UNIVERSITI TEKNOLOGI MARA

A STUDY OF STUDENTS' CONCEPTUAL UNDERSTANDING OF NEWTONIAN MECHANICS IN AFGHANISTAN

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ABSTRACT

This research was conducted to investigate the level of conceptual understanding of Newtonian mechanics among Afghan school and university students in Kabul, Afghanistan. This study employed a quantitative descriptive survey method where the Pashto version of the Force Concept Inventory (FCI) was given to a random sample of 216 school and 90 university students. The collected data was analysed using SPSS v.24 where descriptive and inferential statistical analysis methods were used to determine the level of students' conceptual understanding of Newtonian mechanics. The findings show that the average FCI scores obtained by the school and university students were 20% and 26% respectively. The results of the study reveal that generally, Afghan students had low level of Newtonian mechanics conceptual understanding which is less than the entry threshold for FCI. Furthermore, the results of inferential statistics indicate that student's first language, gender, school, or university didn't have any significant effect on the test scores of school and university students. In the meantime, students from both levels, school and university, had various misconceptions regarding each concept in the six conceptual dimensions of the FCI test. In general, the results confirmed that both school and university students are having difficulties to conceptually understand Newtonian concepts. The average FCI score of Afghan school and university students is lower than the average scores of students from other countries such as USA, UK, China, Russia, Japan, Finland, Africa, Turkey, Saudi Arabia, Thailand, India, Indonesia and Malaysia. However, the Afghan school students result is slightly better than that of Philippines and Iran, while the university students result is better than Laos. Finally, recommendations are made for conceptual learning, effective teaching method as well as for further research.

Key Words: Force Concept Inventory (FCI); Pashto version; conceptual understanding of Newtonian mechanics; Students' performance and entry threshold.

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CHAPTER ONE
INTRODUCTION

1.1 Background of Study

In the teaching and learning process, it is important to know about students' understanding of a concept. Without a good basic knowledge, students will not be able to understand new concepts and facts. A strong foundation will ensure that new knowledge is retained longer and stronger. Hence, it is important for educators to ensure that students' foundation knowledge is strong for them to understand important concepts. This is especially significant in the study of Newtonian (classical) mechanics.

Newtonian mechanics or simply Mechanics is the central topic in Introductory Physics and force is a central concept in all of the Physics. The content is very standardized and in addition, it is an important subject in investigating the physical world, especially Newton's Laws of Motion. It plays a special role in investigating the world. Numerous research-based conceptual inventories have been developed on the Newtonian force concept and related kinematics (Madsen, McKagan, & Sayre, 2017; Von Korff, Archibeque, Gomez, Heckendorf, McKagan, Sayre, 2016). A Concept Inventory is a kind of test by which we can measure school, undergraduate and post graduate students' conceptual understanding in a given area of physics. In 1992 the 34-item Mechanics Diagnostic Test (MDT) was improved by Hestenes and his co-workers to a new 29-item version called the Force Concept Inventory (FCI) (Hestenes, Wells, & Swackhamer, 1992). It was then revised and updated in 1995 by Halloun, Hake, Mosca, Hestenes, Wells and Swackhamer to the current internationally well-known and widely used 30-item standardized conceptual test version (Halloun, Hake, Hestenes, Mosca, Swackhamer, & Wells, 2015; Mazur, 1999). Since then it has been used as one of the assessment instruments to measure students' understanding of fundamental concepts of Newtonian (classical) mechanics. In addition, FCI was also used to assess teaching effectiveness in an introductory physics course (Hestenes & Halloun, 1995; Hestenes et al., 1992; Mazur, 1999; Scott, Schumayer, & Gray, 2012; Von Korff et al., 2016). This 30-question multiple-choice test is research-based, where each question has five conceivable responses (A, B, C, D, and E) with one correct answer. The four incorrect