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Difference in Numeracy Achievement According to Gender for Secondary School Leavers

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ABSTRACT

This quantitative study was done in order to determine the difference in the numeracy achievement of secondary school leavers based on the gender. The study involved 386 lower sixth-form students categorized as secondary school leavers. Students involved were given a numeracy test containing 36 items which consists of Whole Numbers, Fractions, Decimals and Percentages topics in the field of Numbers with a distribution of 9 items for each topic. Independent t-test was used for the analysis of data. Finding of this study shows that there is a significant difference in the numeracy achievement for secondary school leavers of different gender. Since there is a significant difference between male students compared with the female students, the Null Hypothesis in this study is thus rejected. It is hoped that the finding of this study may give inputs to relevant parties so that necessary actions can be implemented.

Keywords: Numeracy, mathematics, real-life situations, secondary school leavers, gender

INTRODUCTION

The Ministry of Education Malaysia (MOE) had defined numeracy as the capability to do basic mathematical operations and understand simple mathematical ideas as well as applying mathematical knowledge and skills in daily life (Kementerian Pelajaran Malaysia, 2010). Numeracy became popular when the government introduced the LINUS program (Literacy and Numeracy Screening) in 2010, which also focused on the capacity of numeracy skills after three years of primary education (Kementerian Pelajaran Malaysia, 2010). Furthermore, at present, mathematics education in Malaysia also concentrates on the results that can be used in real-life situation. This is clearly shown in the objectives of the Secondary School Mathematics Curriculum which aims to develop individuals with mathematical thinking skills and ability to apply mathematical knowledge effectively as well as responsible in solving problems and making decisions, so as to being capable in handling the challenges of daily life in accordance with the development in science and technology (Kementerian Pelajaran Malaysia, 2013).

Numeracy is not limited to mathematics, but also related to other fields such as the fields of science, technology, arts, English language, health (Western Australian Department of Education and Training, 2004), geography, physical education, music and Islamic studies. Apart from that, numeracy constructs are also found in the fields of social, culture, history and politics (Fitzsimons, 2008). In fact, numeracy also exists in real-life situations of an individual which consists of the daily life, work, social, education and recreation (Asiahwati Awi, Munirah Ghazali & Abdul Razak Othman, 2012). In this study, numeracy is associated with mathematics that is used in the real life situations of an individual. Thus, every mathematical problem can also bring implication to an individual's achievement in numeracy.

Problem Statement

Numeracy may vary according to gender. A study found that more than half of the Organisation for Economic Cooperation and Development (OECD) countries showed that males have better numeracy scores than females.

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Countries such as Belgium, Finland, Japan, New Zealand and the United Kingdom showed that achievement in numeracy scores were high with gender differences which were small. However, Russia, New Zealand and Iceland showed that females had higher numeracy scores than males (OECD, 2001).

Furthermore, a profile on numeracy achievement by gender for the population of England was published in 'The Skills for Life'. It was reported that there was a significant difference in the performance on numeracy achievement in which males had fared more favorably than females (William et al., 2003).

Meanwhile, the study of Trends in Mathematics and Science Study (TIMSS) showed that there were significant differences between the gender in mathematics achievement for 8th grade students based on the results of five TIMSS studies that were done (1995, 1999, 2003, 2007, 2011). The countries that showed such differences include Bahrain, Indonesia, Jordan, Lithuania, Malaysia (since 1999), New Zealand, Oman, and Romania. For Malaysia, TIMSS 2011 reported that female students in Form 2 (Grade 8) have better mathematics achievement than male students with significant differences (Mullis, Martin, Foy, & Arora, 2013). Female students showed scores of 521, 512, 479 and 449 respectively in the studies of TIMSS 1999, 2003, 2007 and 2011 compared to male students who obtained 517, 525, 468 and 430. The results showed that the female students' achievement had significantly decreased while male students only increased their achievement in 2003 higher than the average achievement of females. However, the average male students' achievement continued to slide in the 2007 and 2011 reports (Mullis et. al, 2013).

Malaysian students' achievement in Mathematics is less than satisfactory. The test of TIMSS focused on items concerning the solving of real-life mathematical problems. Since numeracy is defined as the ability of an individual to apply mathematical knowledge and skills to solve quantitative problems in real-life situations (Asiahwati Awi et al., 2012), those findings of TIMSS may actually describe the Malaysian students' achievement in numeracy. This study intends to determine the difference in numeracy achievement according to gender for secondary school leavers. The objective of this study should be able to answer the research question about the difference in numeracy achievement according to gender for secondary school leavers.

Research Limitations

This study took only samples of secondary school leavers who are pursuing their lower sixth-form education in Penang. Meanwhile, each information given by the samples were considered true and valid for analysis. Moreover, the scope of this study only involved the field of Numbers which consists of Whole Numbers, Fractions, Decimals and Percentages topics.

LITERATURE REVIEW

Numeracy is described as the same as literacy but it involves more quantitative thinking (Crowther, 1959). Generally, adult numeracy is defined as the knowledge and skills required to manage and respond to the mathematical demands of diverse situations (Gal, van Groenestijn, Manly, Schmitt, & Tout, 2003). Specifically, numeracy at secondary school level is defined as the ability of individuals to identify and understand the role of mathematics in the world, to make judgments, use and engage with mathematics in order to meet the needs of an individual's life as a constructive, concerned and reflective citizen (OECD, 2003). Thus, it is obvious that all the definitions of numeracy show relevance to mathematics in real life situations.

In Malaysia, the primary and secondary school mathematics curricula emphasize the application of knowledge and skills of mathematics in everyday life. This is consistent with the definition of numeracy. Although numeracy does not appear directly as an educational curriculum in Malaysia, its nature has been absorbed and taught through the teaching of Mathematics.

Abroad, numeracy is associated with mathematics and taught through the teaching of Mathematics. Mathematics would have been known as one of the important fields of study and must be learned by the students. Compared with mathematics, numeracy is often not discussed as a discipline by itself. Normally, discussions on numeracy will be associated with mathematics. Since the construction of "numeracy" is usually not accompanied with a universally accepted definition, there is actually no clear statement about how it is different from "Mathematics" (Gal., et al., 2003). Until now, there has been much discussion and debate about the relationship between mathematics and numeracy (Frankenstein, 1989; Johnston, 1994).

METHODOLOGY

The quantitative research design is a cross sectional study as this study is to collect information from a sample of the population that has been identified in advance and carried out in a specific period of time (Noraini, 2013). A total of 600 secondary school leavers who were continuing their studies in the lower sixth-form were selected

as samples. They were selected using a stratified random sampling procedure from three schools that were randomly chosen in each five districts of Penang.

The sample of secondary school leavers consisted of students who have sat for the Malaysian Certificate of Education (SPM). This is because they had gone through the final stages of the Ministry of Education (MOE) syllabus, which generally should be adopted by all students. During this phase, they also experienced a change from late adolescence into adulthood that began at the age of 18 years (Elsevier, 2009; Rakowski et al., 1990). According to Piaget's theory of cognitive development, secondary school leavers are in the formal operational stage which is the last stage of cognitive development. According to the theory, at this stage, they are able to think and solve problems systematically and to examine and apply the same principles to abstract concepts. This stage will be fully realized at the end of adolescence, around age 15 to 20 years (Santrock, 1996). However, at the age of 15 years with the school system, individuals have little preparation for the real-life situations. They need to learn and gain knowledge that can be used in the real-life situations until the age of 18 or 19 years in the formal school system. If they fail to get the knowledge during that time, they need to find for themselves in a world of their adult lives. Thus, the selection of the sample of secondary school leavers is appropriate to fulfill the purpose of the study.

This study measured the students' achievement in numeracy by using the numeracy test and was focused only on Numbers. Topics related to the field of Numbers are Whole Numbers, Fractions, Decimals and Percentages. Each topic contributed nine items which followed the new version of Bloom taxonomy. The items consist of five levels of difficulty from level 1 (easy) up to level 5 (difficult). For every topic chosen, one item was categorized in the level of difficulty 1, two items were categorized in the level of difficulty two, three items were categorized in the level of difficulty 3 and two items were categorized in the level of difficulty 4 while one item was categorized in the level of difficulty 5. Thus, a set of test paper consisting of 36 items was prepared. All the items in this study were to test the students' ability to apply mathematical knowledge and skills in the field of Numbers when solving quantitative problems in the real-life situations (Asiahwati Awi, 2015).

Samples were required to sit for a numeracy test which included 25 objective questions and 11 subjective questions, making it a total of 36 items altogether, at their own schools. The samples needed to give answers inside the given question paper. They had to show their workings for the subjective questions in the provided spaces. The time allocated for the samples to answer was one hour. After that, checking of the answers was done manually and the data was keyed-in for analysis.

Independent-*t* test was done in order to analyze the obtained data using the software *Statistical Package for Social Sciences* (SPSS). The null hypothesis for the test was: there is no significant difference in the mean score according to gender for secondary school leavers.

RESULTS

Only 386 samples fully completed the required information. Hence, analysis was done only on those 386 respondents. Discussion of results is to answer the research question and thus fulfilling the research objective.

Results showed that 191 (49.5%) male students and 195 (50.5%) female students respectively were involved in this study. From the results, it is shown that mean score in numeracy test for male students is 62.2 whilst mean score for female students is 50.7. The objective of the study is intended to determine the difference in numeracy achievement according to gender for secondary school leavers. Therefore, the analysis was continued with the Independent-*t* test. Table 1 shows the result of the Independent-*t* test for numeracy test score based on gender.

TABLE 1
Result of Independent-t test For Numeracy Test Score Based on Gender

	N	Mean	SD	*T*	df	Sig
M	191	62.1896	23.24022			
F	195	50.7435	20.06085	5.183	384	0.0001

*p < 0.05

The results of the Independent-*t* test showed a significant difference ($t = 5.183$, $df = 384$, $p < .05$). Hence, the null hypothesis is rejected. Thus, the study finds that there was a significant difference in the mean score according to gender for secondary school leavers. In addition, the mean score for male students was higher than the mean score for female students in the numeracy test.

DISCUSSION

The objective of this study is to determine the difference in numeracy achievement according to gender for secondary school leavers. The result shows that there is a significant difference between the genders. Male secondary school leavers showed better achievement compared to the female students. This finding is supported by a study on mathematical concept knowledge and achievement relationship done by Hyde et al. (1990) and Parmjit (2005) as well as TIMSS (Mullis et. al, 2013).

This finding is also consistent with the findings by Parmjit (2005) who found that male students seem to show better results than girls at all forms although the difference was only apparent in Form 1 students aged 13. However, the findings of the TIMSS results showed otherwise. TIMSS 2011 also confirms that the average mathematics achievement of students in Form 2 in Malaysia by gender is different. Unfortunately, the findings of TIMSS are contrary to the findings of this study and the study by Parmjit. Although the achievements of female students is declining in the TIMSS study on students' achievement as well as males who plunged in two recent TIMSS studies, the girls showed that their average mathematics achievement was higher than boys in 2007 and 2011, with a significant difference (Mullis et. al, 2013).

The result of this study shows that the mean score of numeracy for males is better than the females. In other words, males know better numeracy compared to females. Hyde et al. (1990) also suggested that the differences between the gender in mathematics achievement is very small, but the difference between the gender in mathematical problem solving (in *real-life situations*) achievement of female students showed lower levels which exist in high schools and colleges.

Therefore, it can be concluded that numeracy is different according to gender. Even so, the difference between the genders is not necessarily remaining in each state or the current state of research done. This can be seen in the study by the 'Department for Education and Skills' (DfES) on the population of England in 2002/03 which also showed a big difference in the performance evaluation numeracy where men have fared more favorably than women even though they have the same literacy level and control of differences in education and employment have been done (William et al., 2003). More than half of OECD countries show that men have better numeracy scores than women. But gender differences were small for Belgium, Finland, Japan, New Zealand and the United Kingdom. In the meantime, Russia, New Zealand and Iceland have shown that females have higher numeracy achievement score compared to the men (OECD, 2001).

Implication of this Study

Mathematics is an essential subject in all domains of life. It is a key at all levels of learning, from primary, secondary up to higher institutions of learning. Thus, much time and effort has being given to the study of the subject so that everybody is able to master and apply mathematical concepts in real life situations. At the same time, students are supposed to take advantage of mathematics not only in the classroom, but outside the classroom. Since numeracy is defined as the ability of an individual to apply mathematical knowledge and skills to solve quantitative problems in real-life situations, everyone needs basic numeracy.

In Malaysia, numeracy is introduced in primary schools. Accordingly, numeracy should also be highlighted in the secondary school curriculum so that secondary school leavers will have a good level of numeracy. Secondary school students also have to go through the learning of numeracy which is actually associated to mathematics. It is one of the most important tasks for the curriculum maker of secondary school syllabus to ensure that no student leaves the school as an 'innumerate' so that they can function in their real life situations after leaving their schooling session.

CONCLUSION

Many hold an opinion that numeracy and mathematics are closely related and inseparable (The Quantitative Literacy Design Team, 2001; Kemp, 2005; Ginsburg et al., 2006). Therefore, an improvement in the mathematics curriculum will also bring about an implication towards numeracy. Since theoretically the curriculum prepared by MOE is already comprehensive, the MOE will just need to give focus on methods of implementing the curriculum so that the objectives of mathematics education will be achieved. At the same time, the education in Malaysia also need to have the same focal point on numeracy and more favorable according to gender.

This focus is necessary because in the future, we are expected to live in an environment which will be flooded by numbers (which requires numeracy) in order to survive the ever-increasing daily activities (Cohen, 2001). In fact at present, numeracy is being given attention by developed countries as special organizations are being set

up to handle matters concerning numeracy. It is hoped that Malaysia will also give a significant attention towards the need and importance of numeracy in the real-life situations for every individual in this 21st century.

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