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Name : SIM SZE KIONG

Date : 02 November 2010
To my dearest family and friends,

My appreciation is beyond words. My thoughts and prayers are always with you all.
ACKNOWLEDGEMENT

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This research is to study the epistemological beliefs, learning attitudes and conceptual understanding towards learning Physics among the first year and final year Physics Education undergraduates (N = 68) from Universiti Teknologi Malaysia for 2009/2010 session. This is a descriptive quantitative research. Data is collected by using two instruments, namely the Physics Epistemological Beliefs and Attitudes Test (PEBAT) and the Force Concept Inventory (FCI). In the pilot study, internal consistency (α = .790) and (α = .712) are found for the epistemological beliefs category and learning attitudes category respectively whereas the FCI has the reliability of .650. Collected data is analyzed by using SPSS version 16.0. The findings show that the mean scores obtained by the overall undergraduates in epistemological beliefs test and learning attitudes test are 69.05% and 72.10% respectively. The results indicate that generally the undergraduates hold high sophistication of epistemological beliefs and favorable attitudes in learning Physics. However, poor conceptual understanding due to misconceptions is detected among them as only one person (1.47%) of the total undergraduates is able to develop coherent understandings in Newtonian force concept (M = 24.47, SD = 11.18). Gender differences are detected in both epistemological beliefs and learning attitudes tests which are in favor of female undergraduates. The t-tests show that there are statistically significant differences in mean scores between first and final year undergraduates for epistemological beliefs as well as learning attitudes. Higher mean scores in both aspects are in favor of the final year undergraduates. Pearson correlations show that there are significant relationships between epistemological beliefs and conceptual understanding (r = .607, p < .01), between epistemological beliefs and learning attitudes (r = .563, p < .01) as well as between learning attitudes and conceptual understanding (r = .496, p < .01).
ABSTRAK

Kajian ini bertujuan untuk mengkaji kepercayaan epistemologi, sikap belajar dan kefahaman konseptual terhadap pembelajaran Fizik di kalangan pelajar-pelajar tahun pertama dan tahun akhir dari jurusan Pendidikan Fizik (N = 68) di Universiti Teknologi Malaysia bagi sesi 2009/2010. Kajian ini ialah kajian kuantitatif berbentuk deskriptif. Data diku OT dengan menggunakan dua instrumen, iaitu Physics Epistemological Beliefs and Attitudes Test (PEBAT) dan Force Concept Inventory (FCI). Dalam kajian rintis, indeks kebolehpercayaan (α = .790) dan (α = .712) telah diperoleh bagi kategori kepercayaan epistemologi dan kategori sikap belajar masing-masing manakala indeks kebolehpercayaan bagi FCI ialah .650. Data yang diperoleh dianalisis dengan menggunakan SPSS versi 16.0. Dapatan kajian menunjukkan min skor yang diperoleh oleh pelajar-pelajar dalam ujian kepercayaan epistemologi dan ujian sikap belajar ialah 69.05% dan 72.10% masing-masing. Keputusan tersebut menunjukkan secara keseluruhan, pelajar-pelajar mempunyai tahap sofistikasi yang tinggi bagi kepercayaan epistemologi serta menunjukkan sikap belajar yang positif terhadap pembelajaran Fizik. Namun demikian, kefahaman konseptual yang lemah yang dipercayai berpunca daripada masalah miskonsepsi telah dikesan di kalangan pelajar. Analisis data menunjukkan hanya satu orang (1.47%) daripada jumlah pelajar yang dikaji berjaya menguasai kefahaman konseptual dalam konsep daya Newtonian (M = 24.47, SP = 11.18). Dapatan kajian menunjukkan terdapat perbezaan yang signifikan di antara jantina bagi ujian kepercayaan epistemologi dan ujian sikap belajar yang mana keputusan kedua-dua ujian tersebut adalah memihak kepada pelajar perempuan. Ujian t-test menunjukkan terdapat perbezaan yang signifikan di antara pelajar-pelajar tahun pertama dan tahun akhir bagi kepercayaan epistemologi dan sikap belajar yang mana min skor yang tinggi dalam kedua-dua aspek adalah memihak kepada pelajar tahun akhir. Analisis korelasi Pearson menunjukkan terdapat hubungan signifikan antara kepercayaan epistemologi dengan kefahaman konseptual (r = .607, p < .01), antara kepercayaan epistemologi dengan sikap belajar (r = .563, p < .01) dan antara sikap belajar dengan kefahaman konseptual (r = .496, p < .01).
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CHAPTER 1

INTRODUCTION

1.1 Introduction

The success of Dr. Sheikh Muszaphar Shukor bin Sheikh Mustapha, our first Malaysian astronaut to travel in outer space and landed in International Space Station (ISS) has become an inspiration to the younger generation to embrace science and technology. This will also encourage more students to study in science stream in their secondary level of education and hopefully will propel them to be actively involved in the study of science domain subject related course or major in subject like Physics in their coming tertiary education. Learning Physics is important as Physics is essential and we need the knowledge of Physics to understand the world around us, the world inside us, and the world beyond us. One of the important aims highlighted in the Physics education’s syllabus compiled by Curriculum Development Centre (2006) is to provide students with knowledge and skills in Physics and technology and enable them to solve problems and make decisions in everyday life based on scientific attitudes and noble values. It is important for students to acquire the knowledge of Physics in dealing with everyday life activities. Hence, it is equally important to study from the students’ point of views, their epistemological beliefs and learning attitudes towards Physics and learning Physics.

Epistemology is defined as the study or a theory of the nature and grounds of knowledge, especially with reference to its limits and validity (Merriam-Webster, 2003). Kortemeyer (2007) described epistemological beliefs about Physics and
Physics learning as the beliefs which concern with what constitutes knowledge in Physics and how knowledge in Physics is developed. Paulsen and Feldman (2005) defined epistemological beliefs as the systems of implicit assumptions and beliefs that students have about the nature of knowledge and its acquisition. Epistemological beliefs involve learners’ theories about knowing, the nature of knowledge, and knowledge acquisition (Schommer, 1990). Meanwhile, the word “attitudes” is defined as the favorable or unfavorable responses to things, places, people, events or ideas (Koballa, 1995). According to Seifert (1991), an attitude is learned and is defined as the acquisition of certain feelings about something or someone, either positively or negatively that influence one’s choices of action in a consistent way. Sprinthall et al. (1994) defined attitude as a learned predisposition to respond either positively or negatively to persons, situations or things. The terms epistemological beliefs and attitudes when applied in the context of students’ Physics learning, one can understand students’ epistemologies as their beliefs or views about how knowledge in Physics is constructed, evaluated and also students’ manner, stance or approach towards learning the subject Physics. So the epistemological beliefs and attitudes of students towards learning Physics are defined as students’ view or way of thinking towards the study of Physics. It is how students think about the knowledge, their knowing in learning Physics and the way they approach the learning.

The term “conceptual understanding” is sometimes called intuitive understanding and it refers to an ability to recognize underlying concepts in a variety of different representations and applications (Richardson and McCallum, 2003). For an example, a student who understands the concept of “velocity” knows that it is the rate of change of position for an object in the moving direction. Furthermore, with good conceptual understanding of the velocity concept, the student is able to identify the slope on a displacement-time graph as displacement over time or also known as velocity and the coefficient of variable, $t$ in a formula giving its position as a function of time, $t$ are all manifestations of the same underlying concept, and knows how to translate between them. Richardson and McCallum (2003) emphasized that in learning Physics, students need conceptual understanding first to develop a sound understanding of key fundamental concepts then using a deeper approach and more sophisticated skills to make the learning become meaningful.
According to Schommer (1990), students’ epistemological beliefs influence learning approaches and subsequently learning outcomes. Apart from that, students’ learning strategies and learning outcomes are also influenced by their personal belief systems about the nature of knowledge and learning, their epistemological beliefs and attitudes. Hence, a student’s personal epistemological beliefs and attitudes towards learning Physics may influence the way they learn and how they master their learning. Hofer and Pintrich (2002) described that epistemological beliefs affect Physics understanding through their indirect effect on learning, text comprehension, and metacomprehension strategies, an argument which is also made by Ryan (1984) and Schommer et al. (1992). Hofer and Pintrich (1997) 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. Settle and Knobloch (2004) revealed that the ways that people know and process knowledge are guided by a set of assumptions and beliefs. These beliefs and attitudes influence how students learn in their college courses and also guide how students acquire, structure, and process the knowledge. The way how students think about the knowledge, its structure and its acquisition process may well reflect the way how students response to the subject itself. Therefore, study on epistemological beliefs and attitudes of students towards learning Physics is needed to tap into the students’ mind frame to investigate their beliefs and perception towards Physics and the attitudes towards learning the subject.

1.2 Research Background

Over the decades, the subject of study on epistemological beliefs of students towards learning has been intensively carried out to investigate the students’ beliefs, perceptions, attitudes and epistemologies towards the process of acquiring knowledge. Epistemological beliefs have gradually become a central focus in educational research because it’s been shown to play an important role in the learning process and predict many aspects of learning process (Malaki et al., 2009).
Beginning with Schommer (1990) who studied on how students’ beliefs about the nature and acquisition of knowledge influence their approach to learning. Hofer and Pintrich (1997) studied on how students interpret their learning experiences and the influence of epistemological beliefs on reasoning when engage in learning process. Sinatra and Pintrich (2003) studied on the impact of epistemological belief sophistication on students’ skills and attitudes towards learning which focus on the aspects of critical thinking, self-regulation, cognitive flexibility, ability to communicate ideas, and to learn from collaboration. It was not until the late 90’s the study of epistemological beliefs of students towards learning started to shift and focus more on specific domain subjects in the like of Science and Physics. Since then Physics education research community has extensively begun to do research on the study of students’ attitudes, expectations and epistemologies towards learning Physics.

In recent years, there have been several popular studies conducted which are related to the relationship between students’ epistemology, attitudes and the learning of Physics. Among them were like survey done by Redish et al. (1998) to investigate students’ expectations in university Physics by using Maryland Physics Expectations Survey (MPEX), study conducted by Elby et al. (1997) to probe students' epistemologies and to investigate their views about the nature of knowledge and learning in the physical sciences by using Epistemological Beliefs Assessment For Physical Science (EBAPS), study conducted by Stathopoulou and Vosniadou (2006) to explore the relationship between Physics-related epistemological beliefs and Physics understanding using Greek Epistemological Beliefs Evaluation Instrument for Physics (GEBEP) and study on students’ beliefs about Physics and learning Physics by using The Colorado Learning Attitudes About Science Survey (CLASS) which was carried out by Adams et al. (2006). According to Brewe et al. (2009) who conducted a study on positive attitudinal shifts in introductory Physics measured with CLASS described that conceptual understanding in Physics is one of many characteristics that distinguish experts from novices, but other attitudinal characteristics discriminate novice and experts as well. These attitudes are not merely a like or a dislike of Physics, but a broader evaluation of cognitive attitudes toward the nature of Physics and the practice of Physics. Apart from that, there are also a few studies on epistemological beliefs based on
gender differences. However, the studies on effects of gender on epistemological beliefs are inconclusive and produce different results. Schommer (1993) in a study investigating the epistemological beliefs across gender reported that girls are less likely to believe in quick learning and fixed ability than boys. On the contrary, Belenky et al. (1986) argued that at the early developmental stage of personal epistemological beliefs, females view knowledge as handed down by authority while males view knowledge as mastering what is handed down by authority.

Students’ conceptual understanding in Physics is also considered as one of the important main subjects to be studied for Physics educationist researchers. McDermott (1984) first studied the student understanding of the concept of velocity in one dimension. He then investigated the student understanding of the concept of acceleration in one dimension a year later. McDermott (1984) also conducted research on conceptual understanding of mechanics to study student understanding of isolated concepts in the field of mechanics. Halloun and Hestenes (1985) first developed an instrument called the Mechanics Diagnostic Test (MDT) which was used to diagnose student conceptual understanding in mechanics. The MDT was used to assess students’ qualitative conceptions of motion and its causes. Hestenes et al. (1992) then improvised the MDT to create the Force Concept Inventory (FCI) which is used to test students’ conceptual understanding in Newtonian force concept. FCI is considered as the most widely used assessment instrument to investigate students’ conceptual understanding of Newtonian force concept (Henderson, 2002). Until now, FCI is still widely used to test students’ conceptual understanding in introductory Physics. Based on a study conducted by Stathopoulou and Vosniadou (2006) on exploring the relationship between Physics-related epistemological beliefs and Physics conceptual understanding, the researchers suggested that there is a relationship between Physics-related epistemological beliefs and Physics conceptual understanding. Students with high level of epistemological beliefs tend to archive a deep, coherent understanding of Newtonian force concept compared to those who have lower level of Physics-related epistemological beliefs.

Epistemological beliefs and learning attitudes are important aspects that may affect students’ approach in learning Physics and extensive study on those aspects need to be carried out. Although epistemological beliefs and learning attitudes have
been the subject of extensive research for so many years in Western countries, but less similar research has been done in non-Western countries. So far there has yet to be any detailed study or education research to investigate students’ epistemological beliefs towards learning Physics among our Malaysian students. Thus, this study is carried out with the aims to examine the Universiti Teknologi Malaysia, Physics education undergraduates’ epistemological beliefs and learning attitudes towards Physics and their conceptual understanding in Newtonian force concept in Physics. The Physics education undergraduates are involved in this study as they are the pre-service Physics teachers in the country. Hence, it is important to prepare the future Physics teachers with good epistemological beliefs and attitudes in learning Physics so that they project good image of Physics discipline to students as well as to look for evidence of conceptual understanding in the teacher’s ability to understand and mastering the Newtonian force concept in Physics.

1.3 Statement of Problem

Rohana and Shaharom (2008) in a study on “Relationship between laboratory work and form 4 Physics students’ achievement in the topic of force” 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. Inevitably, students fail to develop good understanding of the force concept despite being exposed to the basic concept of force in their earlier stage of science education in form two at secondary schools. Poor conceptual understanding about force and motion among pre-service Physics teachers were also found in a Turkish research conducted by Bayraktar (2007). The study shows 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. Generally speaking, a student requires good conceptual understanding in Physics in order to master the subject. However, according to Gray et al. (2008), other factors like epistemological beliefs and learning attitudes also play a substantial role in a student’s ability to learn and understand Physics concepts. He described that students’ epistemological beliefs
towards Physics and the structure of Physics knowledge, their beliefs about the connection between Physics and the real world, their epistemological beliefs in problem solving and their attitudes in learning Physics are all equally important as well. Therefore, this study is initiated with the aims to determine the epistemological beliefs, learning attitudes held by the pre-service Physics teachers in Universiti Teknologi Malaysia and to study their conceptual understanding in Newtonian force concept.

1.4 Research Objectives

This research is aimed to study the Universiti Teknologi Malaysia, Physics education undergraduates’ epistemological beliefs and attitudes towards learning Physics as well as their conceptual understanding in Newtonian force concept in Physics. Therefore, the objectives of this study are to look at the three main aspects, namely epistemological beliefs, learning attitudes and conceptual understanding. There are a total of 10 research objectives in this research. The following statements are the research objectives according to the aspects studied which involved the Physics education undergraduates.

1.4.1 Epistemological Beliefs

In the epistemological beliefs aspect, the research objectives are to determine:-

i. the epistemological beliefs towards Physics and learning Physics held by the Physics education undergraduates.

ii. if there is any significant difference in epistemological beliefs between male and female undergraduates.
iii. if there is any significant difference in epistemological beliefs between First Year and Final Year undergraduates.

1.4.2 Learning Attitudes

In the learning attitudes aspect, the research objectives are to determine:

i. the attitudes towards learning Physics among Physics education undergraduates.

ii. if there is any significant difference in learning attitudes between male and female undergraduates.

iii. if there is any significant difference in learning attitudes between First Year and Final Year undergraduates.

1.4.3 Conceptual Understanding

In the conceptual understanding aspect, the research objectives are to determine:

i. the level of conceptual understanding in Newtonian force concept among Physics education undergraduates.

ii. if there is any significant difference in conceptual understanding between male and female undergraduates.

iii. if there is any significant difference in conceptual understanding between First Year and Final Year undergraduates.
1.4.4 **Relationships between Epistemological Beliefs, Learning Attitudes and Conceptual Understanding**

In this aspect, the research objective is to determine:

1. if there is any significant relationship between epistemological beliefs, learning attitudes and conceptual understanding among the Physics education undergraduates.

1.5 **Research Questions**

This research is carried out in Universiti Teknologi Malaysia to answer the following research questions related to the epistemological beliefs, learning attitudes and conceptual understanding of Physics education undergraduates. There are a total of 10 research questions in this research. The following part show the research questions identified in each aspect studied.

1.5.1 **Epistemological Beliefs**

In the epistemological beliefs aspect, the research questions are as followed:

1. What are the epistemological beliefs towards Physics and learning Physics held by the undergraduates?

2. Is there any significant difference in epistemological beliefs between male and female undergraduates?

3. Is there any significant difference in epistemological beliefs between First Year and Final Year undergraduates?
1.5.2 Learning Attitudes

In the learning attitudes aspect, the research questions are as followed:

i. What are the attitudes of Physics education undergraduates towards learning Physics?

ii. Is there any significant difference in learning attitudes between male and female undergraduates?

iii. Is there any significant difference in learning attitudes between First Year and Final Year undergraduates?

1.5.3 Conceptual Understanding

In the conceptual understanding aspect, the research questions are as followed:

i. What is the level of conceptual understanding in Newtonian force concept among the undergraduates?

ii. Is there any significant difference in conceptual understanding between male and female undergraduates?

iii. Is there any significant difference in learning attitudes between First Year and Final Year undergraduates?