students were selected from a suburban public school in Louisiana. The students were randomly divided into experimental and control groups within four teachers' classrooms. Upon the study's conclusion there was no significant differences noted due to teaching style or time of day. Further, the data showed that students stayed with their personal explanations regardless of the Learning Logs. Students appeared to have held onto their own explanation despite the variables discussed. The persistence of student responses is greater than the random guessing threshold. Moreover, analysis of the data was done to see if other variables such as gender, ethnicity, economic status, or student learning exceptionalities had a significant impaction conceptual mastery. None of the aforementioned variables showed statistical significance.

The above study is similar to the present study primarily because it involved on the concepts of force and motion. However, the two studies differed in terms of research design and respondents. The above study employed experimental design and the respondents were high school students. On the other hand, the present is descriptive-correlation which involved engineering students.

A study entitled "Scientific Explanations and Educational Implications of Superstitious Beliefs Held by Ijara-isin People of Kwara State, Nigeria" was undertaken by Adewara in 2012. This study examined the scientific explanations and educational implications of superstitious beliefs held by Ijara-isin people of Kwara State of Nigeria. A total number of 270 people were purposively sampled across the nine compounds that made up Ijara-Isin town. The instrument used for the study was a researcher designed interview protocol. The interview protocol was to find out the superstitious beliefs held by the people of Ijara-Isin and provide their scientific explanations. Four research questions were raised and answered. The data collected were subjected to frequency count and the percentage. The results indicated that the people of Ijara-Isin held some superstitious beliefs about Health, Pregnancy, Food, Animals, Rain, Trees, Environment, Birth, Diseases, Death, Barrenness, and Family planning. The superstitious beliefs gathered and their scientific explanations underwent scientific validation by three (3) experts in the Department of Plant Biology, University of Ilorin, Ilorin, Nigeria. Based on the findings, it is recommended among others that religious organization should stress on the need for personal responsibility in the determination of one's fate rather than the blind reliance on some spiritual processes to automatically change one's fortunes from poverty to riches overnighter vice versa. Government and other non-government organizations should support any association/organization in its efforts to eradicate superstitious beliefs and discrimination against women and children.

The study of Adewara was considered related for the obvious reason that it also pertain to superstitious beliefs like the present study. The main difference between the two studies is that the study of Adewara employed qualitative research design while the present study is quantitative in nature.

Sinapuelas (2011) embarked on a dissertation entitled "Why do some students struggle while others succeed in chemistry? A study of the influence of undergraduate student beliefs, perceptions, and use of resources on performance in introductory chemistry?" The dissertation explored how student beliefs about the nature of science learning, beliefs in their academic ability, perceptions of the classroom environment, perceptions of external support, and use of resources contribute to success in introductory chemistry as measured by midterm and final exam scores. These factors were selected for study because they are susceptible to instructional intervention. A beliefs and perceptions survey and use of resources framework were developed, tested, and utilized to find predictors for student grades. Factor analysis of student responses yielded four categories of beliefs and perceptions: nature of science learning, academic ability, classroom environment, and external support. A hierarchical linear model estimated the influence of student beliefs and perceptions on exam scores. There was a positive relationship between exam scores and (a) belief in academic ability and (b) belief that learning science involves understanding dynamic processes. There was a negative relationship between exam scores and perception of external support. Perceptions of the classroom environment were not strongly related to exam scores.

The study of Sinapuelas is related to the present study since they involved beliefs in learning science. The main difference is that the previous study was focused on chemistry while the present study is on physics.

Pablico (2010), on the other hand, did a study entitled "Misconceptions of Force and Gravity Among High School Students". The goal of the study was to determine prevalent or dominant misconceptions on force and gravity among high school students. A survey instrument consisting of 12 qualitative questions requiring both answers and written explanations was used to gather students' ideas and beliefs in situations involving force and gravity. Furthermore, it examined whether the proportion of students having misconceptions per question are correlated with gender and the type of school Physics background. The results showed that the respondents have misconceptions that are similar to the misconceptions found in previous research. The number of misconceptions and the proportion of students having misconceptions per question are not correlated with gender. They are, however, correlated with the amount of Physics instruction.

The study of Pablico and the present study are related in the sense that both studies are aimed at identifying the misconceptions of students about force and motion. However, the concept of gravity is not included in the present study making the present study different to the study of Pablico. Moreover, the present study will involve college students unlike the study of Pablico which involved high school students.

Dalagan and Mistades (2010) did a study entitled "Students' Beliefs and Attitudes Toward Learning in the Physics Component of the Lasallian (General Education) Core Curriculum". The study documented the effect of the physics component of the new curriculum on students' beliefs and attitudes by comparing the response profile of the freshmen of AY 2008-2009 with the response profile of the freshmen of AY 2005-2006 and AY 2006-2007. Pre- and Post-Course data was generated using the Maryland Physics Expectations Survey (MPEX) to determine students' "cognitive expectations" – the student's set of attitudes, beliefs, and assumptions about what sorts of things they will learn, what skills will be required, and what they will be expected to do in a physics class. Analysis of the results of the study revealed that the students moved towards an expert-like view in the Reality Link dimension and the Effort Link Dimension of the MPEX.

The study of Dalagan and Mistades (2010) was deemed related to the present study since it also delved on the topic students' beliefs towards learning physics. However, they differed in terms of the instrument used to measure beliefs toward learning physics. The previous study used the Maryland Physics Expectations Survey while the present study used a collected statements derived from the literature.

Lark (2007) did a research entitled "Student Misconceptions in Newtonian Mechanics" which sought to address the foundation of students' knowledge in Newtonian Mechanics in early education. Fourth grade and sixth grade students were first interviewed, testing for current understanding of forces and motion, and subsequently taught four lessons on the topic. Lessons were designed (based on successful classroom ideas described by the literature) to target common misconceptions students have involving forces and motion. Pre-interviews confirm the lack of general understanding of many concepts described by the literature, while post-interviews show statistically significant conceptual changes in many of the targeted conceptual areas. The lessons involved in this study successfully changed student ideas on topics involving friction, forces stopping objects' motion (as opposed to it stopping on its own), an understanding of the different ways motion can change, and that forces are what change motion. Unfortunately, the one topic described by the literature as hardest to alter remained prevalent in the students. Post-interviews show student still answering either the force of the push or some external force that would keep the object moving when asked what keeps an object in motion.

The study of Lark is similar to the present study because the two studies pertain to identification of misconception of the concept force. Primarily, the study of Lark used experimental design and involved elementary student while the present study is descriptive-correlational and will involve college students. Moreover, beliefs towards learning physic was not treated in the study of Lark contrary to the present study.

Campbell (2006) did a study, "The Effects of the 5E Learning Cycle Model on Students' Understanding of Force and Motion", with the intention of investigating fifth grade students' understanding of force and motion concepts as they engaged in inquiry-based science investigations through the use of the 5E Learning Cycle. The researcher's journey through this process was also a focus of the study. Initial data were provided by a pretest indicating students' understanding of force and motion concepts. Four times weekly for a period of 14 weeks, students participated in investigations related to force and motion concepts. Their subsequent understanding of these concepts and their ability to generalize their understandings was evaluated via a posttest. Additionally, a review of lab activity sheets, other classroom-based assessments, and filmed interviews allowed for the triangulation of pertinent data necessary to draw conclusions from the study. Findings showed that student knowledge of force and motion concepts did increase although their understanding as demonstrated on paper lacked completeness versus understanding in an interview setting. Survey results also showed that after the study students believed they did not learn science best via textbook-based instruction.

The above study is deemed similar to the present on the basis of the topic of the two studies which is force and motion. However, the two studies differed in research design. The study of Campbell was experimental while the present is descriptive correlational. Further, the study of Campbell did not treat beliefs towards learning physics.

Yuruk (2005) conducted a study "An Analysis of the Nature of Student's Metaconceptual Processes and the Effectiveness of Metaconceptual Teaching Practices on Students' Conceptual Understanding of Force and Motion". The study had three aims: (1) to investigate the effectiveness of facilitating students' metaconceptual processes, (2) to examine the durability of the impact of metaconceptual teaching on students' conceptual understanding of force and motion, and (3) to gain insight into the nature of meta-conceptual processes as the students participated in the meta-conceptual teaching activities. As regard to conceptual understanding, the ANCOVA results indicated that students who were exposed to meta-conceptual teaching interventions had significantly better conceptual understanding compared to those taught by traditional instruction following the instructional interventions. This finding points out the positive short- and long-term impact of facilitating students' meta-conceptual processes on students' conceptual understanding.

The study of Yuruk is related to the present study since the two studies are after determining conceptual understanding of force and motion concepts. The difference in the two study lie in the research design and inclusion of other variables. The study of Yuruk was experimental whereas the present study is descriptive-correlational. Another difference is that beliefs towards learning physics was not part in the study of Yuruk.

Chapter 3

METHODOLOGY

This chapter discusses the research design, instruments used in data gathering, validation of the instrument, sampling procedure, data gathering procedure and statistical analysis of data.

Research Design

This study employed descriptive-correlational research design. Descriptive since the study aimed at identifying the level of conceptual understanding about force and motion, beliefs toward learning physics, superstitious beliefs and profile variates of student-respondents using a questionnaire. At the same time, the study was also correlational since profile variates, conceptual understanding about force and motion, beliefs towards learning physics, and superstitious beliefs were correlated to each other.

Descriptive and inferential statistical tools were used in the analysis of data such as frequency count, percentage, mean, weighted mean, and Pearson Product Moment Correlation, t-test for independent samples and one way analysis of variance (ANOVA).

Instrumentation

As mentioned earlier, this study used the questionnaire as the main data gathering instrument.

Questionnaire. The questionnaire for student-respondents was consists of three parts. Part I solicited student-respondents demographic profile like age, sex, course, school, religion, family size and average monthly family income.

Part II was composed of 29 items with 5 choices or options for each item intended to measure the level of conceptual understanding about force and motion of student-respondents. The instrument was the product of the work of Hestenes, Wells, and Swackhamer (1992:141-158) called The Force Concept Inventory test.

Part III was composed of 20personal belief statements intended to identify the beliefs towards learning Physics and superstitious beliefs of student-respondents. Each statement was responded using a five-point Liker scale where 5 means strongly agree (SA), 4 for Agree (A), 3 for Uncertain (U), 2 for Disagree (D) and 1 for Strongly Disagree (SD).The instrument was adopted from the work of Adams, Perkins, Podolefsky, Dubson, Finkelstein, and Wieman, (2006:12).

On the part of the teacher-respondents, the researcher drafted 22 statements which were misconceptions of force and motion derived from the literature. Each statement was responded using the following: 2 = YES, 1 = NO, and 0 = I Don't Know.

Validation of the Instrument

Part I and II of the questionnaire for student-respondents did not undergo validation and reliability testing since it has already undergone rigorous validation particularly Part II. The Force Concept Inventory was tested using more than 1500 high-school students and more than 500 university students abroad of different nationalities and content validated by graduate students, physics teachers and experts in physics education. Until now it is the instrument widely used in measuring conceptual understanding about force and motion.

On the other hand, the statements on personal beliefs was administered to five males, five females civil engineering students and five electrical engineering students of Eastern Visayas State University last January 26, 2016. After a week, the same students accomplished again the questionnaire on personal beliefs. The reliability coefficient obtained was 0.89 using Pearson Product Moment correlation. The said value indicated that the questionnaire was applicable to group research.

Sampling Procedure

The respondents of this study were second civil and electrical engineering students coming from three state universities, namely: Samar State University (SSU), Catbalogan City, Samar; Northwestern Samar State University (NWSSU), Calbayog City, Samar; and Eastern Visayas State University (EVSU), Tacloban City, Leyte.

Table 1 below shows the sampling frame of the study. Sample size was determined using Yamane's formula (1967) and stratified random sampling was employed using the fish bowl technique in identifying the respondents.

Table 1

Sampling Frame

School	Section	Male		Female	
		P	S	P	S
	CEA	20	10	7	4
NwSSU	CEB	29	15	10	5
	EEA	19	10	0	0
SSU	CEA	20	10	15	8
	CEB	36	18	16	8
	EEA	26	12	1	1
EVSU	CEA	40	20	10	5
	CEB	44	22	12	6
	CEC	37	19	6	3
	EEA	20	10	3	2
	EEB	25	12	0	0
Total		**316**	**158**	**80**	**42**

Data Gathering Procedure

The researcher wrote a letter to the three Presidents, namely: Samar State University, Catbalogan City, Samar; Northwestern Samar State University, Calbayog City; and Eastern Visayas State University, Tacloban City, Leyte asking permission to administer the questionnaires to the target respondents. After obtaining the approval on February 2, 2016, the researcher proceeded to NWSSU the following day and presented the letter to the Dean of the College of Engineering. The secretary provided the researcher the class schedule of the student-respondents and was informed to proceed immediately to the room where the student-respondents were at the stipulated time reflected in their class schedule. Upon arrival to the room, the approved letter was presented to the subject professor. Immediately the researcher identified the respondents using fish bowl technique. The students who were not included were advised to vacate the room. The researcher proceeded in administering the questionnaire. Almost the same process was done in the other two universities - Eastern Visayas State University and Samar State University.

Statistical Treatment of Data

After retrieving the questionnaires from the respondents, the data were tallied, organized and analyzed. All inferential statistical tests were conducted at 0.05 significance level, two-tailed.

Frequency count and percentage. This was used to present the profile of student-respondents such age, sex, course, school, religion, family size and average monthly family income. The same was used in determining the level of conceptual understanding of force and motion for both student-respondents and teacher-respondents since the researcher considered level conceptual understanding was appropriate for criterion-referenced interpretation.

Mean. This was employed to calculate the averages where the measure is applicable like age and average monthly family income.

Weighted mean. This was employed to determine the level of conceptual understanding of teacher-respondents and student-respondents' personal beliefs.

Pearson Product Moment Correlation (Pearson r). This was used to determine relationships between profile variates of student-respondents and conceptual understanding about force and motion; and personal beliefs.

t-test for independent samples. This was used to determine the difference in conceptual understanding about force and motion according to course.

One Way Analysis of Variance (ANOVA). This was used to determine differences in level of conceptual understanding according to school.

Chapter 4

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the analyses of the data obtained and the corresponding interpretation in connection with the specific questions of the study.

Profile of Student-Respondents

The profile of the student-respondents such as age, sex, course, school, religion and average family monthly income are presented below.

Age and sex. Table 2 shows the distribution or student-respondents according to their age and sex.

Table 2

Age and Sex Distribution of Student-Respondents

Age	Male		Female		Total	
	f	Percent	f	Percent	f	Percent
29 - 30	1	0.5	0	0.00	1	0.5
23 - 24	2	1.0	0	0.00	2	1.0
21 - 22	5	2.5	0	0.00	5	2.5
19 - 20	23	11.5	3	1.5	26	13.0
17 - 18	129	64.5	37	18.5	166	83.0
Total	**160**	**80.0**	**40**	**20.0**	**200**	
Mean	**18.26**		**17.88**		**18.19**	
SD	**1.42**		**0.61**		**1.31**	

About 166 or 83.0 percent of the student-respondents are 17-18 years old composed of 129 or 64.5 percent males and 37 or 18.5 percent females. This is followed by 23or 11.5 percent males and three or 1.5 percent females whose age ranges from 19-20 years old for a total of 26 or 13.0 percent. The oldest is about one or 0.5 percent who is a male with an age range of 29-30 years old.

The mean age of the student-respondents is 18.19 years old with a standard deviation of 1.31 years. It appears that females are younger than males as supported by the mean age of 18.26 years for the male group and 17.88 years for the female group.

Course. The distribution of student-respondents in terms of their course is given in Table 3.

Table 3

Course Distribution of Student-Respondents

Course	*Frequency*	*Percent*
BS Civil Engineering	153	76.5
BS Electrical Engineering	47	23.5
Total	**200**	**100**

Based on the table above, 153 or 76.5 percent of the student-respondents are BS Civil Engineering and 47 or 23.5 percent are BS Electrical Engineering.

School. Table 4 provides the distribution of student-respondents according to school.

The highest number of student-respondents came from Eastern Visayas State University which is 99 or 49.5 percent followed by 57 or 28.5 percent from Samar State University and finally 44 or 22.0 percent from Northwestern Samar State University.

Table 4

School Distribution of Student-Respondents

School	Frequency	Percent
Samar State University	57	28.5
Eastern Visayas State University	99	49.5
Northwestern Samar State University	44	22.0
Total	***200***	***100***

Religion. Table 5 reflects the distribution of student-respondents religious affiliation.

As reflected from the table, 162 or 81.0 percent of the student-respondents are Roman Catholics while 17 or 8.5 percent are Christians. Fourteen or 7.0 percent are Born Again, four or 2.0 percent are Baptist, two or 1.0 percent are IFI and one or 0.5 percent are Latter Day Saints.

Table 5

Religion Distribution of Student-Respondents

Affiliation	Frequency	Percent
Roman Catholic	162	81.0
Born Again	14	7.0
Baptist	4	2.0
Christian	17	8.5
IFI	2	*1.0*
Latter Day Saints	1	0.5
Total	**200**	**100**

Family size. Table 6 is the presentation of family size of student-respondents.

The table shows that 79 or 39.5 percent of the student-respondents have family size ranging from 6-7 and this is followed by 64 or 32 percent ranging from 4-5, 35 or 17.5 percent from 8-9. Seven or 3.5 percent of the student-respondents have family size of 2-3 members and 12-13 members, respectively. The mean family size is seven with a standard deviation of two members in the family.

Table 6

Family Size of Student-Respondents

Family Size	Frequency	Percent
12 – 13	7	3.5
10 – 11	8	4.0
8 – 9	35	17.5
6 – 7	79	39.5
4 – 5	64	32.0
2 – 3	7	3.7
Total	***200***	***100***
Mean	**7**	
SD	**2**	

Average monthly family income. In Table 7 is shown the average monthly family income of student-respondents.

As can be seen from the table, 50 or 16.4 percent of the student-respondents have average family income below Php5, 001.00. This is followed by 49 or 16.1 percent from Php20,000.00–Php15,001.00, 37 or 37.2 percent from Php10,000.00–Php5,001.00, and 30 or 16.1 percent from Php15,000.00–Php10,001.00. Twelve or 5.9 percent are earning above Php30,001.00. The lowest number of student-respondents is two or 0.7 percent whose family income is ranging from Php35,000.00–Php30,001.00.

The mean average family income is Php13, 035.03 and a standard deviation of Php10, 345.32. This mean average family income is higher compared to the Php10,969.00 poverty threshold as of 2015 (Philippine Statistics Authority, n.d.).

Table 7

Average Monthly Income of Student-Respondents Parents

Average Monthly Income (Php)	*Frequency*	*Percent*
Above 30,001.00	12	5.9
35,000.00 – 30,001.00	2	0.7
30,000.00 – 25,001.00	10	4.3
25,000.00 – 20,001.00	*10*	3.3
20,000.00 – 15,001.00	49	16.1
15,000.00 – 10,001.00	30	16.1
10,000.00 – 5,001.00	37	37.2
Below 5,001.00	*50*	16.4
Total	200	100
Mean	**Php13,035.03**	
SD	**Php10,345.32**	

<u>Student-Respondents' Level of Conceptual Understanding of Force and Motion</u>

Table 8 reflects the level of conceptual understanding of student-respondents of force and motion.

Table 8

Student-Respondents' Level of Conceptual
Understanding of Force and Motion

Percentage Score	Level of Understanding	Frequency	Percent
41 – 60	Moderate	6	3.0
21 – 40	Low	137	68.5
1 – 20	Very low	57	28.5
Total		200	**100**
Mean	**24**		
SD	**8**		

Out of 200 student-respondents, 137 or 68.5 percent have "low" conceptual understanding corresponding to a percentage score of 21-40. Fifty seven or 28.5 percent have "very low" level of understanding with percentage scores 1-20, and six or 3.0 percent have "moderate" level of conceptual understanding at percentage scores between 41-60.

The overall level of conceptual understanding of engineering student-respondents of force and motion is "low" as supported by mean percentage score of 24 with standard deviation of 8.

In a study conducted by Martín-Blas, Seidelb, and Serrano-Fernándeza (2010) involving first year engineering students, one of the most striking misconceptions is the wrong idea that there must always be a net force parallel to the velocity vector. It was found that the number of correct answers to the questions related to this misconception is surprisingly low. The only situation in which most students are able to correctly describe the movement under a net force is when a particle follows a straight path under a frictional force. The most persistent conceptual error is that the most massive object or the moving object exerts the biggest force in an action–reaction pair.

Teacher-Respondents' Level of Misconception of Force and Motion

The weighted means of the twenty two statements used to determine the level of conceptual understanding of teacher-respondents of force and motion concepts are presented in Table 9 below.

Three statements obtained weighted mean ratings of 2.0 interpreted as "very high misconception" in terms of level of conceptual understanding of force and motion concepts by teacher-respondents. The statements which obtained the said weighted means are statement 10 (The motion of an object is always in the direction of the net force applied to the object), statement 13 (A force is needed to keep an object moving with a constant speed) and statement 17 (An increase in force will produce an increase in speed, more of A, more of B).

This is followed by six statements which obtained weighted mean ratings ranging from 1.55-1.99 interpreted as "moderate misconception" level of conceptual understanding. These are statement 5 (Things fall because you let them go, but to go up you have to push them up) a weighted mean rating of 1.88,

Table 9

Teacher-Respondents' Level of Conceptual *Understanding of Force and Motion*

Statements	Weighted Means	*Interpretation*
10. The motion of an object is always in the direction of the net force applied to the object.	2.00	VHM
13. A force is needed to keep an object moving with a constant speed.	2.00	VHM
17. *An increase in force will produce an increase in* speed (*more of A, more of B*).	2.00	VHM
5. Things fall because you let them go, but to go up you have to push them up.	1.80	MM
6. An object stops because of the lack of action to keep *the object going.*	1.80	MM
9. Force is a property of an object. An object has force and when it runs out of force it stops moving.	*1.60*	*MM*
11. Centripetal and centrifugal forces both act on a body moving in a circle.	1.80	MM
16. Force as a kind of fuel or energy that sustains the motion but at the same time is consumed by the *motion itself.*	1.60	MM
15. If an object is moving, then there must be a force in the direction of motion.	*1.60*	*MM*
2. An object stops moving because "the push wore off."	1.40	SM
3. An object that moves has that ability to do so by itself (in-built ability to move).	1.40	SM
4. "People move because they have legs" or "Bikes move because they have wheels."- a part of an object creates the motion.	1.40	SM
7. The only "natural" motion is for an object to be at rest.	1.20	SM
21. A force applied by, say a hand, still acts on an object after the object leaves the hand.	1.20	SM
22. An object moves up or down depending on whether *either the velocity or the kinetic energy is larger or* smaller than the force of gravity.	1.40	SM
1. Only animate objects can exert a force. Thus, if an *object is at rest on a table, no forces are acting upon* it.	*1.00*	NM
8. If an object is at rest, no forces are acting on the *object.*	1.00	NM

Statements	Weighted Means	Interpretation
12. Friction always hinders motion. Thus, you always want to eliminate friction.	1.00	NM
14. If an object is not moving, then there can be no force acting on it.	1.00	NM
18. *If an object is on the ground then gravity is not* acting on it, because it has already fallen to the ground.	1.00	NM
19. Gravity is the result of air pressure.	1.00	NM
20. Those objects that fall have more gravity than stationary objects, or gravity is not exerted upon stationary objects.	1.00	NM
Grand Mean	**1.42**	**SM**

Legend: 2.00 Very High Misconception (VHM)
1.51 – 1.99 Moderate Misconception (MM)
1.10 – 1.50 Slight Misconception (SM)
1.00 No Misconception (NM)

statement 6 (An object stops because of the lack of action to keep the object going) at 1.80, statement 9 (Force is a property of an object. An object has force and when it runs out of force it stops moving) at 1.60, statement 11 (Centripetal and centrifugal forces both act on a body moving in a circle)at 1.80, statement 15 (If an object is moving, then there must be a force in the direction of motion) at 1.60, statement 16 (Force as a kind of fuel or energy that sustains the motion but at the same time is consumed by the motion itself) at 1.60.

On the other hand, six statements obtained weighted mean ratings with ranges 1.10-1.50 interpreted as "slight misconception". These are statement 2 (An object stops moving because "the push wore off.") obtained a weighted mean rating of 1.40, statement 3 (An object that moves has that ability to do so by itself (in-built ability to move) weighted mean of 1.40, statement 4 ("People move because they have legs" or "Bikes move because they have wheels."- a part of an object creates the motion) weighted mean of 1.40, statement 7 (The only "natural" motion is for an object to be at rest) weighted mean of 1.20, statement 21 (A force applied by, say a hand, still acts on an object after the object leaves the hand) weighted mean of 1.20, and statement 22 (An object moves up or down depending on whether either the velocity or the kinetic energy is larger or smaller than the force of gravity) with a weighted mean rating of 1.40.

Seven statements yielded weighted mean ratings of 1.00 interpreted as "no misconception" of force and motion. These are statement 1(Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting upon it), statement 8 (If an object is at rest, no forces are acting on the object), statement 12 (Friction always hinders motion. Thus, you always want to eliminate friction), statement 14 (If an object is not moving, then there can be no force acting on it), statement 18 (If an object is on the ground then gravity is not acting on it, because it has already fallen to the ground.), statement 19 (Gravity is the result of air pressure) and statement 20 (Those objects that fall have more gravity than stationary objects, or gravity is not exerted upon stationary objects.)

Overall, the teacher-respondents have "slight misconception" of conceptual understanding force and motion as supported by a grand mean of

1.42. This finding is similar to the study of Narjaikaew (2013) where it was found out that science teachers have low conceptual understanding on force and motion. For example, more than 50% of the teachers believed that the speed of motion is proportional to the applied force. If the speed of an object is constant, the applied force is constant. These indicate teachers' misconception relating to force with motion even when the object is moving at constant velocity.

Relationship Between Student-Respondents' Conceptual Understanding of Force and Motion and Profile *Variates*

Table 10 below provides the coefficients of correlation and p-values between student-respondents' conceptual understanding of force and motion concepts and their profile variates.

Table 10

Correlation Between Student-Respondents' Conceptual Understanding of Force of Motion and Profile Variates

Profile variates	r_{xy}	p-value	Evaluation	Decision
Age	-0.161	0.023	S	Reject H_o
Sex	0.210	0.003	S	Reject H_o
Course	0.164	0.020	S	Reject H_o
Average Monthly Family Income	0.235	0.001	S	Reject H_o
School	0.120	0.092	NS	Accept H_o
Religion	0.016	0.821	NS	Accept H_o
Family Size	0.040	0.576	NS	Accept H_o

Legend: α = 0.05; df = 198; two-tailed; S – Significant; NS – Not Significant

The following correlation coefficients and p-values were obtained between student-respondents' conceptual understanding of force and motion and profile variates: -0.161 and 0.023 with age; 0.210 and 0.003 with sex; 0.164 and 0.020; and 0.235 and 0.001 with average monthly family income. The accompanying p-values are lower than the 0.05 significance level which means significant relation between variables. So, the hypotheses "there are no significant relationship between conceptual understanding of force and motion and age; sex; course; and average monthly family income" is rejected.

In contrast, the following coefficients of correlation and p-values were obtained from the remaining profile variates: 0.120 and 0.092 for school; 0.016 and 0.821 for religion; and 0.040 and 0.576 for family size. The p-values are higher than the 0.05 significance level implying no significant relationship between variables. The hypotheses "there are no significant relationships between student-respondents' conceptual understanding of force and motion and school; religion; and family size" is accepted.

Difference in Student-Respondents' Conceptual Understanding of Force and Motion

Below is presented the results of the comparative analysis in conceptual understanding of force and motion according to course and school.

Course. Table 11 presents the comparison of level conceptual understanding of force and motion between BS Civil and BS Electrical student-respondents.

The table below shows that there is a significant difference in terms of level of conceptual understanding of force and motion concepts in favor of the civil engineering student-respondents. This is supported with a p-value of 0.019 which is lower than the 0.05 significance level. The hypothesis "there is no significant difference in level of conceptual understanding of force and motion between civil and electrical engineering student-respondents" is rejected.

Table 11

Comparison in Conceptual Understanding of Force and *Motion Between Civil and Electrical Engineering*

Group	n	Mean	SD	*t*-value	*p*-value	*Evaluation/* Decision
Civil Eng'g.	153	24.58	7.90	2.37	*0.019*	Significant/ Reject H_o
Electrical Eng'g.	47	21.40	8.54			

Legend: α = 0.05; df=98

The difference in conceptual understanding between BS Civil Engineering students and BS Electrical Engineering in favor of the civil engineering is that the concepts of force and motion are applied in higher civil engineering subjects like structural analysis and less on higher electrical engineering subjects.

In the same study conducted by Martín-Blas, Seidelb, and Serrano-Fernándeza (2010), the study revealed that students from an Industrial Engineering school had higher level of conceptual understand than Forestry Engineering School. However, no explanation was provided of the observed difference in conceptual understanding.

School. Provided in Table 12 is the result of the ANOVA regarding the differences in conceptual understanding of force and motions concepts by student-respondents group according to their school.

Table 12

Comparison of Student-Respondents' Conceptual Understanding of Force According to School

Group	Sum of Squares	df	Mean Square	F	p-value	Evaluation/ Decision
Between Groups	114.977	2	57.488	0.865	0.423	*NS/Accept* H_o
Within Groups	13088.578	197	66.439			
Total	13203.555	199				

Legend: $\alpha = 0.05$; *NS = Not Significant*

The entries of the table show that the F value of 0.865 is accompanied by a *p*-value of 0.423. This *p*-value is greater than the 0.05 significance level which no significant difference in conceptual understanding of student-respondents from the three schools. The hypothesis "there is no significant difference in conceptual understanding of force and motion grouped according to school" is accepted.

Relationship Between Student-Respondents' Conceptual Understanding and Teachers' Misconception *of Force and Motion*

Table 13 presents the correlation between teacher-respondents' and student-respondents' conceptual understanding of force and motion using Kendall tau statistics.

Table13

Correlation Between Student-Respondents' Conceptual Understanding and Teachers' Misconception of Force of Motion

Conceptual Understanding	r_{xy}	*p*-value	Evaluation	Decision
Teachers vs Students	*0.200*	*0.720*	*NS*	Accept H_o

Legend: α = 0.05; df = 3; two-tailed; S – Significant; NS – Not Significant

No significant relationship was found out between teacher-respondents' and students respondents' conceptual understanding of force and motion. This is supported by the p-value of 0.72 which is greater than the 0.05 significance level. So, the hypothesis "there is no significant relationship between teacher-respondents' and student-respondents' conceptual understanding of force and motion" is accepted. This result does not mean that teachers'/professors' lectures have no effect on students' conceptual understanding of force and motion. It could mean that the data do not support or there is no enough variation of the data.

Student-Respondents' Personal Beliefs

The personal beliefs of student-respondents along beliefs toward learning physics and superstitious beliefs are provided in Table 14 and Table 15.

Beliefs towards learning Physics. In Table 14 are presented the categorization of student-respondents in terms of level of beliefs towards learning Physics.

Table 14

Level of Beliefs Towards Learning Physics of Student-Respondents

Beliefs	*Frequency*	*Percent*
Moderately Rational	5	2.5
Uncertain	105	52.5
Moderately Irrational	87	43.5
Highly Irrational	3	1.5
Total	***200***	***100***
Mean	**3.48**	
SD	**0.47**	

Legend: 4.51-5.00 Highly Irrational (HI)
3.51-4.50 Moderately Irrational (MI)
2.51-3.50 Uncertain (U)
1.51-2.50 Moderately Rational (MR)
1.00-1.50 Highly Rational (MR)

Out of 200 student-respondents, 105 or 52.5 percent are "uncertain" followed by 87 or 43.5 percent "moderately irrational", five or 2.5 percent are "moderately rational" and three or 1.5 percent are "highly irrational" level of beliefs towards learning physics.

Overall, the level of beliefs towards learning Physics of student-respondents is "uncertain" as supported by a mean of 3.48 and a standard deviation of 0.47.

While the result of the present study did not reveal that engineering students have rational or irrational belief towards learning physics, the study conducted by Alhadlaq, Alshaya, Alabdulkareem, Perkins, Adams, and Wieman (2012) showed the engineering students tend to express irrational beliefs towards learning physics.

Superstitious beliefs. Table 15 shows the categorization of student-respondents according to their level of superstitious beliefs.

Table 15

Level of Superstitious Beliefs of Student-Respondents

Overall Beliefs	*Frequency*	*Percent*
Highly Rational	154	77.0
Moderately Rational	46	23.0
Total	**200**	**100**
Mean		
SD		

Legend: 4.51-5.00 Highly Irrational (HI)
3.51-4.50 Moderately Irrational (MI)
2.51-3.50 Uncertain (U)
1.51-2.50 Moderately Rational (MR)
1.00-1.50 Highly Rational (MR)

Of the 200 student-respondents, 154 or 77 percent of them are "highly rational" followed by 46 or 23.0 percent "moderately rational" level of superstitious beliefs.

As a whole, the student-respondents are "highly rational" as revealed by a mean value of 1.27 with a standard deviation of 0.33. This highly rational superstitious belief is confirmed by the study of Sagone and De Caroli (2015). The study revealed that psychology and pedagogy students expressed a greater personal belief in good luck than engineering students which is tantamount that engineering students are highly rational.

Relationship Between Student-Respondents' Profile Variates and Personal Beliefs

The results of the correlational analysis performed between student-respondents profile variates and personal beliefs along beliefs towards learning Physics and superstitious beliefs are provided in Table 16 and Table 17.

Beliefs towards learning Physics. The results of the correlation between student-respondents' beliefs towards learning Physics and their profile variates are given in Table 16.

Based on the table, age and school yielded a Pearson coefficients of correlation of -0.262 and 0.187 and a p-values of 0.001 and 0.008, respectively. These p-values are lower than the 0.05 significance level indicating significant relationships between paired variables. So, the hypotheses "there are no significant relationships between beliefs towards learning physics and age; and school" is rejected.

Table 16

Correlation Between Student-Respondents' Beliefs Towards Learning Physics and Profile Variates

Profile variates	r_{xy}	p-value	Evaluation	Decision
Age	-0.262	0.001	S	Reject H_o
School	0.187	0.008	S	Reject H_o
Sex	0.009	0.903	NS	Accept H_o
Course	0.129	0.069	NS	Accept H_o
Religion	0.060	0.396	NS	Accept H_o
Family Size	-0.001	0.990	NS	Accept H_o
Average Monthly Family Income	-0.028	0.692	NS	Accept H_o

Legend: α = 0.05; df = 198; two-tailed; S – Significant; NS – Not Significant

On the one hand, the following are the Pearson coefficients of correlation and p-values between beliefs towards learning physics and remaining profile variates: 0.009 and 0.903 for sex; 0.129 and 0.069 for course; 0.060 and 0.396 for religion; -0.001 and 0.990 for family size; -0.028 and 0.692 for Average monthly family income. All the p-values are higher than the 0.05 significance level implying no significant relationships between paired variables. Hence, the hypotheses "there are no significant relationship between belief towards learning physics and sex; course; religion; family size and average monthly family income" is accepted.

Superstitious beliefs. The results of the correlation between student-respondents' superstitious beliefs and their profile variates are given in Table 17.

Table 17

Correlation Between Student-Respondents' Superstitious Beliefs and Profile Variates

Profile variates	r_{xy}	p-value	Evaluation	Decision
Course	0.169	0.016	S	Reject H_o
Religion	0.145	0.040	S	Reject H_o
Average Monthly Family Income	-0.147	0.038	S	Reject H_o
Age	-0.043	0.548	NS	Accept H_o
Sex	0.046	0.515	NS	Accept H_o
School	0.038	0.591	NS	Accept H_o
Family Size	0.021	0.770	NS	Accept H_o

Legend: $\alpha = 0.05$; df = 198; two-tailed; S - Significant; NS - Not Significant

The table shows that course, religion and average monthly family income yielded a Pearson coefficients of correlation of 0.169, 0.145 and -0.147 with p-values of 0.016, 0.040 and 0.038, respectively. These p-values are lower than the 0.05 significance level indicating significant relationships between paired variables. So, the hypotheses "there are no significant relationships between superstitious beliefs and course; religion; and average monthly family income" is rejected.

The significant relationship between superstitious belief and course is similar to the result of the study conducted by Sagone and De Caroli (2015)wherein psychology and pedagogy students were more superstitious than engineering students. On the other hand, George and Sreedhar (2006) found out that among the three religious groups in the study, Christians have least belief in superstitions, Muslims having the most and Hindus coming in between them.

In contrast, the following are the Pearson coefficients of correlation and p-values were obtained between superstitious beliefs and remaining profile variates: -0.043 and 0.548 for age; 0.046 and 0.515 for sex; 0.038 and 0.591 for school; and 0.021 and 0.0770 for family size. All the p-values are higher than the 0.05 significance level implying no significant relationships between paired variables. Hence, the hypotheses "there are no significant relationship between superstitious belief and age; sex; school; and family size" is accepted.

Sex difference had much effect on the irrational belief variables with females possessing more irrational beliefs than males (Georgeand Sreedhar, 2006).

Relationship Between Student-Respondents' *Conceptual Understanding of Force* and Motion and Personal Beliefs

The result of the correlation between student-respondents' level of conceptual understanding of force and motion and personal beliefs along beliefs towards learning physics and superstitious belief are presented below.

Beliefs towards learning Physics. Table 18 shows the results of the correlational analysis conducted between student-respondents' conceptual understanding and beliefs towards learning Physics.

Table 18

Correlation Between Student-Respondents' Conceptual Understanding of Force and Motion and Beliefs Towards Learning Physics

Variables	r_{xy}	p-value	Evaluation	Decision
Conceptual Understanding vs Belief Towards Learning Physics	0.040	0.571	NS	Accept H_o

Legend: α = 0.05; df = 198; two-tailed; S – Significant; NS – Not Significant

The result of the analysis yielded a coefficient of correlation of 0.040 with a p-value of 0.571. This p-value is greater than the stipulated 0.05 significance level indicating no significant relationship between the two variables. So, the "there is no significant relationship between student-respondents' conceptual understanding of force and motion and beliefs towards learning physics" is accepted.

Superstitious beliefs. Table 19 shows the results of the correlational analysis between student-respondents' conceptual understanding of force and motion and superstitious beliefs.

Table 19

Correlation Between Student-Respondents' Conceptual Understanding of Force and Motion and Superstitious Beliefs

Variables	r_{xy}	p-value	Evaluation	Decision
Conceptual Understanding vs Superstitious Belief	-0.198	0.005	S	Reject H_o

Legend: $\alpha = 0.05$; df = 198; two-tailed; S – Significant; NS – Not Significant

A correlation coefficient of -0.198 and *p*-value of 0.005 were obtained between the two variables. This indicates a significant relationship between the two variables because the *p*-value obtained is lower than the 0.05 significance level. Hence, the hypothesis which says "there is no significant relationship between level of conceptual understanding of force and motion and overall beliefs towards learning physics" is rejected.

This finding implies that as conceptual understanding becomes higher, the student-respondents become more rational, meaning less on superstitious belief.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of major findings, the conclusions drawn and the recommendations that were formulated based on the results of the study.

Summary of Findings

The following are the salient findings of the study:

1. About 166 or 83.0 percent of the student-respondents were 17-18 years old composed of 129 or 64.5 percent males and 37 or 18.5 percent females. This was followed by 23or 11.5 percent males and three or 1.5 percent females whose age ranges from 19-20 years old for a total of 26 or 13.0 percent. The oldest was about one or 0.5 percent who is a male with an age range of 29-30 years old.The mean age of the student-respondents was 18.19 years old with a standard deviation of 1.31 years. The females were younger than males as supported by the mean age of 18.26 years for the male group and 17.88 years for the female group.

2. One hundred fifty three or 76.5 percent of the student-respondents were BS Civil Engineering and 47 or 23.5 percent were BS Electrical Engineering.

3. The highest number of student-respondents came from Northwestern Samar State University which was 80 or 40.0 percent followed by

72 or 36.0 percent from Eastern Visayas State University and finally 48 or 24.0 percent from Samar State University.

4. About 162 or 81.0 percent of the student-respondents were Roman Catholics while 17 or 8.5 percent were Christians, 14 or 7.0 percent were Born Again, four or 2.0 percent were Baptist, two or 1.0 percent were IFI and one or 0.5 percent was affiliated with Latter Day Saints.

5. Seventy nine or 39.5 percent of the student-respondents had family size ranging from 6-7 and this was followed by 64 or 32 percent ranging from 4-5, 35 or 17.5 percent from 8-9. Seven or 3.5 percent of the student-respondents had family size of 2-3 members and 12-13 members, respectively. The mean family size was seven with a standard deviation of two members in the family.

6. Fifty or 16.4 percent of the student-respondents had average family income below Php5, 001.00. This was followed by 49 or 16.1 percent from Php20,000.00–Php15,001.00, 37 or 37.2 percent from Php10,000.00–Php5,001.00, and 30 or 16.1 percent from Php15,000.00–Php10,001.00. Twelve or 5.9 percent were earning above Php30,001.00. The lowest number of student-respondents was two or 0.7 percent whose family income was ranging from Php35,000.00–Php30,001.00.The mean family income was Php13, 035.03 and a standard deviation of Php10, 345.32.

7. Out of 200 student-respondents, 137 or 68.5 percent had "low" level of conceptual understanding corresponding to a percentage score of 21-40. Fifty

seven or 28.5 percent had "very low" level of understanding with percentage scores 1-20, and six or 3.0 percent have "moderate" level of understanding at percentage scores between 41-60. The overall level of conceptual understanding of student-respondents of force and motion was 24 interpreted as "low" conceptual understanding with standard deviation of 8.

8. Of the 22 statements to check teacher-respondents' level of understanding of force and motion, three statements obtained weighted mean ratings of 2.0 which imply "very high misconception" misconceptions among teacher-respondents in terms of level of conceptual understanding of force and motion concepts. The statements which obtained the said weighted means are statement 10 (The motion of an object is always in the direction of the net force applied to the object), statement 13 (A force is needed to keep an object moving with a constant speed) and statement 17 (An increase in force will produce an increase in speed, more of A, more of B). This was followed by six statements which obtained weighted mean ratings ranging from 1.55-1.99 interpreted as "moderate misconception" level of conceptual understanding. These were statement 5 (Things fall because you let them go, but to go up you have to push them up) a weighted mean rating of 1.88, statement 6 (An object stops because of the lack of action to keep the object going) at 1.80, statement 9 (Force is a property of an object. An object has force and when it runs out of force it stops moving) at 1.60, statement 11 (Centripetal and centrifugal forces both act on a

body moving in a circle)at 1.80, statement 15 (If an object is moving, then there must be a force in the direction of motion) at 1.60, statement 16 (Force as a kind of fuel or energy that sustains the motion but at the same time is consumed by the motion itself) at 1.60.On the other hand, six statements obtained weighted mean ratingswith ranges 1.10-1.50 interpreted as "slight misconception". These are statement 2 (An object stops moving because "the push wore off.") with weighted mean rating of 1.40, statement 3 (An object that moves has that ability to do so by itself (in-built ability to move) weighted mean of 1.40, statement 4 ("People move because they have legs" or "Bikes move because they have wheels."- a part of an object creates the motion) weighted mean of 1.40, statement 7 (The only "natural" motion is for an object to be at rest) weighted mean of 1.20, statement 21 (A force applied by, say a hand, still acts on an object after the object leaves the hand) weighted mean of 1.20, and statement 22 (An object moves up or down depending on whether either the velocity or the kinetic energy is larger or smaller than the force of gravity) with a weighted mean rating of 1.40.Seven statements yielded weighted mean ratings of 1.00 interpreted as "no misconception" of force and motion. These were statement 1(Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting upon it), statement 8 (If an object is at rest, no forces are acting on the object), statement 12 (Friction always hinders motion. Thus, you always want to eliminate friction), statement 14 (If an object is not moving, then there can be no force acting on it),statement 18 (If an object is on the ground then gravity is not acting on it, because it has already fallen to the ground.), statement 19 (Gravity is the result of air pressure) and statement 20 (Those objects that fall have more gravity than stationary objects, or gravity is not exerted upon stationary objects.)Overall, the teacher-respondents had "slight misconception" of conceptual understanding force and motion as supported by a grand mean of 1.42.

9. The following correlation coefficients and p-values were obtained between student-respondents' conceptual understanding of force and motion and profile variates: -0.161 and 0.023 with age; 0.210 and 0.003 with sex; 0.164 and 0.020; and 0.235 and 0.001 with average monthly family income. The accompanying p-values were lower than the 0.05 significance level which means significant relation between variables. So, the hypotheses "there are no significant relationship between level of conceptual understanding of force and motion and age; sex; course; and average monthly family income" was rejected. In contrast, the following coefficients of correlation and p-values were obtained from the remaining profile variates: 0.120 and 0.092 for school; 0.016 and 0.821 for religion; and 0.040 and 0.576 for family size. The p-values were higher than the 0.05 significance level implying no significant relationship between variables. The hypotheses "there are no significant relationships between student-

respondents' level of conceptual understanding of force and motion and school; religion; and family size" was accepted.

10. The comparison in conceptual understanding of force and motion of student-respondents according to course obtained a p-value of 0.019 which was lower than the 0.05 significance level in favor of the civil engineering group which means a significant difference exists. The hypothesis "there is no significant difference in conceptual understanding of force and motion between civil and electrical engineering student-respondents" was rejected.

11. In terms of school, the ANOVA result revealed a p-value of 0.423 which was higher than the 0.05 significance level implying no significant difference in conceptual understanding among student-respondents from the three schools. The hypothesis "there is no significant difference between groups and within groups" wasaccepted.

12. No significant relationship was found out between teacher-respondents'misconception and students respondents' conceptual understanding of force and motion. This was supported by the p-value of 0.72 which was greater than the 0.05 significance level. So, the hypothesis "there is no significant relationship between teacher-respondents' and student-respondents' conceptual understanding of force and motion" was accepted.

13. Out of 200 student-respondents, 105 or 52.5 percent had "uncertain" level of beliefs towards learning Physics, followed by 87 or 43.5

percent who were "moderately irrational", five or 2.5% were "moderately rational" and three or 1.5 percent had "highly irrational" level of beliefs towards learning physics. Overall, the level of beliefs towards learning Physics of student-respondents was "uncertain" as supported by a mean of 3.48 and a standard deviation of 0.47.

14. Of the 200 student-respondents, 154 or 77% were "highly rational", followed by 46 or 23.0 percent who were "moderately rational" in their superstitious beliefs. As a whole, the student-respondents were "highly rational" as revealed by a mean value of 1.27 with a standard deviation of 0.33.

15. Beliefs towards learning Physics of student-respondents yielded the following Pearson coefficients of -0.262 and 0.187 with age and school and p-values of 0.001 and 0.008, respectively. The p-values were lower than the 0.05 significance level indicating significant relationships between paired variables. So, the hypotheses "there are no significant relationships between beliefs towards learning physics and age; and school" was rejected.

16. On the one hand, the following were the Pearson coefficients of correlation and p-values between beliefs towards learning physics and remaining profile variates: 0.009 and 0.903 for sex; 0.129 and 0.069 for course; 0.060 and 0.396 for religion; -0.001 and 0.990 for family size; -0.028 and 0.692 for Average monthly family income. All the p-values were higher than the 0.05 significance level implying no significant relationships between paired variables.

Hence, the hypotheses "there are no significant relationship between belief towards learning physics and sex; course; religion; family size and average monthly family income" was accepted.

17. Student-respondents' superstitious beliefs obtained the following coefficients of correlation and p-values: 0.169 and 0.040 with course; 0.145 and 0.040 with religion; and -0.147 and 0.038 with average monthly income. These p-values were lower than the 0.05 significance level indicating significant relationships between paired variables. So, the hypotheses "there are no significant relationships between superstitious beliefs and course; religion; and average monthly family income" was rejected.

18. In contrast, the following Pearson coefficients of correlation and p-values were obtained between superstitious beliefs and remaining profile variates: -0.043 and 0.548 for age; 0.046 and 0.515 for sex; 0.038 and 0.591 for school; and 0.021 and 0.0770 for family size. All the p-values were higher than the 0.05 significance level implying no significant relationships between paired variables. Hence, the hypotheses "there are no significant relationship between superstitious belief and age; sex; school; and family size" was accepted.

19. The result of the analysis between student-respondents' conceptual understanding of force and motion yielded a coefficient of correlation of 0.040 with a p-value of 0.571 with beliefs towards learning Physics. The p-value obtained was greater than the stipulated 0.05 significance level indicating no

significant relationship between the two variables. So, the "there is no significant relationship between student-respondents' conceptual understanding of force and motion and beliefs towards learning physics" was accepted.

20. A correlation coefficient of -0.198 and p-value of 0.005 were obtained between student-respondents' conceptual understanding of force and motion and superstitious beliefs implying a significant relationship between the two variables because the p-value obtained was lower than the 0.05 significance level. Hence, the hypothesis which says "there is no significant relationship between student-respondents' conceptual understanding of force and motion and superstitious beliefs.

Conclusions

The following are the conclusions derived from the findings enumerated above.

1. Majority of the student-respondents are 17-18 years old males, taking up civil engineering, enrolled at Northwestern Samar State University, Roman Catholic, and parents earning on average monthly family income at Php20,000.00-Php15,000.00.

2. Overall, the teacher-respondents had slight misconception of conceptual understanding of force and motion.

3. Student-respondents' conceptual understanding of force and motion was significantly related with age; sex; and average monthly family income but not with school; religion; and family size.

4. There was no significant difference in conceptual understanding of force and motion between civil and electrical engineering student-respondents.

5. There was no significant difference in conceptual understanding according to school.

6. Student-respondents' conceptual understanding and teachers' misconception of force and motion were not significantly related.

7. Overall, the level of beliefs towards learning Physics of student-respondents was uncertain.

8. As a whole, the student-respondents were highly rational in their superstitious beliefs.

9. Student-respondents' beliefs towards learning Physics was significantly related to their age; and school; but not with sex; course; religion; family size and average monthly family income.

10. Student-respondents' superstitious belief was significantly related to course; religion; and average monthly family income but nor with age; sex; school; and family size" was accepted.

11. There was no significant relationship between student-respondents' conceptual understanding of force and motion and beliefs towards learning physics.

12. There was significant relationship between student-respondents' conceptual understanding of force and motion and superstitious belief.

Recommendations

The following are the recommendations of the study based on the conclusions above.

1. Physics professors should improve their content knowledge about force and motion through pursuing graduate degree in Physics.

2. Physics educators should endeavor to relate physics more closely to the learners' societal or cultural environment so as to minimize the conflictsthat might arise from the student views of the world and that of science.

3. Science educators, engineering educators, social researchers and others should do a survey to establish how widespread and deepseated the belief in superstition since it would be helpful as a first stepin the direction of eradicating this social hindrance in learning.

4. It is suggested that this study be replicated in other schools and other degree programs so as to have a wider perspective on conceptual understanding of force and motion; beliefs toward learning physics, and superstitious beliefs.

BIBLIOGRAPHY

A. BOOKS

Handy, M. (2008). Cautionary notes on the appeal of the new 'ism" (constructivism) in science education. In K.G. Tobin (Ed), *The practice of constructivism in science education*. Washington, DC: AAAS Press.

Hofer, B. and Pintrich, P. (2002). *Personal Epistemology: The Psychology of Beliefs about Knowledge and Knowing*. New Jersey: Lawrence Erlbaum Associates, Mahwah.

Inglehart, R. (2008). Cultural Evolution in Advanced Societies. Tehran: Kavir Press.

Giancoli, D. (2014). Physics: Principles with Applications. 7th Ed. New York: Pearson, Inc.

Karl, F. (2010). The importance of specific science content in the enhancement of metacognition. In P. Fensham, R. Gunstone, & R. White (Eds.), *The content of science: A constructivist approach to its teaching and learning*. London: Falmer Press.

Park, R. (2008). Superstition: Belief in the Age of Science. University of Maryland. Princeton University Press.

Santrock, J. (2011). Educational Psychology. 5th Ed., New York: McGraw-Hill, Inc.

Schoen, A. (2005). Learning to think mathematically: Problem solving, metacognition, and sense-making in mathematics, In D. A. Grouws (Ed.), *Handbook of Research in Mathematics TEaching and Learning*. New York: MacMillan.

Sinelli, R. (2010), Sustainable Science: A look at science through historic eyes and through the eyes of indigenous peoples. In S. Abell (Ed.) Science teacher education: An international perspective. Boston: Kluwer Academic Publishers.

Troban, M. (2006). Cultural perspectives on science education. In M. Ogawa (Ed.) Traditional culture, science & technology, and development: Towards a new literacy for science and technology. (pp. 75-99. Tokyo Institute of Technology, Japan.

Yamane, T. (1967). Statistics: An Introductory Analysis. 2nd Ed., New York: Harper and Row

Young, H., Freedman, R., and Lewis Ford, A. (2012). Sear and Zemanky's University Physics with Modern Application. 13th Ed. New York: Addison-Wesley.

B. JOURNALS/PUBLICATION/PERIODICALS

Albert, R. (2010). Relationship between Beliefs in Superstitions and other Factors. Journal of Educational Research 38(8), 101-108.

Aguirre, J. (2008). Student Preconceptions about Vector Kinematics. The Physics Teacher, 212-216.

Azman, N., Alia, M. and Mohtar, L. (2013). The Level Misconceptions on Force and Motion among Physics Pre-Services Teachers in UPSI. 2nd *International Seminar on Quality and Affordable Education (ISQAE 2013)*

Beck, J. and Forstmeier, W. (2007). Superstitions and Belief as inevitable by-products of an adaptive learning strategy. *Human Nature*, 18(1), 35-46.

Berthold, K. and Renkl, A. (2009). Instructional aids to support a conceptual understanding of multiple representations. *Journal of Educational Psychology,* 101, 70-87. doi:10.1037/a0013247.

Carey, S. (2005). An experiment is when you try it and see if it works: A study of grade 7 students' understanding of the construction of scientific knowledge. *International Journal of Science Education*, 11, 514-529.

Chin, H. (2007). Learning physics vs. passing courses. *Physics Teacher*, 20(3), 151-157.

Chiu, C. (1997). Lay Dispositionism and Personal Beliefs. *Journals of Personality and Social Psychology*. 73.19-30.

Chu, H., Treagust, D., and Chandrasegaran, A. (2008). Naive Students' Conceptual Development and Beliefs: The Need for Multiple Analyses to Determine What Contributes to Student Success in a University Introductory Physics Course. *Research in Science Education,* 38(1), 111-125.

Clement, J. 91982). Students' preconceptions in introductory mechanics. *American Journal of Physics,* 50(1), 66-71.

Colburb, A. (2010). Constructivism: Science education's grand unifying theory". *The Clearing House,* 9-12.

Dalagan, A.M. and Mistades, V. (2010). Students' Beliefs and Attitudes Toward Learning in the Physics Component of the Lasallian (General education) Core Curriculum. *KBM Journal of Science Education*. 1(1): 1-6

Doran, A. (2009). The Effect of Traditional Lecturing on Students' Misconceptions in a Mechanics Course. Education and Science, 269122), 72-77.

Eryilmaz, A. (2012). Effects of Conceptual Assignments and Conceptual Change Discussion on Students' Misconceptions and Achievement Regarding Force and Motion. *Journal of Research in Science Teaching,* 39(10), 1001-1015.

Feinstein, W. (2011). The Assessment of Scientific Literacy in the PISA Project. Studies in Education. 36, 79-104.

George, S. and Sreedhar, K. (2006). Globalisation and the Prevalence of Superstitious Beliefs. *Journal of the Indian Academy of Applied Psychology,* Vol. 32. No.3, 241-247.

Gonzales, P. (2004, December). *Highlights from the Trends in International Mathematics and Science Study (TIMSS) 2003*. Washington, DC: National Center for Educational Statistics.

Gray, K., Admas, W., Wieman, C., and Perskins, K. (2008). Students know what Physicists believe, but they don't agree: A study using the CLASS survey. *Physics Education Research.* 4(2), 1-10.

Gunstone, G. (2011), Constructivist perspectives on science learning. *Science Education*, 75(1), 9-21.

Halloun, I. (1998). Schematic concepts for schematic models of the real world: The Newtonian concept of force. *Science Education*, 82, 239-263.

Halloun, I. and Hestenes D. (2005). The initial knowledge state of college physics students. *American Journal of Physics*, 53(11), 1043-1048.

Hestenes, D., Wells, M., and Swackhamer, G. (1992). Force Concept Inventory. *The Physics Teacher,* Vol. 30, 141-158.

Hewson, M. and Hewson, P. (2003). Effect of Instruction Using Students' Prior Knowledge and Conceptual Change Strategies on Science Learning. *Journal of Research in Science Teaching,* 40, Supplement, 86-98.

Hofer, B. and Pintrich, P. (2007). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. Review of educational research, 67(1), 88-140

Jegede, O. and Okebukola, P. (1991). The relationship between African traditional cosmology and students' acquisition of a science process skill. *International Journal of Science Education* , 13, 37-47.

Khashei, H. (2009). Psychological Bases of Superstition. *Pilgrim Journal.* No. 79, 21-26.

Kikas, E. (2004). Teachers' conceptions and misconceptions concerning three natural phenomena. *Journal of Research in Science Teaching,* 41(5),. 432-448.

Kortemeyer, G. (2007). Correlations between student discussion behavior, attitudes, and learning. *Physical Review Special Topics - Physics Education Research,* 3(1), 1-8.

Mahr, M. (2006). Is Religious Education Compatible with Science Education? *Science and Education,* 3, 357.

Martini, E. (2008). Pseudoscience, Paranormal, and Science Education. S*cience and Education*, 3, 357.

McDermott, L. (2008). Research on conceptual understanding in mechanics. Physics Today, 37, 24-32.

Mistades, V. M. (2007). Exploring business students' and liberal arts students' beliefs about physics and physics learning. *Asia Pacific Education Review,* 8(1), 100-106.

Narjaikkaew, P. (2013). Aleternative Conception of Primary School Teachers of Science About Force and Motion. Procedia - Social and Behavioral Sciences. Volume 88, 250-257.

O'Shea, M.J. (2004). Snowboard humping, Newton's second law and the force of standing. *Physics Education*, 39(4), 335-341.

Riley, M.J. (2004). International Development and Science Education: Issues and Considerations. CICE Hiroshima University. J*ournal of International Cooperation in Education,* Vol. 4 No. 1 (2001) pp. 53-63.

Sagone, E. and De Caroli, M. (2015). Beliefs About Superstition And Luck In External Believers University Students. Procedia - Social and Behavioral Sciences 191, 366-371.

Sancar, N. (2009). Concepts in Force and Motion. The Physics Teacher. 530-533.

Songer, N. (2006). How do students' views of science influence knowledge integration? *Journal of Research in Science Teaching,* 28(9), 761-784.

Undie, Josephine, Duruamaku, and Agba, Rose. (2015). Superstitious Beliefs and Academic Performance of Pupils in Early Childhood Science. *British Journal of Education.* Vol. 3, No. 11, pp. 54-62.

Weiner, B. (2011). Ultimate and proximal determinants of motivation given an attribution perspective and the metaphors guiding attribution theory. Probing the neural basis off superstition. *Journal of Applied Social Psychology,* 36(10), 2532-2533.

White, R. (2008). Science teaching and the development of reasoning [Special issue]. *Journal of Research in Science Teaching,* 40 (Supplementent), S51-S57. (Original work published in 1977).

Young, E. (2009). Effects of Gender, Cognitive Development and Socioeconomic Status on Physics Achievement. *Journal of Research in Science Teaching,* 32(4), 387-398.

Yen, F. (2009). Gender Differences in Students' Experiences, Interests, and Attitudes Towards Physics. Science Education. 84, 180-192.

C. UNPUBLISHED MATERIALS

Abdal-Razzaq, H. (2014). "To What Extent Do Engineering Students Master and Retain an Understanding of Newtonian Mechanics Throughout Their University Life". Unpublished Doctoral Dissertation. Easter Mediterranean University, Gazimagusa, North Cyprus.

Adewara, Mary Oladunni. "Scientific Explanations and Educational Implications of Superstitious Beliefs Held by Ijara-isin People of Kwara State, Nigeria ". Unpublished Master's Thesis. University of Ilorin, 2012.

Campbell, Meggann. "The Effects of the 5E Learning Cycle Model on Students' Understanding of Force and Motion". Unpublished Master's Thesis. University of Central Florida, Orlando, Florida, 2006.

Crouch, Issac. "On the Effect of Virtual Reality on Student Understanding of and Interest in Physics". Unpublished Master's Thesis. Michigan Technological University, 2014

Lark, Adam. "Student Misconceptions in Newtonian Mechanics". Unpublished Master's Thesis. Bowling Green State University, 2007.

Pablico, Jane. "Misconceptions of Force and Gravity Among High School Students". Unpublished Master's Thesis. Louisiana State University, 2010.

Sinapuelas, Michelle Leigh. "Why do some students struggle while others succeed in chemistry? A study of the influence of undergraduate student beliefs, perceptions, and use of resources on performance in introductory chemistry?" Unpublished Doctoral Dissertation. University of California, Berkeley, 2011.

Stecklein, Jason Jeffrey. "Effects of Interactive Technology, Teacher Scaffolding and Feedback on University Students' Conceptual Development in Motion and Force Concepts". Unpublished Doctoral Dissertation". University of Iowa, 2014

Underwood, John Arthur. "Do Learning Logs Have an Impact on the Conceptual Mastery of Force and Motion?" Unpublished Master's Thesis. Louisiana State University and Agricultural and Mechanical College, 2012.

Yuruk, Nejla. "An Analysis of the Nature of Student's Metaconceptual Processes and the Effectiveness of Metaconceptual Teaching Practices on Students' Conceptual Understanding of Force and Motion". Unpublished Doctoral Dissertation. Ohio State University, 2005.

D. OTHER SOURCES

American Association of University Educational Foundation (AAUEF). (2010). How Schools Shortchange girls: A study of major findings on girls and education. Washington, DC: American Association of University Women

National Headquarters. Retrieved October 2, 2015 from http://www.enc.org/topics/equity/articles/

Azman, N., Alia, M., and Mohtar, L. (2013). The Level of Misconceptions on Force and Motion among Physics Pre-Services teachers in UPSI. 2nd International Seminar on Quality and Affordable Education (ISQAE 2013).

Carballo, A. (2009). Analyzing the Status of Math and Science Education. Growth Revolution Magazine. Retrieved January 29, 2016 from https://growthrevolutionmag.wordpress.com/2009/09/22/educationanalyzing-the-status-of-math-science-education/

Darling, G. (2012). How Does Force Affects Motion. Science and Children. Pp. 20-53. Retrieved September 10, 2015 from http://eric.ed.gov/?id=EJ1001643

Educating Engineers to Drive the Innovation Economy. (2012). The Royal Academy of Engineering (RAE). London. Retrieved January 29, 2016 from www.raeng.org.uk/innovationeconomy.

Flynn, C., Davidson, C., and Dotger, S. (2014). Engineering Student Misconceptions about rate and Accumulation Processes. ASEE 2014 Zone 1 Conference, April 3-5, 2014, University of Bridgeport, Bridgeport, CT, USA.

George, H. (2008). *On Superstition.* Retrieved February 1, 2016 from www.randi.org/site/index.php/swift-blog/330-on-superstition.html

Halloun, I., Hake, R., Mosca, E., and Hestenes, D. (1995). Force Concept Inventory (revised 1995) and password protected at http://modeling.html.

Lawsoon, M. and Askell-Williams, H. (April, 2007). Outcomes-Based Education. Discussion paper. Prepared for the Associations of Independent Schools of SA. Centre for the Analysis of Educational Futures, Flinders University. Retrieved October 13, 2015 from https://www.ied.edu.hk/obl/files/practical_guide_5.pdf

Martin-Blas, T., Seidelb, L., and Serrano-Fernandeza, A. (2010). Enhancing Force Concept Inventory diagnostics to identify dominant misconceptions in first year engineering physics. DOI: 10.1080/03043797.2010.497552. Retrieved September 12, 2015 from http://www.informaworld.com

Office of the Prime Minister's Science Advisory Committee (OPMSAC). (2011). Looking Ahead: Science Education for the Twenty-First Century. A report from the Prime Minister's Chief Science Advisor. Auckland 1150, New Zealand. Retrieved October 4, 2015 from http://www.pmcsa.org.nz/wp-content/uploads/looking-ahead-Science-education-for-the-twenty-first-century.pdf

Redish, E., Saul, J., and Steinberg, R. (2008). Student Expectations in Introductory Physics. Retrieved November 24, 2015 from http://www.physics.umd.edu/perg/papers/redish/experts.pdf

Rohana Mohd. Atan and Shaharom Noordin (2008). Relationship between Practical Work Culture and Achievement of Students in Form 4 Force Concept. *Proceedings of the National Science & Mathematics education Seminar*. 11-12 October. Universiti Teknologi Malaysia, Skudai. 1-10.

Science Clarified. 92015). From Parlor Tricks to Space Ships. retrieved October 2, 2015 from http://www.scienceclarified.com/everyday/Real-Life-Chemistry-Vol-3-Physics-Vol-1/Laws-of-Motion-Real-life-applications.html

Sincero, S. (2011). What is Social Learning Theory? Retrieved February 2, 2016 from Experiment Resources: http://www.experiment-resources.com/social-learning-theory.html

The LawPhil Project. (n.d.). Philippine Country Report: EFA 1990-2015. Retrieved october 2, 2015 from http://www.unesco.gov.ph/content/article/Philippine%20Country%20Report%20EFA%201990-2015

APPENDICES

APPENDIX A

LETTERS TO SUC PRESIDENTS

Republic of the Philippines
SAMAR STATE UNIVERSITY
College of Graduate Studies
Catbalogan City

February 2, 2016

DR. AVELINA N. BERGADO
University President
Northwestern Samar State University
Calbayog City, Samar

ATTENTION: ROMEO B. SANTOS, ME
Dean, College of Engineering and Technology
Northwestern Samar State University

Sir:

The undersigned is a graduate student of Samar State University, Catbalogan City. He is presently conducting a research study entitled "COLLEGE STUDENTS' KNOWLEDGE OF FORCE AND MOTION AND BELIEFS TOWARDS LEARNING PHYSICS."

In this regard, he would like to ask permission from your good office to allow him to conduct a pilot testing of the study's research instrument among the Physics professors for validation and data collection purposes from Civil and Electrical Engineering students. The data which will be gathered will be held confidential.

Hoping for your favorable approval and accommodation on this request.

Respectfully yours,

NICOLAS O. BOCO, JR.
Researcher

Recommending Approval:

ROMEO B. SANTOS, ME
Dean, College of Engineering and Technology

Approved:

AVELINA N. BERGADO, Ed. D.
University President

APPENDIX B

LETTERS TO SUC PRESIDENTS

X.16.02.04.X214.NOB

VISAYAS STATE UNIV.
02.04.16
DATE
RECEIVED
BY: 9:25
RECORDS OFFICE

Republic of the Philippines
SAMAR STATE UNIVERSITY
College of Graduate Studies
Catbalogan City, Samar

February 3, 2016

OAX021601C

DOMINADOR O. AGUIRRE JR, D.M.
University President
Eastern Visayas State University
Tacloban City

Sir:

The undersigned is a graduate student of Samar State University, Catbalogan City. He is conducting a research study entitled "COLLEGE STUDENTS' KNOWLEDGE OF FORCE AND MOTION AND BELIEFS TOWARDS LEARNING PHYSICS."

In this regard, the undersigned would like to ask permission from your good office to allow him to field his questionnaire for the data gathering in connection to the research mentioned above. This will include Physics professors and Second year Civil and Electrical Engineering students from the College of Engineering. The data which will be gathered will be held confidential.

Hoping for your favorable approval and accommodation on this request.

Respectfully yours,

NICOLAS O. BOCO, JR.
Researcher
09077007306

Noted:

MARILYN D. CARDOSO, Ph. D.
Dean, College of Graduate Studies

Approved:

DOMINADOR O. AGUIRRE JR. D.M.
University President

APPENDIX C

LETTERS TO SUC PRESIDENTS

Republic of the Philippines
SAMARSTATEUNIVERSITY
College of Graduate Studies
CatbaloganCity, Samar

February 3, 2016

EUSEBIO T. PACOLOR Ph.D.
University President
Samar State University
Catbalogan City, Samar

Sir:

The undersigned is a graduate student of Samar State University, Catbalogan City. He is conducting a research study entitled "COLLEGE STUDENTS' KNOWLEDGE OF FORCE AND MOTION AND BELIEFS TOWARDS LEARNING PHYSICS."

In this regard, the undersigned would like to ask permission from your good office to allow him to field his questionnaire for the data gathering in connection to the research mentioned above. This will include Physics professors and Second year Civil and Electrical Engineering students from the College of Engineering. The data which will be gatheredwill be held confidential.

Hoping for your favorable approval and accommodation on this request.

Respectfully yours,

NICOLAS O. BOCO, JR.
Researcher

Noted:

MARILYN D. CARDOSO, Ph. D.
Dean, College of Graduate Studies

Approved:

EUSEBIO T. PACOLOR, Ph.D.
University President

APPENDIX D

QUESTIONNAIRE FOR STUDENTS

Republic of the Philippines
SAMAR STATE UNIVERSITY
COLLEGE OF GRADUATE STUDIES
Catbalogan City

Dear Respondents:

Mabuhay!

The undersigned is presently conducting a study entitled "**ENGINEERING STUDENTS' CONCEPTUAL UNDERSTANDING OF FORCE AND MOTION AND PERSONAL BELIEFS**" as a requirement to complete my degree leading to Master of Arts in Teaching Physics at the Samar State University (SSU), Catbalogan City, Samar.

In this connection, may I seek your help to answer the attached questionnaire with honesty and sincerity. Rest assured that your responses will be treated with confidentiality for the purpose of this research endeavor.

Thank you very much.

Very truly yours,

NICOLAS O. BOCO, JR.
Researcher

PART 1. PERSONAL INFORMATION

Direction: Kindly supply with the information asked from you in the space provided or by putting a check mark (√) where it is needed.

Name: ______________________________
(Optional)

1. Age: _______ 2. Sex: [ ] Male [ ] Female

3. Course: [ ] Civil Engineering [ ] Electrical Engineering

4. School: [ ] SSU [ ] EVSU [ ] NwSSU

5. Religion: ____________________________________

6. Family size: _______

7. Average monthly family income: Php ____________________

PART II. BELIEFS TOWARDS LEARNING PHYSICS

Direction: Kindly describe on how you agree or disagree to the belief statements below by checking (√) opposite each statement using the following scales:

5=Strongly Agree
4=Moderately Agree
3=Uncertain
2=Moderately Disagree
1=Strongly Disagree

Belief Statements	5	4	3	2	1
1. Learning physics changes my ideas about how the world works.					
2. I think about the physics I experience in everyday life.					
3. I am not satisfied until I understand why something works the way it does.					
4. After I study a topic in physics and feel that I understand it, I have difficulty solving problems on the same topic.					
5. If I don't remember a particular equation needed to solve a problem on an exam, there's nothing much I can do (legally!) to come up with it.					

6. I enjoy solving physics problems.					
7. I can usually figure out a way to solve physics problems.					
8. If I get stuck on a physics problem, there is no chance I'll figure it out on my own.					
9. To understand physics, I sometimes think about my personal experiences and relate them to the topic being analyzed.					
10. Nearly everyone is capable of understanding physics if they work at it.					
11. I study physics to learn knowledge that will be useful in my life outside of school.					

PART III. SUPERSTITIOUS BELIEFS

Direction: Kindly describe on how you agree or disagree to the belief statements below by checking (√) opposite each statement using the following scales:

5=Strongly Agree
4=Moderately Agree
3=Uncertain
2=Moderately Disagree
1=Strongly Disagree

Belief Statements	5	4	3	2	1
1. While number 7 and 11 bring good luck, number 13 is never used as an address number, the number of a story in a building, or seat number in an airplane.					
2. To make a house typhoon-resistant, the posts should be turned clockwise before being permanently cemented and secured.					
3. The foundation of a post should be bathed with the blood of a pig or white chicken to appease the spirits presiding on the land on which the house was erected.					
4. An injury to a construction worker while a house or building is being erected is an omen of bad luck that can be neutralized by killing a pig or a white chicken and sacrificing its blood to the spirits.					
5. During thunder storm all mirrors in the house should be covered to avoid being struck by lightning.					

6. A mirror placed on the wall facing the main door of a house will deflect good luck that enters the house.					
7. Palm fronds consecrated by a priest are placed in the different corners of the house to prevent the entry of evil spirits.					
8. For those living in concrete houses, an old coin must be imprinted on the cemented doorstep to ensure a steady flow of money.					
9. Another popular house-building practice is the cornerstone laying ritual of burying coins under the posts of a house being erected to attract prosperity and good luck					

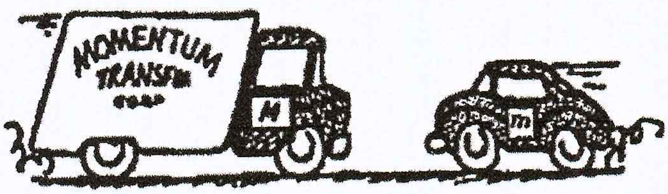
PART IV. FORCE AND MOTION KNOWLEDGE TEST

Direction: This test is intended to measure your knowledge of force and motion concepts. Each item has five choices. Kindly write on the answer sheet provided the letter which corresponds to the best answer.

1. Two metal balls are the same size, but one weighs twice as much as the other. The balls are dropped from the top of a two story building at the same instant of time. The time it takes the two balls to reach the ground below will be:

   A. about half as long for the heavier ball.
   B. about half as long for the lighter ball.
   C. about the same time for both balls.
   D. considerably less for the heavier ball, but not necessarily half as long.
   E. considerably less for the lighter ball, but not necessarily half as long.

2. Imagine a head-on collision between a large truck and a small compact car shown below.



   During the collision,

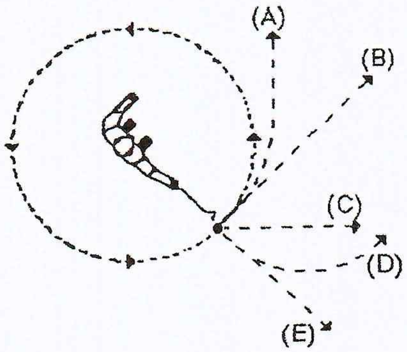
   A. the truck exerts a greater amount of force on the car than the car exerts on the truck.

B. the car exerts a greater amount of force on the truck than the truck exerts on the car.
C. neither exerts a force on the other, the car gets smashed simply because it gets in the way of the truck.
D. the truck exerts a force on the car but the car does not exert a force on the truck.
E. the truck exerts the same amount of force on the car as the car exerts on the truck.

3. Two balls, one of which weighs twice as much as the other, roll of a horizontal table with the same speeds. In this situation:

A. both balls impact the floor approximately the same horizontal distance from the base of the table.
B. the heavier ball impacts the floor at about half of the horizontal distance from the base of the table than does the lighter ball.
C. the lighter ball impacts the floor at about half the horizontal distance from the base of the table than does the heavier ball.
D. the heavier ball hits considerably closer to the base of the table than the lighter ball, but not necessarily half the horizontal distance.
E. the lighter ball hits considerably closer to the base of the table than the heavier ball, but not necessarily half the horizontal distance.

4. A heavy ball is attached to a string and swung in a circular path in a horizontal plane as illustrated in the diagram to the right. At the point indicated in the diagram, the string suddenly breaks at the ball. If these events were observed from directly above, indicate the path of the ball after the string breaks.



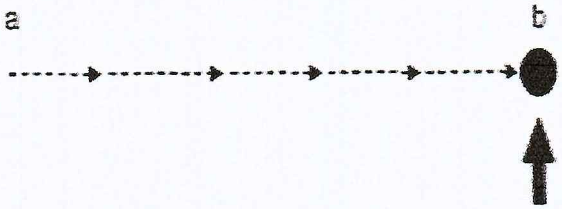
5. A boy throws a coin straight up. Disregarding any effects of air resistance, the force(s) acting on the coin until it returns to the ground is (are):

A. directed vertically downward along with a steadily decreasing upward force.
B. a steadily decreasing upward force from the moment it leaves the hand until it reaches its highest point beyond which there is a steadily increasing downward force of gravity as the object gets closer to the earth.

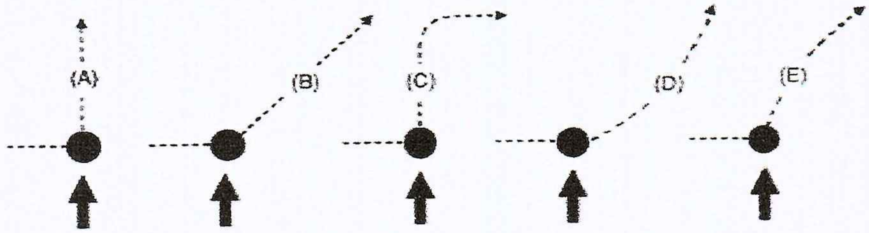
C. a constant downward force of gravity along with an upward force that steadily decreases until the coin reaches its highest point, after which there is only the constant downward force of gravity.
D. a constant downward force of gravity only.
E. none of the above, the coin falls back down to the earth simply because that is its natural action.

- **Use the statement and diagram below to answer questions 6-9.**

The diagram depicts a hockey puck sliding, with a **constant velocity**, from point "a" to point "b" along a **frictionless horizontal surface**. When the puck reaches point "b", it receives an instantaneous vertical "kick" in the direction of the heavy print arrow.



6. Along which of the paths below will the hockey puck move after receiving the "kick"?



7. The speed of the puck just **after** it receives the "kick"?

A. Equal to the initial speed (v_o) it had before it received the "kick"
B. Equal to the speed (v) it acquires from the "kick", and independent of the initial speed (v_o).
C. Equal to the arithmetic sum of speeds "v_o" and "v"
D. Smaller than either of speeds "v_o" or "v"
E. Greater than either of speeds "v_o" or "v", but smaller than the arithmetic sum of these two speeds.

8. Along the **frictionless** path you have chosen, how does the speed of the puck vary **after** receiving the "kick".

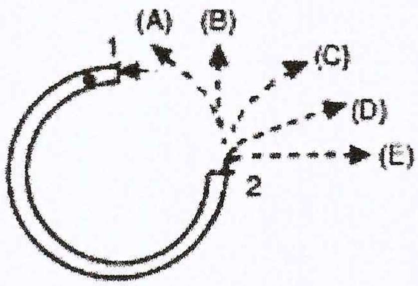
A. No change.

B. Continuously increasing.
C. Continuously decreasing
D. Increasing for a while, and decreasing thereafter
E. Constant for a while, and decreasing thereafter.

9. The main forces acting, **after** the "kick", on the puck along the path you have chosen are:

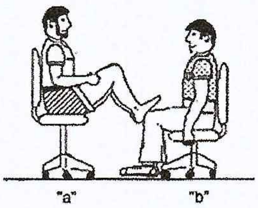
A. The downward force due to gravity and the effect of air pressure.
B. The downward force of gravity and the horizontal force of momentum in the direction of motion
C. The downward force of gravity, the upward force exerted by the table, and a horizontal force acting on the puck in the direction of motion.
D. The downward for of gravity and an upward force exerted on the puck by the table.
E. Gravity does not exert a force on the puck, it falls because of the intrinsic tendency of the object to fall to its natural place.

10. The accompanying diagram depicts a semicircular channel that has been securely attached, in a horizontal plane to a table top. A ball enters the channel at "1" and exists at "2". Which of the path representations would most nearly correspond to the path of the ball as it exists the channel at "2" and rolls across the table top.



11. Two students, student "a" who has a mass of 95 kg and student "b" who has a mass of 77 kg sit in identical office chairs facing each other. Student "a" places his bare feet on student "b's" knees as shown below. Student "a" then suddenly pushes forward with his feet, causing both chairs to move. In this situation,

A. neither student exerts a force on each other.
B. student "a" exerts a force on "b", but "b" does not exert any force on "a".
C. each student exerts a force on the other but "b" exerts the larger force.
D. each student exerts a force on the other but "a" exerts the larger force.
E. each student exerts the same amount of force on the other.



12. A book is at rest on top of a table. Which of the following force(s) is (are) acting on the book?

I. A downward force due to gravity.
II. The upward force by the table.
III. A net downward force due to air pressure.
IV. A net upward force due to air pressure.

A. I only
B. I and II
C. I. II. and III
D. I, II, and IV
E. none of these, since the book is at rest there are no forces acting on it.

- **Refer to the following statement and diagram while answering questions 13 and 14.**

A large truck breaks down out on the road and receives a push back into town by a small compact car.

13. While the car, still pushing the truck, is **speeding up** to get up to cruising speed;
   A. the amount of force of the car pushing against the truck is equal to that of the truck pushing back against the car.
   B. the amount of force of the car pushing against the truck is less than that of the truck pushing back against the car.
   C. the amount of force of the car pushing against the truck is greater than that of the truck pushing against the car.
   D. the car's engine is running so it applies a force as it pushes against the truck but the truck's engine is not running so it cannot push back against the car, the truck is pushed forward simply because it is in the way of the car.
   E. neither the car nor the truck exert any force any force on the other, the truck is pushed forward simply because it is in the way of the car.

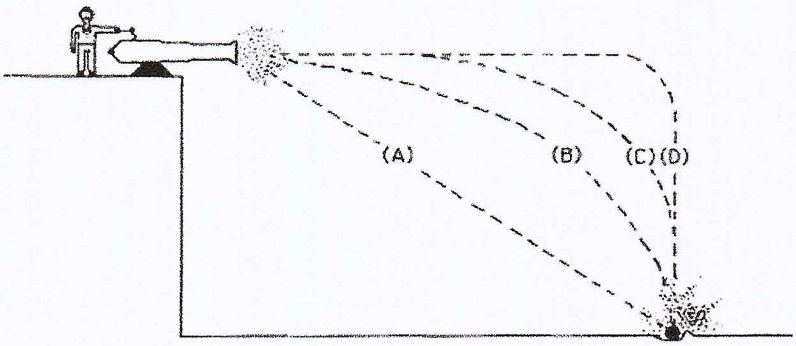
14. After the person in the car, while pushing the truck, reaches the cruising speed at which he/she wishes to continue to travel at a constant speed:

A. The amount of force of the car pushing against the truck is equal to that of the truck pushing back against the car.
B. The amount of force of the car pushing against the truck is less than that of the truck pushing back against the car.
C. The amount of force of the car pushing against the truck is greater than that of the truck pushing against the car.
D. The car's engine is running so it applies a force as it pushes against the truck but the trucks engine is not running so it cannot push back against the car, the truck is pushed forward simply because it is in the way of the car.
E. Neither the car nor the truck exert any force on the other, the truck is pushed forward simply because it is in the way of the car.

15. When a rubber ball dropped from rest bounces off the floor, its direction of motion is reversed because;

A. Energy of the ball is conserved.
B. Momentum of the ball is conserved
C. The floor exerts a force on the ball that stops its fall and then drives it upward.
D. The floor is in the way and the ball has to keep moving.
E. None of these.

16. Which of the following indicated paths in the diagram best represents the path of the cannon ball?



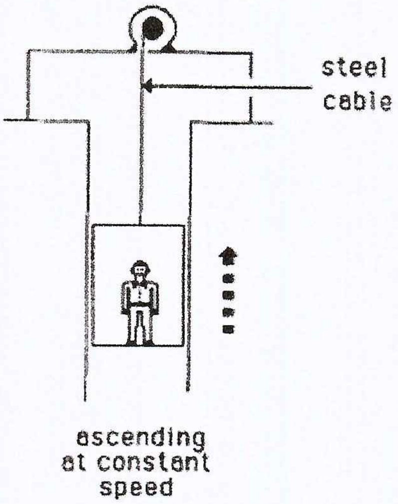
17. A stone falling from the roof of a single story building to the surface of the earth,

A. Reaches its maximum speed quite soon after release and then falls at a constant speed thereafter.

B. Speeds up as it falls, primarily because the closer the stone gets to the earth, the stronger the gravitational attraction.
C. Speeds up because of the constant gravitational force acting on it.
D. Falls because of the intrinsic tendency of all objects to fall forward the earth.
E. Falls because of a combination of the force of gravity and the air pressure pushing it downward.

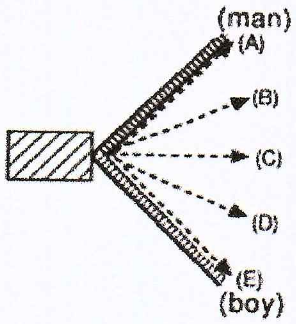
- **When responding to question 18 refer to the figure below and assume that any <u>frictional forces</u> due to air resistance are so small that they <u>can be ignored</u>.**

18. An elevator, as illustrated below, is being lifted up an elevator shaft by a steel cable. When the elevator is moving up the shaft at a **<u>constant velocity</u>**;



A. The upward force on the elevator by the cable is greater than the downward force of gravity.
B. The amount of upward force on the elevator by the cables equal to that of the downward force of gravity.
C. The upward force on the elevator by the cable is less than the downward force of gravity.
D. It goes up because the cable is being shortened, not because of the force being exerted on the elevator by the cable.
E. The upward force on the elevator by the cable is greater than the downward force due to the combined effects of air pressure and the force of gravity.

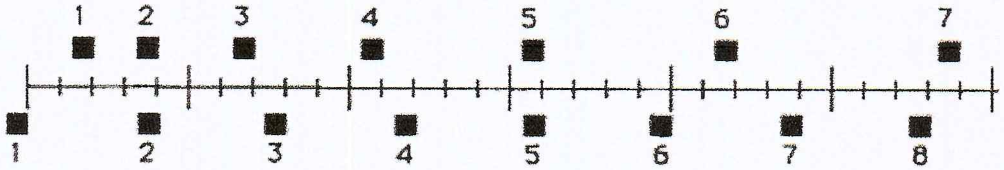
19. Two persons, a large man and a boy, are pulling as hard as they can on two ropes attached to a crate as illustrated in the diagram below.



Which of the indicated paths (A-E) would most likely correspond to the path of the crate as they pull it along?

- **When responding to questions 20-21, refer to the statements and figures below.**

The positions of two blocks at successive 0.20 second time intervals are represented by the numbered squares in the diagram below. The blocks are moving to the right.



20. Do the blocks ever have the same speed?

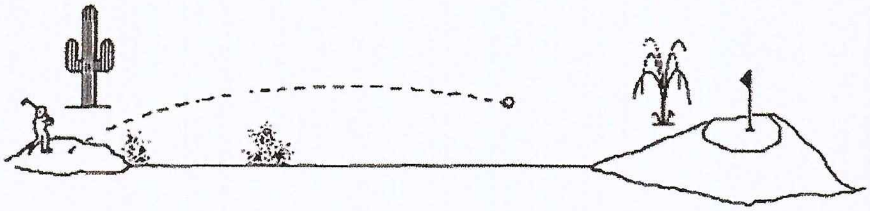
A. No
B. Yes, at instant 2

20. Those objects that fall have more gravity than stationary objects, or gravity is not exerted upon stationary objects.			
21. A force applied by, say a hand, still acts on an object after the			

21. The acceleration of the blocks are related as follows:

A. Acceleration of "a" is greater than the acceleration of "b".
B. Acceleration of "a" is equal to the acceleration of "b" but greater than 0.
C. Acceleration of "b" greater than the acceleration of "a".
D. Acceleration of "a" is equal to the acceleration of "b" but equal to 0.
E. Not enough information to answer.

22. A golf ball driven down a fairway is observed to travel through the air with a trajectory (flight path) similar to that in the depiction below.

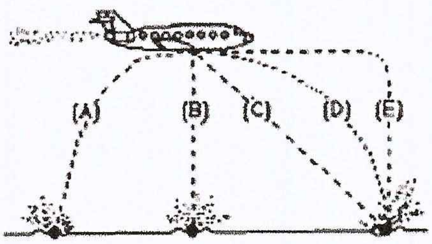


Which of the following force(s) is (are) acting on the golf ball during its entire flight?

I. The force of gravity
II. The force of the "hit"
III. The force of air resistance

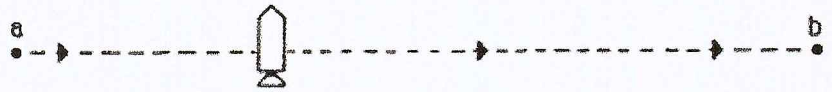
A. I only
B. I and II
C. I, II and III
D. I and III
E. II and III

23. A bowling ball accidently falls out of the cargo bay of an airliner as it flies along a horizontal direction. As seen from the ground, which indicated path would the bowling ball most closely follow after leaving the airplane?

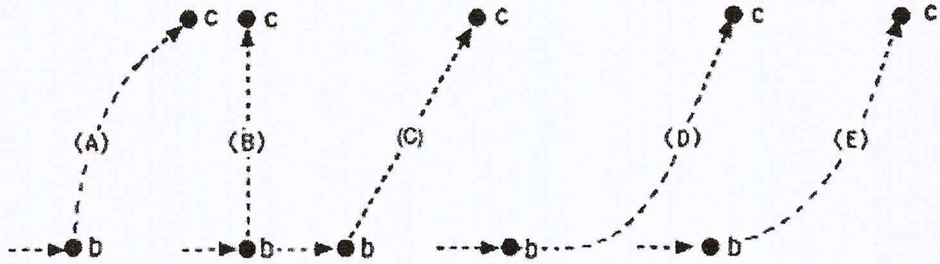


- **When answering questions 24, 25, 26 and 27, refer to the following statement and diagrams below.**

A rocket, drifting sideways in outer space from position "a" to position "b". Is subject to no outside forces. At "b", the rocket's engine starts to produce a constant thrust at right angles to line "ab". The engine turns off again as the rocket reaches some point "c".



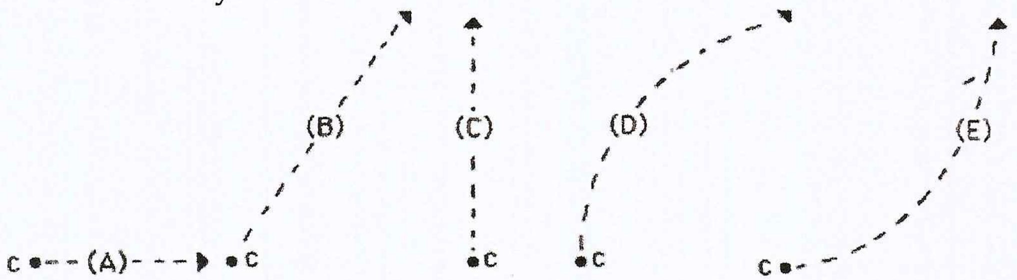
24. Which indicated path below best represents the path of the rocket between "b" and "c"?



25. As the rocket moves from "b" to "c", its <u>speed</u> is

A. Constant
B. Continuously increasing
C. Continuously decreasing
D. Increasing for a while and constant thereafter
E. Constant for a while and decreasing thereafter

26. At "c" the rocket's engine is turned off. Which of the paths below will the rocket follow beyond "c"?



27. Beyond "c", the speed of the rocket is;

A. Constant
B. Continuously increasing
C. Continuously decreasing
D. Increasing for a while and constant thereafter
E. Constant for a while and decreasing thereafter.

28. A large box is being pushed across the floor at a constant speed of 4.0m/s. What can you conclude about the forces acting on the box?

    A. If the force applied to the box is doubled, the constant speed of the box will increase to 8.0m/s.
    B. The amount of force applied to move the box at a constant speed must be more than its weight.
    C. The amount of force applied to move the box at a constant speed must be equal to the amount of the frictional forces that resist its motion.
    D. The amount of force applied to move the box at a constant speed must be more than the amount of the frictional forces that resist its motion.
    E. There is a force being applied to the box to make it move but the external forces such as friction are not "real" forces they just resist motion.

29. If the force being applied to the box in the preceding problem is suddenly discontinued, the box will

    A. stop immediately.
    B. continue at a constant speed for a very short period of time and then slow to a stop.
    C. immediately start slowing to a stop.
    D. continue at a constant velocity.
    E. increase its speed for a very short period of time, then start slowing to a stop.

THANK YOU VERY MUCH!

APPENDIX E

CONCEPTUAL UNDERSTANDING TESTS FOR PROFESSORS

Dear Professor:

The undersigned is presently conducting a research study entitled **"ENGINEERINGSTUDENTS' CONCEPTUAL UNDERSTANDING OF FORCE AND MOTION AND PERSONAL BELIEFS"** as part of the requirements for the degree Master of Arts in Teaching Physics.

In this regard, I would like to ask your assistance to conduct a try-out for validation purposes of his proposed research instrument by accomplishing the said instrument.

Thank you very much and may the good Lord shower you more blessings.

Very truly yours,

NICOLAS O. BOCO, JR.
Researcher

Direction: Kindly describe on how you agree or disagree to the statements below by checking opposite each statement using the following scales:

2 = YES
1 = NO
0 = I Don't Know

Statements	2	1	0
1. Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting upon it.			
2. An object stops moving because "the push wore off."			
3. An object that moves has that ability to do so by itself (in-built ability to move).			
4. "People move because they have legs" or "Bikes move because they have wheels."- a part of an object creates the motion.			
5. Things fall because you let them go, but to go UP you have to push them up.			
6. An object stops because of the lack of action to keep the object going.			
7. The only "natural" motion is for an object to be at rest.			
8. If an object is at rest, no forces are acting on the object.			
9. Force is a property of an object. An object has force and when it runs out of force it stops moving.			
10. The motion of an object is always in the direction of the net force applied to the object.			
11. Centripetal and centrifugal forces both act on a body moving in a circle.			
12. Friction always hinders motion. Thus, you always want to eliminate friction.			
13. A force is needed to keep an object moving with a constant speed.			
14. If an object is not moving, then there can be no force acting on it.			
15. If an object is moving, then there must be a force in the direction of motion.			
16. Force as a kind of fuel or energy that sustains the motion but at the same time is consumed by the motion itself.			
17. An increase in force will produce an increase in speed (*more of A, more of B*).			
18. If an object is on the ground then gravity is not acting on it, because it has already fallen to the ground.			
19. Gravity is the result of air pressure.			

20. Those objects that fall have more gravity than stationary objects, or gravity is not exerted upon stationary objects.			
21. A force applied by, say a hand, still acts on an object after the object leaves the hand.			
22. An object moves up or down depending on whether either the velocity or the kinetic energy is larger or smaller than the force of gravity.			

Thank You.

CURRICULUM VITAE

CURRICULUM VITAE

Name	:	Nicolas O. Boco, Jr.
Address	:	Brgy 4, Catbalogan City
Date of Birth	:	October 22, 1991
Place of Birth	:	Catbalogan City
Age	:	25
Sex	:	Male
Civil Status	:	Married

EDUCATIONAL BACKGROUND

Elementary	:	San Sebastian Elementary School San Sebastian, Samar 1998 – 2004
Secondary	:	San Sebastian National High School San Sebastian, Samar 2004 – 2008
Tertiary	:	Samar State University Catbalogan City, Samar 2008 – 2012 Bachelor of Secondary Education major in Physics
Graduate	:	Samar State University Catbalogan City, Samar 2013 – 2016 Master of Arts in Teaching major in Physics

WORK EXPERIENCE

June 2012 – March 2014	Secondary Teacher Samar College Catbalogan City

June 2014 – Present	Physics Instructor Samar State University Catbalogan City

LIST OF TABLES

LIST OF TABLES

Table		Page

LIST OF FIGURE

LIST OF FIGURE