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Gender Analysis of MyCT (Malaysian Critical Thinking) Instrument

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Abstract

This study aims to determine the ability of critical thinking of male and female students in Malaysia aged 16-17 years using MyCT instrument. The objective is to omit the Gender Differential Item Functioning (GDIF) in the items to improve the quality of this instrument in the future. The survey involved 517 students in Kuantan, Pahang. The results show $t_{obtained}$ = -1.88 and p_{value}= 0.061 meaning that, there is no significant difference between the critical thinking of male and female students. GDIF analysis using WINSTEP version 3.64.2 indicates that 15% of the items in MyCT instruments are still gender bias.

Keywords: Malaysian critical thinking; Gender differential item functioning, Mean score, MyCT instrument, Gender bias

1. Introduction

Browne and Keely in Elizabeth Tice (2005) defines Critical Thinking as the screening process, alienating something relevant that has no connection or relationship. Missimer (1990), Kahane (1992), Beardsley (1975) and Freeman (1993) provide definitions of Critical Thinking as understanding the arguments, recognizing something that is believed to be true but is erroneous (fallacies). In addition, it is the rational to differentiate between premises and conclusions and wise alienate important issues than the intimation that there was no relationship. Meanwhile, Bandman and Bandman (1995) define critical thinking as a rational explanation than the idea, inference, arguments, and assumptions that lead to a conclusion, problems, statements, beliefs and actions. On the other hand, Miller and Malcolm (1990) identify critical thinking as a combination of thought into the question that is supported by certain knowledge and ultimately further extended by the ability to apply it. The most easiest concept to understand about critical thinking is the term of "*problem solving*".

Critical thinking can be set apart from problem solving in that problem solving is a linear process of evaluation, while critical thinking is a comprehensive set of abilities allowing the inquirer to properly facilitate each stage of the linear problem-solving process (Hedges, 1991). According to Victoria Zascavage et al. (2006), Critical Thinking revolves since the days of Socrates (about 2500 years ago). According to Victoria (2006), starting from 21st century, Critical Thinking is applied in order to create productive workers and serve as a basic component for creating a qualified education.

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Critical Thinking is conceptualized as an important part in education. Researchers, educators and psychologist had been emphasizing on the importance of critical thinking in education (Ennis, 1987; Gadzella, et al. 1997; Halonen & Gray, 2001). Education will produce scientists who could contribute to other fields such as science and technology. Recently, a variety of methodologies are being conducted to enhance critical thinking abilities of students. There are widely known standard instruments which are used to analyse critical thinking, such as Watson-Glasser Critical Thinking Assessment (1994), Critical Thinking Assessment Test (CAT) and UNCG Critical Thinking Skills Evaluation Instrument.

In Malaysia, MyCT (Malaysian Critical Thinking) is a tool to measure students' critical thinking age between 16 to 17 years old. This instrument was built by Prof. Dr. Siti Rahayah Arifin et al. This instrument consists of 62 items and divided into four constructs : *reasoning, analytical and logical, disposition and assumption*. Undeniably, there are biased items based on factors such as gender, culture and ethnic. Even in Raven tests that have been standardised, there is still gender biased. (Francisco et al., 2004).

Reasoning in Malaysian Critical thinking refers to focusing on making a decision regarding the case which should be trusted or that should be done. It could involve the process of coaching and assessing in order to support the reasons for belief. Furthermore, *analytical* means ability to know problem, assumption , consider the conclusions reserves, making the formulation of legal and judge the statement based on a given issue. Meanwhile, *disposition* denotes producing one of the best ideas that can be implemented in situation. Moreover, *assumption* means the case which assumed to be true, something which is believed to approve things without any evidence solid.

Efforts are continuously made to improve quality of this instrument, including conducting various analysis using various technique and evaluation methods such as Classical Test Theory (CTT) and Item Response theory (IRT). The second fundamental distinction of this theory lies the measured aspect. IRT measurement does not only focus on the person but also involves the item. Both of this theory is equally important in measurement because an instrument can be more valid and reliable if we understand about those theory. The study tries to use these two points of views to answer some issues related to gender differences in the instruments used in Critical Thinking in Malaysia (Malaysian Critical Thinking). CTT classical theory or approach is referred as what the differences in mean scores between male and female while IRT theory approach represents gender biased item (GDIF). GDIF statistics reveal whether members of two groups (in this case group male and female) , matched on the ability measured by the test, have different probabilities of answering an ***item*** correctly (Hamilton, 1999).

The objective of this study are : (i) To find out whether there is a significant distinction between the mean score of male and female in the four constructs of critical thinking (ii) To examine gender biased items in MyCT instrument and (iii) To determine numbers of GDIF items that need to be excluded in order to construct a qualified MyCT.

2. Methodology

This study employs survey as a methodology to gather data. The population consists of randomly selected 517 Biology students (221 men and 296 women) aged between 16 to 17 years in Kuantan Pahang, Malaysia. The data was analyzed using SPSS 11.5 and Winsteps version 3.64.2. The instrument consists of 62 items that test 17 construct of reasoning items, analytical and logical 15 items, 14 items disposition and 16 items Assumption. To analyze the data in this study, the aspects of the mean and standard deviation are taken into consideration. Further data analysis are carried out using Rasch Model to establish GDIF instrument. This step is important to improve the quality of gender biased items.

3. Results

This study aims to investigate the significant distinction between the mean scores of male and female's critical thinking. The study also aims to establish (GDIF) in MyCT instrument. The result of the study proves that there is no distinction between men and women because $p = 0061$. GDIF analysis shows the reliability before exclusion of items for construct reasoning = 0.98, analytical and logical = 0.99 assumption = 0.99 and disposition = 0.99. After the items are excluded, the reliability of construct reasoning increases to 0.99 while for the construct of analytical equipment is unchanged.

Table 1 shows the demographic profile of respondents who has answered MyCT. Based on the Table, the number of female respondents is 57%, higher than male respondents which is only 43%. Most of the respondents are Malays (65.6%) and only 34.4% which are non Malays.

Table 1. Demographic Profile of Respondents

Demographic factors	**Number**	**Factor**	**Frequency**	**Percent**
Gender	517	Male	221	43
		Female	296	57
Nation	517	Malays	339	65.6
		Non Malays	178	34.4
Income	517	<RM 1000	122	23.6
		RM. 1000 - 2000	134	25.9
		RM. 2001 - 4.000	125	24.2
		> RM 4.000	136	26.3

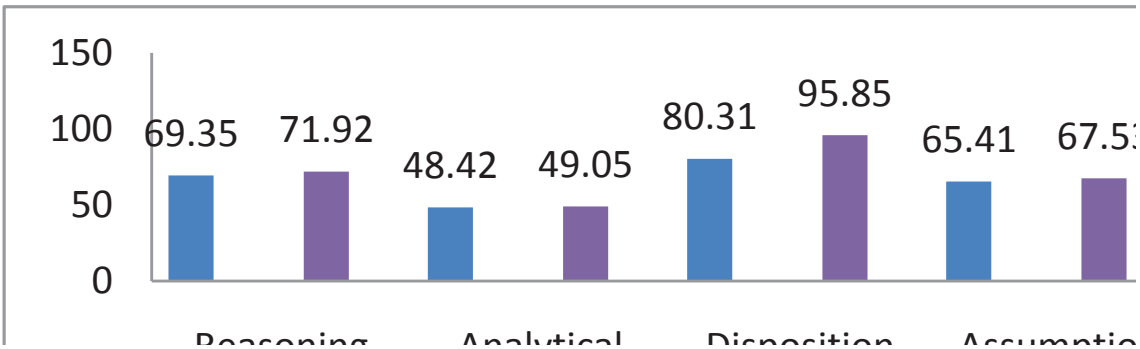
The result of the distinction between mean score of male and female in the four constructs of critical thinking by using MyCT instrument are in the following table:

Table 2. Gender Analysis Base on Four Construct

Gender	**n**	**Reasoning**		**Analytical**		**Disposition**		**Assumption**		**Overall**	
		Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Male	**221**	69.35	15.22	48.42	12.25	80.31	9.48	65.41	12.36	65.87	7.14
Female	**296**	71.92	15.85	49.05	11.53	95.85	9.77	67.53	11.42	67.02	6.70
t		-1.86		-0.60		0.85		-1.99		-1.85	
p		**0.06**		**0.55**		0.**39**		**0.05***		0.06	

***** *Significant at α : 0.05.*

Based on the table above, it can be concluded that there is no significant distinction between Critical Thinking of male and female aged 16 - 17 years. The table proves there is only one construct that indicates a significant distinction between male and female (assumption constructs).



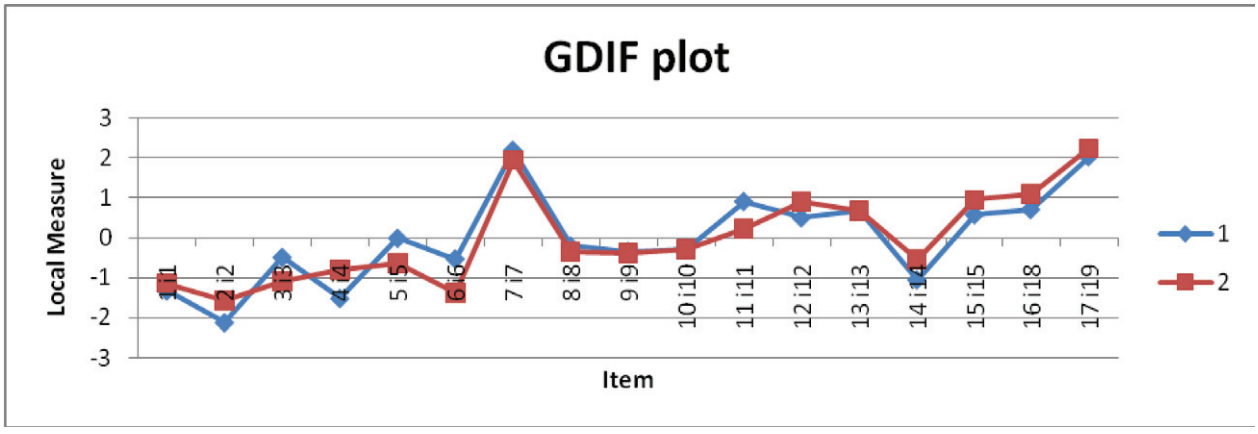
Graph 1. Critical Thinking distinction Between Male and Female

Based on the above table, female did better than male in all tested constructs. The mean score from the point is difference. After being tested using independent t-test, it showed the Table 2. All constructs have $p_{value} > 0.05$. Hence, it can be concluded that there is no significant distinction of critical thinking among students of male and female aged 16 to 17 years in Malaysia.

The following gender analysis will be reviewed from the GDIF perspective. To determine the GDIF, indicator from Tennant & Pallant (2007) with some criteria are being employed (i) the value of Dif Contrast greater than -0.5 or greater than 0.5, (ii) t value greater than -0.2 or greater than 2.0 (iii) $p_{value} < 0.05$. p is always coherent with t. This means if t is detected as a significant value to exclude the item, then the value of p must have the same conclusion. The criteria found to have the value of all three indicators in constructing the MyCT are as follows:

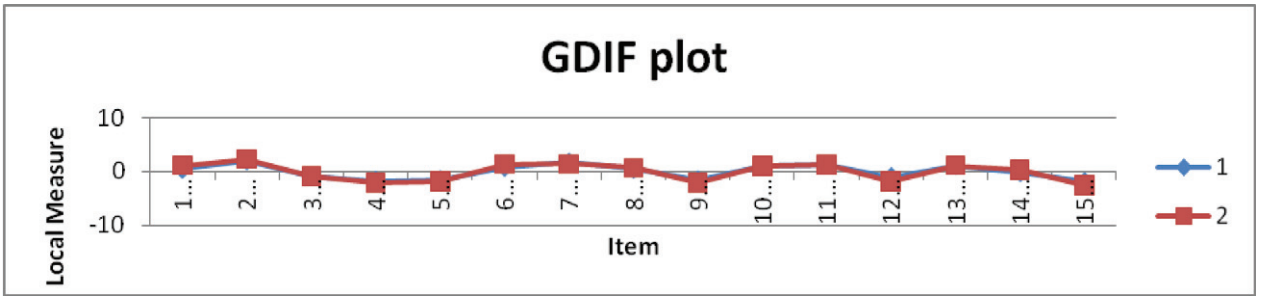
Table 3. GDIF Analysis for Reasoning Construct

Item Number :	t	Dif contrast	*P*	Easier to
'i11	-3,05	-0,68	0,0024	Female
'i6	-2,78	-0,85	0,0056	Female
'i5	-2,46	-0,64	0,0159	Female
'i4	-2,20	-0,72	0,0282	Male
'i3	-2,05	-0,59	0,0405	Female



Graph 2. GDIF for Construct Reasoning

Item Number	t	Dif contrast	P	Easier to
‘ii31	-3,91	-0,90	0,0001	Female
‘ii20	-3,39	-0,68	0,0008	male
‘ii25	-2,81	-0,59	0,0052	male
‘ii34	-2,10	-0,60	0,0362	female



Graph 3. GDIF for Construct Analytical and Logical

For construct Disposition and Assumption There were no GDIF items Detected because all of the indicator still in acceptable criteria.

Table 5 .Overall Analysis Critical Thinking construct

No	Construct	First Total Item	Item drop base on GDIF	Total Item Drop	Last Item
1.	Reasoning	**17**	i3,i4,i5,i6 and i11	**5**	**12**
2.	Analytical and Logical	**15**	‘ii20,ii25,ii31, and ii34	**4**	**11**
3.	Disposition	**14**	There is no item omitted	**0**	**14**
4.	Assumption	**16**	There is no item omitted	**0**	**16**
	Total			**9**	**53**

Based on the above table, MyCT are still gender biased items on the construct of reasoning and analytical constructs. Two of these construct need to be paid attention for quality improvement.

4. Discussion

Critical thinking is very important in every action and decision. Because by having a good critical thinking, someone also can good in problem solving. This statement supported by the research by Ayse Yenilmez and Semra Sungur (2006) which said that there is a significant correlation between reasoning student’s capacity with their achievement test. From gender perspective, this research found that there is a significant gender difference. But we know that reasoning is only a part of critical thinking capacity. Contrary with the finding from this reseach which said that no significant differences between female and male critical thinking especially for students whose age 16-

17 in Malaysia. This reseach support the finding from Irwing Paul and Richard Lynn (2005) who said that basically, there's no difference in core of intelligent or "g" or general factor between male and female. The difference only happen in specific cognitive abilities, such as male better in quantitative and female better in verbal. The score obtained from the average of different abilities including verbal comprehension and reasoning, immediate memory, visualization, spatial and perceptual abilities. This definition normally used by educational, clinical, and occupational psychologists. In particular, people think that male students tended to outperform female students on measures requiring visual or spatial processing (Halpern, 1997; Lohman, 1993). Although the implications of this difference for achievement in science were not explored extensively, there was some evidence that it affected performance on certain types of mathematics items (Halpern, 1992). Male students tended to perform better on geometry items than did female students who were matched on total test score (O'Neill & McPeek, 1993).

A research about gender academic result in Malaysia, has an interesting result who founded by Zalizan Moh. Jelas et all. (2005). She said that, in five years national exam result, the female always outperform than male in all subject. After a deep investigation, then it conclude that the factor are because the learning style of female different from male and female more prepare for the exam than male. Another factor is because female teachers, sometimes have a negative perception to male student. By seeing how low is the result for analytical and logical thinking for example, it can be sign for teachers and curriculum designer to create a model of teaching and learning which can improve the ability of critical thinking. Learning style must change from *"exam oriented"* to *"problem solving oriented"*. This instrument is very good to measure student in this age because they are going to be *" a future leader"* and a good leader must have a good critical thinking to solve many problems. Someone who have a high education level, not guarantee he or she also have a good critical thinking. We should measure it first before we can decide. Now in Malaysia, there is no instrument that can measure critical thinking for more than 18 years old. But at least this is a good beginning to know the potential teenager for us as a teacher and for government as a decision maker.

5. Conclusions And Suggestion

Based on the study, we can summarized that Malaysian Critical Thinking instrument (MyCT) has a good quality. This is a result of there are only 8 out of 62 items containing gender biased. This connotes only about 15% items that should be disqualified. If we analyze from the mean score, it is known that there is no significant difference between male and female in Critical Thinking Skill of students aged 16 to 17 years in Malaysia. This reflects the instrument is quite fair for both male and female. Further study could be carried out not only based on gender but also based on other factors such as student's demographic, ethnicity and economic status.

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