

Conceptions of Mathematics among Diploma in Actuarial Science Students

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Abstract

This study aims to identify students' conceptions of mathematics in the Diploma in Actuarial Science programme. It focuses specifically on how Diploma in Actuarial Science students conceptualize aspects of mathematics such as the meaning of mathematics, the meaning of learning mathematics, and the use of mathematics in daily life. This study is based on the universal integrated perspective and uses the case study design. Findings show that the Diploma in Actuarial Science students used the universal integrated perspective to interpret the acquisition of mathematical knowledge but their understandings of mathematical concepts, process of learning mathematics, and proper usage of mathematical ideas are mostly at the surface level, rather than deep understanding.

Keywords: Diploma in Actuarial Science Students, Conceptions, Mathematics, and Universal Integrated Perspective.

1. Introduction

The literature review shows that students find it difficult to learn mathematics and that they often developed misconceptions about the basic ideas in the subject (FitzSimons, Seah, Bishop & Clarkson, 2000; Gordon & Nicholas, 2013; Grootenboer, 2002; Ignacio, Blanco & Barona, 2006; Lim, Fatimah & Munirah 2003; Zan, Brown, Evans & Hanulla, 2006). Many critical questions arise in connection with the subject of mathematics and one of it is the deficiency in their comprehension of the various aspects of mathematics. Furthermore the problem of understanding mathematics is also seen connected to the development of images, interpretation, or meaning by individual concerning the nature of mathematics (Nik Aziz, 2008). Then comes the idea of learning mathematics for the exams as the education system is exam oriented and not for actualization a form of knowledge. Within this context what is seen among students learning mathematics is that they are doing so as a cognitive challenge rather than viewing it as knowledge gained (Nik Aziz, 2014). Therefore, an extensive and in depth research is required to gain meaningful understandings on the learning of mathematics and the students' conception of the structure or mathematical objects.

The focus of research, explicitly and implicitly to a great extent related to the conceptions of mathematics relied on the development of cognitive, affective, and behavioural features in the teaching and learning of mathematics in schools and universities (Andrews & Hatch, 2000; Anna & Petocz, 2006; Atallah, 2003, Aringbabu & Miji, 2005; Evans, 2007; Munirah, 2010; Reid, Petocz, Smith, Wood, & Dortins, 2003; Wong, 2002, Greiffenhagen & Sharrock, 2011; Lim, Fatimah & Tan, 2003; Nik Azis, 2008). Within this situation, the use of concepts such as metaphors and images to describe personal development has been a focus in previous research studies on conceptions (Black & Halliwell, 2000; Groth & Bergner, 2005; Lakoff & Nunez, 2000; Lim, 1999; Picker & Berry, 2000; Nik Azis, 2008). Research done in other countries where the concepts of individual groups about mathematics and mathematics education were studied, it was perceived that the findings from that research are significant and the conceptions of mathematics are based on the secularism. Secularism is a philosophical approach in which religion is removed from the discussion of everyday activities and is human centered, rather than God centered. The research on mathematics and the teaching and learning of mathematics done in Malaysia is important because mathematics is a main component in the curriculum and it is stated in the Malaysian Philosophy of Education that the aim of giving due consideration for this subject is to raise the level and creative potential of students in the subject holistically.

In reality, the phenomena observed surrounding the teaching and learning of mathematics appears to be intense, but there is no stress on the behavior and conception related to the actualization and acculturation of knowledge. In connection with this issue being there is a need to use an epistemological perspective in studying the teaching and learning of mathematics. This epistemology perspective deals with truth, belief, and justification of knowledge and how to build up meaningful mathematical knowledge.

2. Purpose and Objectives of Study

Until now, there has been no broad and in depth study on mathematics as understood by

Diploma students. This study involving Diploma in Actuarial Science students focuses on the concepts of mathematics, the concept of the learning of mathematics, images of learning mathematics, metaphors for the learning of mathematics, and the use of mathematics in daily life. In this study, the term images include oral representation and graphical representation (figurative), and may be associated with beliefs, opinions, feelings, emotions, and individual attitudes towards mathematics and mathematics learning (Nik Azis, 2009). In this case, the visualization of the role of students while learning mathematics in the context of classroom is expressed through the creation of linguistic representation, graphics, or drawings, and explanations of these representations are expected to help in understanding the nature of mathematics learning among the participants.

Further, the term metaphor is a form of speech with one word or expression that indicates the nature of things or ideas literally used to substitute other words or phrases to suggest similarity or analogy between them (Nik Azis, 2009). The term conception refers to the abstraction of generalizable patterns from perceptions and sequences of mental operations and the term “meaning” refers to the ability to place something at the right place (Nik Azis, 2014). In addition, students’ knowledge on mathematics and mathematics learning are abstract from various activities and different experiences throughout their lives, including experiences involving mathematics education. Therefore, the knowledge from the research may be useful in helping mathematicians to raise the quality of teaching and learning mathematics.

In the modern culture, behaviourism, cognitivism, and constructivism support secularism. The first three learning theories have incompatible assumptions with what is stated in the Rukun Negara (National Principles) and the National Philosophy Education of Malaysia. For example, the first three theories mention about a rational state of mind (antroposentric), while the the second perspective proclaims the strong beliefs in God (teocentric). Supporters of ‘anthropocentrism’ view human beings as the most significant factor in the present world, especially with regard to deciding on values. On the other hand, supporters of ‘teosentrism’ refer to God as the most important factor and give preferences to the elements of religion, rational thinking, and empirical experiences. God is the source for the creation of human beings and the entire world including the pinnacle of authority.

In short, a dynamic alternative and logical step to be taken is the use of psychology along the lines of teosentrism, namely universal integrated approach or UIA (Nik Aziz, 2014). UIA defines the concept of mathematics with reference to the inner spiritual self and with complete surrender to God. Even Groth dan Bergner (2005) suggest perspectives that involve mortals and education as a whole is better to be used as a theoretical framework to identify the conception, images, and personal metaphors compared to perspectives that are not holistic. Briefly, previous research have clarified experinces of people concerning mathematics based on secular perspective. However, the Diploma Sains Aktuari students conceptions of mathematics has yet to be studied using the universal integrated approach.

3. Methodology

This investigation uses a case study. The participants are five students, two males and three females within the age range of 18 till 20 and in different semesters. Selection was done based on five criteria: (a) they have ten years or more of experience learning mathematics and agree to take part in the activities (b) interested in the study (c) the participation is not an obstacle to their class attendance (d) the participants' will give detail explanations in the clinical sessions (e) the participants who are enrolled in the Diploma Actuarial Science programme have obtained the consent of the faculty to participate in the study.

The clinical technique for the interview was used for data collection (Steffe & Olive, 2010). Each student was interviewed five times lasting from 40 to 50 minutes per participant, depending on the time taken by each participant. The protocol for the first interview involved components such as mental image for mathematics and description of the nature of mathematics. The second protocol involved the mental image for the learning of mathematics, the role of the learner of mathematics presented as a metaphor, and the images of mathematics learning. The third protocol involved the use of mathematics in daily life, in other subjects, in different areas of study, and in the occupation.

Data for this research was collected in the form of video recording, notes and sketches done during the interview. The analysis was done in four stages. The first stage was the transcription of the video recording. The second stage was to develop the case study for each participant using written information such as researched notes, drawings and notes by participants. The third stage was the cross analysis for the case study was to identify the specific behavioural patterns of the participants. The fourth stage was the conclusion of the students' conceptions of mathematics with reference to what was recognized in their behavioural patterns.

4. Results and Findings

In this section, the discussion of the research findings are done taking into account the research questions. Also, past research is referred to in the discussion.

4.1 Meaning of mathematics

Diploma in Actuarial Science students' conceptions of the meaning of mathematics are described below:

4.1.1 Mental images

The dominant mental image is related to the content of mathematics. This aspect involves numbers, symbols, equations, abstract calculation, and mathematical language. Mathematics is also described in its various branches such as trigonometry, calculus, statistics and probability; solutions to problems in the use of mathematics in the fields of industry, and the art of mathematics including elements of geometry in craftsmanship.

4.1.2 Nature of mathematics

Conceptions of participants about the nature of mathematics involve four main ideas: truth of mathematics, origin, the importance of mathematics, and the structure of mathematics. The first concept is on the truth of mathematics where majority of the participants agreed that mathematics is in the truth and does not need to be verified. The second concept is the views on its origin where some participants viewed mathematics from the realistic point of view, while others looked at it from the idealistic point of view. However, the participants agreed that mathematics is something created by God. The third concept is the importance of mathematics, where most of the participants concluded that mathematics is an important field within the activities of the daily routine. The final concept is the structure of mathematics where majority of the participants agreed that mathematics is a formal discipline which uses symbols without the difficulty of referencing for meanings.

4.2 *Meaning of the learning of mathematics*

Diploma in Actuarial Science students' conceptions of the meaning of learning mathematics is in line with some aspects pertaining to the theory of the learning of mathematics.

4.2.1 Mental images

The dominant mental aspect of learning mathematics involves activities such as receiving, remembering, and using what has been learnt, where the information received is through the five senses.

4.2.2 The study of mathematics in the metaphoric form

Three out of five participants used different metaphors to portray the learning of mathematics, while the other two used similar metaphors. Four words used in metaphors were: pencil, black hole, an empty lamp, and white cloth. All activities focused on receiving information from the surroundings using the five senses. The first metaphor is the used of the pencil where one of the participants acted as a student learning mathematics. He held a pencil and it was learnt that the pencil represented the teacher who was training and the pencil represented the effort put in by students to learn such as revising. Another representation of the pencil was that of the medium of transferring information received from the teacher. The second metaphor is the black hole where a student represented himself as a hole which could absorb all information from its surroundings. The third metaphor is the empty lamp where a student represented herself as an empty lamp. It was explained that the teacher filled the empty lamp with all kinds of new mathematical knowledge of facts, skills, and procedures. The fourth, is the metaphor of a white cloth. Two participants assumed they represented a white cloth that is clean as nothing has been written on it. Whatever the teacher teaches will be the designs on the cloth that will shape the experiences of the student.

4.2.3 Importance factors related to the learning of mathematics

According to the participants, factors that are important for the learning of mathematics are: the teacher or the lecturer of mathematics, the students, and the school or institution. Teachers and

students dominate the issue. Participants stated that the lecturer or the teacher of mathematics were important influencing factors in the learning of mathematics.

The elements in connection to the teacher factor are the lecturer should be one who has a wide knowledge, good physique, health and a stable emotion. The elements in connection to the students factor such that the student's attitude, interest in mathematics, and the opinion of the subject, the peers, and the preparation and knowledge of mathematics needs to be taken into account. The elements in connection to the school factor are the physical factor within the classroom such as the atmosphere and learning facilities available for the student such as books and technology and other apparatus.

4.2.4 The image of learning mathematics

This section involves the mental images shown in drawing by students such as student centered learning of skills, teacher centered learning, the class atmosphere, technology based learning and affective orientation. The dominant component was the one with student centered learning and acquisition of skills. Majority of the students imaged student centered learning. The student centered learning referred to images showing them engaged actively in various activities such as drawing graphs and internalising mathematical components. The teacher centred learning referred to images showing the conduciveness of the classroom and the technology centered learning referred to images showing the use of computers to enhance learning. For example, listening to music with laptop speakers to get rid of boredom.

4.3 Use of mathematics in daily life

Daily concepts involves the use of mathematics are at home, at the supermarket, in schools, and in occupation. Mathematics is considered to be an instrument for solving problems and the arithmetic skill is used by everyone where numbers are involved.

5. Conclusion

In general, the findings of this study are compatible with findings of previous studies (Attalah, 2003; Lam, Wong, & Wong, 2001; Lepmann & Afanasjev, 2000; Kislenko, Grevholm & Lepik, 2005; Petož *et al.*, 2006; Koester; 2000). These investigations reveal that students regard mathematics as a subject associated with calculations, involves the process of thinking and is used in daily life. Mathematics has a close relationship with the thinking patterns of human beings and involves interaction with the environment and other human beings. In other word, mathematics is considered as a field of knowledge for man. The difference between this study and others is that which involves the perspectives of students. The conceptions of students of Diploma in Actuarial Science concerning mathematics ranges from relative view to absoluten view, while most studies done overseas shows students' conceptions of mathematics as an absolute entity. Other than that, students of Diploma in Actuarial Science regard mathematics as the product of the mind and the senses. In this context, they regard that mathematics originated from God and was acquired by individuals through their individual experiences. In addition, mathematics is viewed as the truth that must be conveyed or discovered objectively.

In previous study, mathematics was considered as a class of knowledge that was different with independent values and culture, but useful as original, universal, knowledge (Attalah, 2003; Kislenco, Grevholm & Lepik, 2005; Koester, 2000). In the context of mathematics being universally considered as the truth, it never alters. As to the concepts of Diploma in Actuarial Science students about learning mathematics they regard it as one that is integrated in specific stages within the spiritual, cognitive, affective and behavioural aspect. Within this context, the impression of the participants on the learning of mathematics encompasses elements such as understanding, solution to problems, utilization, and acquisition. This appears to be an important aspect of teaching and learning which is promoted by the perspective of consolidation. In addition, this investigation is similar to other research done locally (Nik Azis, 2008) and abroad (Petocz *et. al.*, 2006; Koester 2000; Atallah, 2003; Reid *et. al.*, 2003). The research done locally finds that mathematics is being used in formal education and daily life whereas the research done in other countries finds that mathematics is used as a school subject, in daily, occupation, and in higher studies.

In short, this study identified students' conceptions of mathematics aspects based on the universal integrated perspective. It focuses on students meaning of mathematics, learning of mathematics, and of mathematics in daily life. On the other hand, studies done in other countries viewed mathematics from secular perspectives such as rationalism and pragmatism. The learning of mathematics in classrooms represents the art of acquiring basics skills and building up meaningful mathematical knowledge, rather than just the use of mathematics in examinations. The participants did not have deep understandings of mathematical concepts and process of learning mathematics and further investigation is needed to identified factors contributing to these phenomenon.

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