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The Perception of Critical Thinking and Problem Solving Skill among Malaysian Undergraduate Students

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Abstract

This study aims to investigate students' perception on their critical thinking and problem solving skill. It also aims to determine whether there are differences between genders and academic disciplines on this skill. A sample of 2000 undergraduate students from six Malaysian public universities completed the survey. Findings indicate that students perceived they have high critical thinking and problem solving skill. It is also revealed that male students are perceived to have better critical thinking and problem solving skill. Social science students appear to perform better in this skill, as compared to science and engineering students.

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*Keywords:*Critical thinking, gender differences, academic discipline; problem solving; Malaysian undergraduate students.

1. Introduction

Critical thinking refers to an ability to analyze information, to determine the relevance of information gathered and then to interpret it in solving the problems (Gagné, 1988). It requires high-level thinking; involves the process of analysis, evaluation, reasonableness and reflection (Jeevanantham, 2005). As future human capital, university students need to equip themselves with critical thinking and problem solving skill as this is the focus of employers in hiring new people. Unfortunately, there are past studies and news reported that most university graduates are still lacking with this skill. For example, a survey by ManpowerGroup (2012) found that employers are not satisfied with

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graduates' problem solving skill and their ability to deal with ambiguity or complexity. Consistenly, the Director of Students Affairs Development in the Ministry of Higher Education Malaysia, Professor Dr. Mohd Fauzi Ramlan, claimed that graduates are lacking with communication skill and problem solving skill (KOSMO, 2012). If the issue or problem is not addressed, an implication would be an increase in number of unemployed graduates in the future.

According to Othman, Mohd Salleh, al-Edrus and Sulaiman (2008), students learning context is one of the factors that contributes to generic skills deficiency, particularly towards critical thinking and problem solving skill. For example, teaching and learning process in the classroom which emphasize on rote learning and too focused on the content cause students to memorize the knowledge learned, rather than to analyze and synthesize the exact meaning of the knowledge. Since they do not have deep understanding regarding the knowledge learned, it leads to reduce their ability to think critically as well as to solve complicated problems (Shakir, 2009). Other than students learning context, Pumphrey and Slater (2002) claimed that technology advancement is also a factor that causes development of critical thinking and problem solving skill being less efficient. With the technology advancement, students can get access to all the information through internet, which then causes negative effect as they simply adopt the information without analyzing, interpreting and thinking critically (Purcell, et al., 2012). This also hinder their ability to solve the problems because internet offers most of the solutions.

For the above mentioned reasons, this study intends to investigate investigate students' perception on their critical thinking and problem solving skill. It also further examines if there are differences between gender and academic discipline on this skill. Three academic discipline of social science, science and engineering will be the focus of this study. The remainder of the paper is structured as follows. A theoretical framework adopted in the study and key literature will be reviewed in the next section. Then, research methodology used in the study is explained and followed by presentation of results. Lastly, this paper will finalize with the conclusion.

2. Literature review

2.1. A model of critical thinking and problem solving

In describing students' thinking process, this study implements model (see Figure 1) by Haller, Fisher and Gapp (2007) which is the main focus in learning and teaching context. Based on Figure 1, the model suggests that students engaged with learning process through repetitive activities, memorizing, understanding and reflecting. All of these processes require them to think in order to achieve effective learning outcomes and thereby enhance problem solving skill. Yet, the order of thinking differs at each stage. For example, reflecting stage requires higher order thinking (critical thinking) as compared to repetitive or memorizing stage. There are factors which may influence students' thinking process. These factors are teacher-student relationship, collective or collaborative studying, deep approach and transformational learning. In the context of this study, lecturer plays main role in providing clear instruction and conduct interesting activities in the class because it influence students' thinking process. The lecturer should emphasize in giving students with challenging tasks that require them to think critically, instead on focusing in rote learning (Schafersman, 1991).

Moving from repetitive activities or memorizing into understanding stage, students may influence with the second factor, which is collective or collaborative studying. By working collaboratively, students will experience the process of analyzing the problems and express their ideas to other team members (Forgarty & McTighe, 1993) which later enhance their understanding of knowledge learned. At this understanding stage, students will attempt to make sense of the knowledge learned through deep approach to learn. Students who integrate with this approach have commitment to understand the knowledge, and thereby reflected in using variety of methods.

As mentioned by Colley, Bilics & Lerch (2012), reflection process is one of essential elements in critical thinking. Reflection requires one's thought in making inferences, analogies, evaluations and explore deep understanding regarding the specific knowledge, and these relate to problem solving (Kitchenham, 2008). The outcome of reflecting process then results in the transformational learning (depicted as fourth factor in model of Figure1) as it influence the whole learning process. In short, transformative learning requires students to have broader view based on their past experience through critical reflection process.

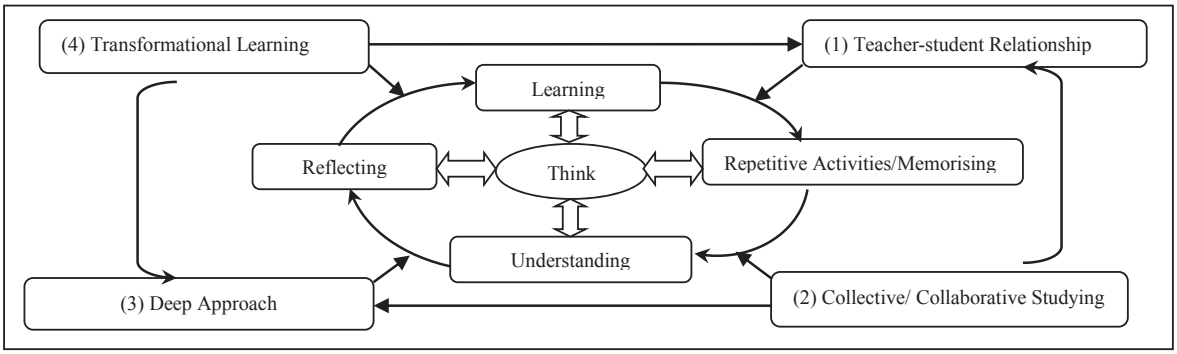

Fig. 1. A Model of Critical Thinking and Problem Solving
Source: Haller, et al. (2007)

2.2. Gender, academic discipline, critical thinking and problem solving skill

Numerous studies look into critical thinking and problem solving skill with regards to gender differences and academic disciplines (Aliakbari & Sadeghdaghighi, 2011; Kathiravelu, Tapsir, & Osman, 2004; Leach & Good, 2011; Sacli & Demirhan, 2011). However, results of these studies have been mixed. Aliakbari & Sadeghdaghighi (2011), for example, surveyed 84 university students regarding their critical thinking skill and found male students gain more critical thinking skill compare to female students. Consistently, male students also being reported to score high mean on five dimensions (analysis, induction, deduction, evaluation and inference) of critical thinking than female counterparts (Leach & Good, 2011). In the Malaysian setting, Kathiravelu, et al. (2004) found contrast finding, where female students performed better in critical thinking. Despite of differences between gender, Sacli and Demirhan (2011) discover there is no differences between genders towards critical thinking skill. In overall, findings from past studies suggested that male students think critically in solving problems than female students.

The differences in nature of work within social science, science and engineering drives this study to identify whether these academic disciplines significantly influence the means of critical thinking and problem solving skill. Most of past studies discovered that academic discipline has influenced on this skill (Aliakbari & Sadeghdaghighi, 2011; Leach & Good, 2011; Mahdyeh & Arefi, 2014). By making comparison between humanities and engineering students, a recent study demonstrates that there is a significant difference between these two fields on critical thinking skill (Mahdyeh & Arefi, 2014). The finding indicates that engineering students score high mean of critical thinking than humanities students. In addition, Aliakbari & Sadeghdaghighi (2011) have studied on 84 students from three different groups in regards to investigate their critical thinking. They found similar finding, as engineering students are more critical thinkers than social science and basic science students. In other study, Leach and Good (2012) conducted a survey aims to determine differences in major college of study (consist of Arts and Sciences, Business and Technology, Clinical and Rehabilitative Health Sciences, Continuing Studies, Education, Nursing, and Public Health) on five dimensions of critical thinking. The findings reveal that all dimensions; analysis, induction, deduction, evaluation and inference were significantly influenced by these major college of study. In analysis dimension, for example, nursing school scored high mean, while Nursing, Arts and Science score high mean for induction dimension. For the deduction and inference dimensions, two majors (Business Technology and Art and Sciences) performed better than others. Lastly, students who enrolled in Arts and Science scored higher mean of evaluation dimension compared to the rest.

3. Methodology

The population of undergraduate students in public universities was studied. This population were then stratified randomly according to their academic discipline (refer to Social Science, Science and Engineering disciplines). Using survey method, a total of 2800 questionnaires were distributed to students in six Malaysian public universities, however only 2000 students completed the questionnaire indicating 71.4% of response rate. Students from Social Science discipline enrolled in five programs including accounting, human resource management, management

technology, marketing and psychology. Meanwhile, Science discipline involves students in four programs of biology, chemistry, physics and mathematical science. In engineering discipline, the participation was from students in three programs; consist of civil, mechanical and electrical engineering. This study adopts eleven statements of critical thinking and problem solving skill from thinking roles (include monitor evaluator, plant and specialist roles) of Belbin Team Role Self-Perception Inventory (BTRSPI) (Belbin, 2013). Descriptive analysis (such as mean and standard deviation), t-test and analysis of variance (ANOVA) were employed in this study. In investigating differences between genders on critical thinking and problem solving skill, this study used t-test as it permits to identify any significance in the means for two groups (Sekaran & Bougie, 2009). Meanwhile, ANOVA is used to examine the significance mean differences between academic disciplines (Sekaran & Bougie, 2009).

4. Data analysis

4.1. Respondents' demographic

Table 1 reports the distribution of respondents' demographic related to gender, age, races and academic disciplines. From a total of 2000 students who involved in the survey, 682 were male students (34.1%) while 1318 students were female students (65.9%). Students between the age of 19 to 24 (87.7%) dominate the sample and the rest were between the age of 24 and above (12.4%). With the respect of races, more than half of the respondents were Malay (69.8%), followed by Chinese respondents (24.1%) and the remaining are Indians and others races contributed to 2.5% and 3.6% respectively. The distribution of respondents in regards to academic discipline appears that social science respondents accounted for 39.3%, while 32.4% were engineering respondents and the rest were science respondents (28.4%).

Table 1. Respondents' demographic

Students' Demographic	Number	Percentages
Gender		
Male	682	34.1%
Female	1318	65.9%
Age		
19 - 23	1753	87.7%
24 and above	247	12.4%
Race		
Malay	1396	69.8%
Chinese	482	24.1%
Indian	49	2.5%
Others	72	3.6%
Academic Discipline		
Social Science	785	39.3%
Science	568	28.4%
Engineering	647	32.4%

4.2. Perception of critical thinking and problem solving skill

The following analysis was to report students' perception regarding critical thinking and problem solving skill by computing mean score for each statement (refer Table 2). Overall, mean score for each statement reports above 4.00 indicated that students perceived that they able to think critically in solving problems. Briefly, students highly agreed that they analyzed other people's ideas objectively, by evaluating both advantages and disadvantages as this statement shows the highest mean score of 5.35. The second highest mean score (5.30) appears that students agreed to have creative approach and evaluate range of suggestions before solving a complex problem. Perhaps, these creative and evaluation abilities learnt in the classroom lead them to agree with the statement of able to integrate ideas and techniques into new concept (5.21), able to connect pattern in solving problems than others (5.16) and approach new project in analytical way (5.13). Although all statements report means score above 4.00, which indicate high level of skill, but students slightly agreed to make critical discrimination between alternatives (5.09) and take an independent

and innovative look at most situations (5.07). In other words, students may require assistance from the lecturers in solving problems as they still in learning process. On the other hand, students less agreed with the statement of able to find the argument in denying unsound propositions (4.89). This situation may demonstrate that students are lack of understanding regarding topic learnt in the classroom since they unable to differentiate between valid and invalid facts. Lastly, students expressed that feelings have influenced on their judgement when given difficult task with limited time and unfamiliar people as the mean score is the lowest (4.79).

Table 2. Computed means for statements of critical thinking and problem solving skill

No.	Statements	Mean	SD
1	In seeking satisfaction through my work, I tend to have a creative approach to solve problem solving.	5.30	1.02
2	In carrying out my day-to-day work, I tend to see pattern in solving problems where others would see items as unconnected.	5.16	1.03
3	When suddenly asked to consider a new project, I am able to take an independent and innovative look at most situations.	5.07	1.06
4	I can see how ideas and techniques can be used in perceiving new relationships.	5.21	1.02
5	I analyse other people's ideas objectively, by evaluating both advantages and disadvantages.	5.35	1.01
6	In seeking satisfaction through my work, I like to make critical discrimination between alternatives.	5.09	1.20
7	When trying to solve a complex problem, I like to weigh up and evaluate a range of suggestions thoroughly before choosing.	5.30	1.03
8	In carrying out my day-to-day work, I can usually find the argument to deny unsound propositions (ie. propositions that contain of invalid facts).	4.89	1.13
9	If I am suddenly given a difficult task with limited time and unfamiliar people, my feelings seldom interfere with my judgement.	4.79	1.17
10	When suddenly asked to consider a new project, I approach the problem in a carefully analytical way.	5.13	1.04
11	I take considerable amount of time to make judgement but most often, the judgement made is accurate.	5.09	1.05

4.3. Differences in gender on critical thinking and problem solving skill

Table 3. Compare means between gender on critical thinking and problem solving skill

No.	Statements	Male	Female	t	Sig.
1	In seeking satisfaction through my work, I tend to have a creative approach to solve problem solving.	5.32	5.30	.386	.700
2	In carrying out my day-to-day work, I tend to see pattern in solving problems where others would see items as unconnected.	5.18	5.15	.725	.469
3	When suddenly asked to consider a new project, I am able to take an independent and innovative look at most situations.	5.14	5.04	2.052	**.040***
4	I can see how ideas and techniques can be used in perceiving new relationships.	5.21	5.20	.147	.883
5	I analyse other people's ideas objectively, by evaluating both advantages and disadvantages.	5.37	5.34	.656	.512
6	In seeking satisfaction through my work, I like to make critical discrimination between alternatives.	5.14	5.06	1.550	.121
7	When trying to solve a complex problem, I like to weigh up and evaluate a range of suggestions thoroughly before choosing.	5.33	5.28	1.063	.288
8	In carrying out my day-to-day work, I can usually find the argument to deny unsound propositions (ie. propositions that contain of invalid facts).	4.96	4.86	1.888	.059
9	If I am suddenly given a difficult task with limited time and unfamiliar people, my feelings seldom interfere with my judgement.	4.88	4.75	2.420	**.016***
10	When suddenly asked to consider a new project, I approach the problem in a carefully analytical way.	5.18	5.11	1.577	.115
11	I take considerable amount of time to make judgement but most often, the judgement made is accurate.	5.16	5.05	2.268	**.023***

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

Table 3 reports that there are no significant differences between male and female on this skill except for three statements (Statements 3, 9 and 11). In Statement 3, it shows that male students (significant at $p<0.05$) are more able to take an independent and innovative look at most situations than female students. As expected, male students $(t=2.420, p<0.05)$ have high agreement that feelings seldom undermine their judgement when given to work with

limited time and unfamiliar people, compared to female students. Finally, there is a significant differences of Statement 11, where it demonstrates that male students *(t=2.268, p<0.05)* take longer time than female in making accurate judgement. In overall, the findings of mean differences between genders suggest that male students are more critical thinker and competent problem solver than female students, which similar with the prior study by Leach & Good (2011) and Aliakbari and Saghedi (2011).

4.4. Differences in academic discipline on critical thinking and problem solving skill

Table 4. ANOVA table between academic discipline and critical thinking and problem solving skill

No.	Statements	Frequency Distribution			ANOVA		*Bonferroni post hoc tests*			
		Academic Dicsiplines	**Mean**	**SD**	**F**	**Sig.**	**Academic Dicsiplines (I)**	**Academic Dicsiplines (J)**	**Mean Difference (I-J)**	**Sig.**
1	In seeking satisfaction through my work, I tend to have a creative approach to solve problem solving.	Social Science	5.49	1.02	23.08	**.000****	Social Science	Science	.292	**.000****
		Science	5.20	0.96			Social Science	Engineering	.331	**.000****
		Engineering	5.16	1.04			Science	Engineering	.038	1.000
2	In carrying out my day-to-day work, I tend to see pattern in solving problems where others would see items as unconnected.	Social Science	5.33	1.03	16.96	**.000****	Social Science	Science	.249	**.000****
		Science	5.08	0.98			Social Science	Engineering	.291	**.000****
		Engineering	5.04	1.05			Science	Engineering	.042	1.000
3	When suddenly asked to consider a new project, I am able to take an independent and innovative look at most situations.	Social Science	5.24	1.06	17.45	**.000****	Social Science	Science	.292	**.000****
		Science	4.95	1.00			Social Science	Engineering	.275	**.000****
		Engineering	4.97	1.07			Science	Engineering	-.017	1.000
4	I can see how ideas and techniques can be used in perceiving new relationships.	Social Science	5.41	1.00	26.76	**.000****	Social Science	Science	.319	**.000****
		Science	5.09	0.95			Social Science	Engineering	.350	**.000****
		Engineering	5.06	1.05			Science	Engineering	.031	1.000
5	I analyse other people's ideas objectively, by evaluating both advantages and disadvantages.	Social Science	5.50	1.03	15.26	**.000****	Social Science	Science	.215	**.000****
		Science	5.28	1.00			Social Science	Engineering	.277	**.000****
		Engineering	5.22	0.96			Science	Engineering	.062	.839
6	In seeking satisfaction through my work, I like to make critical discrimination between alternatives.	Social Science	5.23	1.11	11.71	**.000****	Social Science	Science	.249	**.000****
		Science	4.98	1.07			Social Science	Engineering	.235	**.000****
		Engineering	5.00	1.08			Science	Engineering	-.014	1.000
7	When trying to solve a complex problem, I like to weigh up and evaluate a range of suggestions thoroughly before choosing. Tarrely evaluate suggestion tarreli to solving complex problem	Social Science	5.44	1.04	12.93	**.000****	Social Science	Science	.198	**.001****
		Science	5.24	1.02			Social Science	Engineering	.262	**.000****
		Engineering	5.17	1.00			Science	Engineering	.065	.809
8	In carrying out my day-to-day work, I can usually find the argument to deny unsound propositions (ie. propositions that contain of invalid facts). Argue unsound proposition	Social Science	5.01	1.19	7.78	**.000****	Social Science	Science	.154	**.039***
		Science	4.85	1.05			Social Science	Engineering	.229	**.000****
		Engineering	4.78	1.11			Science	Engineering	.075	.737
9	If I am suddenly given a difficult task with limited time and unfamiliar people, my feelings seldom interfere with my judgement. During work under pressure	Social Science	4.84	1.26	1.22	.295	Social Science	Science	.057	1.000
		Science	4.78	1.05			Social Science	Engineering	.096	.367
		Engineering	4.74	1.15			Science	Engineering	.038	1.000
10	When suddenly asked to consider a new project, I approach the problem in a carefully analytical way.	Social Science	5.28	1.07	13.66	**.000****	Social Science	Science	.207	**.001****
		Science	5.07	1.00			Social Science	Engineering	.271	**.000****
		Engineering	5.01	1.01			Science	Engineering	.064	.830
11	I take considerable amount of time to make judgement but most often, the judgement made is accurate.	Social Science	5.29	1.05	24.42	**.000****	Social Science	Science	.305	**.000****
		Science	4.99	0.99			Social Science	Engineering	.351	**.000****
		Engineering	4.94	1.06			Science	Engineering	.046	1.000

** Significant at the 0.01 level (2-tailed); * Significant at the 0.05 level (2-tailed)

Table 4 presents the ANOVA results which show that there are differences in academic discipline and critical thinking and problem solving skill. All statements reported to have highly significant differences (p=.000) between

academic disciplines, except for Statement 9 which related to the interference of feelings in making judgement when working with unfamiliar people and limited time. It demonstrates that one's judgement may be affected by other factors such as people to work with as well as time given to complete the work. A Bonferroni pos hoc test was run in order to further examine the differences in these statements. The test shows that there are significant differences between social science and both science and engineering disciplines, but there is no significant difference between science and engineering discipline. This may be due to the similarity of these two disciplines which known as critical and tough program. In details, social science students were perceived to have high critical thinking and problem solving skill than science and engineering students. The social science students tend to have creative approach and able to see pattern in solving problem as well as take an independent and innovative look at most situations ($p=0.000$ for these statements). Before making any conclusion, social science students prefer to evaluate and make critical discrimination between several alternatives, compared to other two disciplines. In the statement of find the argument to deny unsound propositions, there is a significant difference between social science students and both science ($p=0.039$) and engineering students ($p=0.000$).

5. Conclusion

This study has achieved its objectives. Firstly, the study aims to investigate the perception of critical thinking from the students' perspective. Finding revealed that students perceived themselves highly critical thinking and problem solving skill as they agreed with the statement of evaluating both advantages and disadvantages when analysed other people's ideas. Most probably, one's has being taught to evaluate pro and cons before making decision in solving the problem. They also have a creative approach and innovative look in solving problem. Furthermore, they agreed that they able to make accurate judgement with given sufficient time to think by making critical discrimination between alternatives. It shows that students understand and reflect what they have learned in classroom as these processes lead to higher order thinking in solving the problems as depicted in the model of critical thinking and problem solving by Haller, et al. (2007). However, they stated that feelings have undermined their judgement when given a difficult task with limited time and unfamiliar people. In other words, the capability to make accurate judgement may drop when they feel uncomfortable to discuss with unfamiliar people, with the addition of time pressure which then lead to stress in work. As asserted by Stonehouse, Hamill, Campbell and Purdie (2004), people who work together should share similar meaning on issues discussed in solving the problems. Moreover, Milliken and Martins (1996) claimed that the diversity (such as gender differences and different background) leads to affect cohesion in reaching any consensus regarding work.

Secondly, the study aims to determine if there are any differences between genders and academic disciplines on this skill. In terms of gender differences, male students are more critical thinker and competent problem solver than female counterparts, which in contrast with the finding of study in Malaysian setting by Kathiravelu, et al. (2004). This could be explained by Herrmann (1996) as males often using their left brain dominance, which refer to logical and analytical thinking, whereas females incline to use right brain as their preferences to feelings and interpersonal based thinking. On the other hand, there are highly significant differences between social science and both science and engineering disciplines. The findings revealed that social science students performed better than the other two discipline which in contrast with the past studies (Aliakbari & Sadeghdaghighi, 2011; Mahdyeh & Arefi, 2014). Most probably engineering and science students only understand subject learnt during lecture, but do not reflect it when solving the problems as compared to social science students. However, the findings indicated that there is no significant difference between science and engineering disciplines. This may be due to the similarity of these two disciplines which known as tough and critical programs.

Based on this finding, students need to be well prepared to work with different people and deal with unpredictability (such as time constraint) especially in real workforce. As this skill are important for future career, this study recommends that lecturers should provide clear instruction and conduct interesting activities in the class because it influence students' thinking process. The lecturers also should emphasize in giving students with challenging tasks that require them to think critically, instead on focusing in rote learning (Schafersman, 1991). Furthermore, this study recommends that students need to focus in class by understanding the subject learnt so that they able to perform better in test and produce high quality of assignment. Other activities such as co-curriculum, training and camp related to critical thinking and problem solving skill should be promoted to the students. Among recommendations is that

university should ensure the courses and activities are effective and achieve the learning outcome.

Findings of this study are significance to students, higher education practitioners (mostly lecturers), and higher learning institutions, mainly to public universities in Malaysia. Firstly, the findings of this study indicates to what extent students perceived about critical thinking and problem solving skill that be implemented in the classroom. Secondly, higher education practitioners may improve method in facilitating the development of these skill, like conducting brainstorming session. At the same time, higher learning institutions able to identify if any loopholes within the integration of this skill in the undergraduate syllabus. In addition, the findings also make an important contribution to the body of knowledge regarding critical thinking, primarily in Malaysian context.

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