Conceptual Understanding of Newton's Laws of Motion as a Phenomenological Experience

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Abstract This paper examined the students' phenomenological experiences in their conceptual understanding Newton's laws of motion. The participants in this research were 3 physics college students in a Teacher Education Institution in Iloilo City, Philippines. The data in this research were gathered through individual semi-structured interview to each of the participants. The explicitation of the data through phenomenological analysis (Hycner, 1999). The study revealed that the phenomenological experiences of students in his/her teacher in understanding Newton's laws of motion were teacher demonstration, reviewing the previous topic, giving questions, giving situations to analyze, getting volunteers for the activities, application of topic to our daily life situation, using analogies to motivate the students, familiarize the basic concepts about Newton's laws of motion, relate the equations from other situations. The researchers further found that the phenomenological experiences of students help build their conceptual understanding about Newton's laws of motion by seeing it to understand, give and take knowledge, teaching styles, and students participation. Results also showed that teachers' teaching style also determines how the students will respond, at times receptive, sometimes withdrawn. The pedagogy of the teacher also affects the students understanding and these are the reasons of students: intimidating teacher, open mindedness, eagerness and interest in teaching, and use of words. Moreover, it was pointed out that students also play an important role in the teaching-learning process. The students should not lie only to the teachers but they should do research or read books in the library. Furthermore, students gave some suggestions to refine the teaching-learning process and these are using visual aids, models or representations, and teaching styles should coincide with the students multiple intelligences to achieve understanding. Finally, the teachers; skill in employing interesting, challenging and relevant teaching methodologies which motivate the students to actively participate and manage their own learning serves as the best guarantee of beneficial and respectful classroom control and making the teaching-learning process fruitful. Both enjoy a winning situation, the students gaining knowledge and useful information on one hand and the teachers feeling satisfied and rewarded in seeing them learn.

Keywords: *Constructionism, Conceptual Understanding, Newton's Laws of Motion, Phenomenology*

Background of the Study. Over the past three decades, the study of conceptual change has been a major research area within science education (Duit & Treagust, 2012), especially on the topic of Newton's laws of motion for both physics majors and non-physics majors (Spyrtou, Hatzikraniotis & Kariotoglou, 2009; Tao & Gunstone 1999). Mechanics is known as an extremely difficult field to be taught. Students come to science lessons with their own pre-instructional conceptions that are differing from science views (Treagust & Duit, 2008). These preconceptions or misconceptions encompass fundamental concepts about velocity, acceleration or force and the basic laws such as Newton's laws of motion. Often, students are not aware of the fact that velocity, acceleration and force have a direction, that they are vectors. Students also have an alternative understanding of the relationship of these entities of physics (Schecker & Wiesner, 2011; Wodzinski, 1996). Many students conserve these incorrect beliefs, even after science instruction, so they are handicapped in learning the scientific views about force and movement (Duit & Treagust, 2012). Although misconceptions are rather resistant to change, effective theories may help to overcome them. Different scientific approaches, for example a dynamic concept of mechanics (Wilhelm, 2005), are expected to promote conceptual development and direct students' conceptual knowledge towards the right way in physics education.

Why Study Conceptual Understanding of Newton's Laws of Motion?

This study serves as a reference to college physics instructors/professors to determine the effective strategy in making students conceptual understanding in Newton's Laws of Motion more meaningful.

Research Purpose and Questions

The purpose of this study was to examine the students' phenomenological experiences in their conceptual understanding of Newton's Laws of Motion of college physics students at a Teacher Education Institution in Iloilo City of the Academic Year 2014-2015.

In order to achieve the research purpose, this study was guided by the following research questions:

1. What phenomenological experiences encountered by students in their conceptual understanding of Newton's Laws of Motion?
2. How do these phenomenological experiences build conceptual understanding of Newton's Laws of Motion?

Overview of the Epistemological and Theoretical Framework

As an interpretative study, this research is situated in the epistemology of constructionism (Crotty, 2003) and the theoretical perspective of phenomenology (. According to Crotty (2003), meanings are constructed by human beings as they engage with the world they are interpreting.

Epistemology	Theoretical Perspective	Micro-Theories
• Constructionism (Crotty, 2003)	• Interpretivism (Schwandt, 1994) ✓ Phenomenology (Husserl, 1931)	• Phenomenological Research (Husserl, 1931)

Constructionism Paradigm. The constructivist view of learning has made a major impact on science education, particularly during the past decade (Treagust, 1996). The implications for a science curriculum centered on a constructivist philosophy were identified initially in a number of research studies which focused on students' concept learning in science (Driver & Oldham, 1986). The constructivist view of learning has had the most noticeable influence on curriculum thinking in science since 1980 (Wubbels & Brekelmans, 1997). From an educational standpoint, students construct knowledge as they attempt to make sense of what is being taught by trying to fit it in with what they already knew. Ernst Von Glasersfeld (2005) proposed a radical form of constructivism, which advances the notion that knowledge is not a kind of product that exists apart from the knower but an activity or process that has purpose and direction. The validity of a knowledge claim is not to be found in the relationship of reference or correspondence to an independently existing world; rather, a claim is thought to be valid if it is viable or if it provides functional fit, that is, if it works to achieve a goal (Denzin & Lincoln, 1994).

Phenomenology. According to Husserl (1931), Phenomenology invites us to set aside all previous habits of thought, see through and break down the mental barriers which these habits have set along the horizons of our thinking . . . to learn to see what stands before our eyes. For a start, researchers claiming to be phenomenological talk of studying experience from the point of view or perspective of the subject. What phenomenologists are interested in is everyday experience, experience as people understand it in everyday terms. If they talk at all of phenomenon, it is either used interchangeably with experience or presented as an essence distilled from everyday accounts of experience, a total picture synthesized from partial accounts.

Research Design. In this study, the phenomenological method was used. It deals about the structures of conscious experience as experienced from the first-person point of view, along with relevant conditions of experience. According to Husserl (1931), our experience is directed toward — represents or "intends" — things only *through* particular concepts, thoughts, ideas, images, etc. These make up the meaning or content of a given experience, and are distinct from the things they present or mean.

The participants of the study were the three (3) fourth year college physics students of a Teacher Education Institution for the second semester of the school year 2015-2016.

This study started when the students make written reflections on how they conceptually understand Newton's laws of motion were the first step in this study. The researchers gathered the written reflections and analyzed the results. After analyzing the results of the written reflections the researchers distributed the consent form to the participants for the in-depth interview. Then the researchers also sought signatures of participants and right away informed them of the possible schedule of the interview – to gather more reliable data on their conceptual understanding of Newton's laws of motion, the researchers suggested picture documentation.

According to Hycner (1999), "analysis" has dangerous connotations for phenomenology. The term "analysis" usually means a breaking into parts and therefore often means a loss of the whole phenomenon. While "explicitation" implies an investigation of the constituents of a phenomenon while keeping the context of the whole (Hycner, 1999). Now that the term "explicitation" has been clarified, we can turn to a simplified version of Hycner's (1999) explicitation process which we used. This explicitation process has five steps or phases which are: (1) Bracketing and phenomenological reduction, (2) Delineating units of meaning, (3) Clustering of units of meaning to form themes, (4) Summarizing each interview, validating it and where necessary modifying it, and (5) Extracting general and unique themes from all the interviews and making a composite summary. The researchers concludes the explicitation by writing a composite summary, which must reflect the context or horizon from which the themes emerged (Hycner, 1999; Moustakas, 1994).

Results. Findings of the study using phenomenological analysis (Hycner, 1999) revealed that the phenomenological experiences encountered by students in the conceptual understanding of Newton's Laws of Motion were teacher demonstration, topic review, asking questions by the teacher, analysing situations, real life application of the topic, analogies as student motivation, familiarization of basic concepts in Newton's Laws of Motion, relating equations to other equations, experimentation, integration of concepts to real life situations.

Thru the phenomenological experiences, the students were able to conceptually understand Newton's laws of motion when they were able to see it (visual representation) in order to understand, teacher adjustment to teaching pedagogy, student participation, relate one variable to another in equations (derivation of equations), and Newton's Laws of Motion are mechanisms that can be encounter in daily life.

The findings also revealed that the pedagogy of the teachers through the students lens that affects students conceptual understanding are intimidating teacher, teacher's eagerness and interest of the topic, and simple words to describe/explain.

Based on the findings of the study, the learner's role in building conceptual understanding are listen attentively and understand the relationship of the variables rather than memorizing the formula.

Furthermore, when the learners would like to suggest some strategy to refine the teaching-learning process in understanding Newton's Laws of Motion and these are visual aids, using models and computer simulation of motions.

Conclusion.

1.) The phenomenological experiences of students described the experiences of students in his/her teacher in understanding Newton's laws of motion were teacher demonstration, topic review, asking questions by the teacher, analyzing situations, real life application of the topic, analogies as student motivation, familiarization of basic concepts in Newton's Laws of Motion, relating equations to other equations, experimentation, integration of concepts to real life situations.

2.) The students phenomenological experiences build conceptual understanding explained how students achieved understanding of Newton's Laws of Motion. They were able to build their understanding by "to see is to understand", Lyn emphasized that "in order to understand New-

ton's laws of motion, you need to see it through demonstration". Moreover, "teacher adjustment to teaching pedagogy" is also important for the students to build understanding. The teacher should adjust on the learners capability whether they are fast or slow learners. The teacher should also look through the Multiple Intelligences of the students. Furthermore, "Student participation" plays also an important role in the teaching-learning process. Giving examples of Newton's Laws of Motion in our day to day life encounter would greatly contribute to the students conceptual understanding.

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