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Exploring the Mastery Level of Critical Thinking and Problem Solving Skill among the Technical Undergraduate

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Abstract: Statistics from the Department of Statistics showed that 76200 graduates in this country still failed to get a job. One of the main reasons of this phenomenon is the graduates are still unable to meet the demand of the current job market. The current job market is not only take seriously on knowledge and technical skills but also soft skills. Therefore, the Ministry of Higher Education (MOHE) listed seven soft skills that should be possessed by the graduates. Among the seven soft skills, critical thinking and problem solving is the one of the emphasized skill. In this skills, there are three main subskills must be mastery from a total number subskills of seven. Thus, a survey was conducted to identify the level of critical thinking and problem solving skills among the engineering undergraduate students. A total of 341 final year students of Bachelor's degree in Universiti Tun Hussein Onn Malaysia were stratified randomly selected as respondents. Data was collected through an achievement test on critical thinking and problem solving skills. Mean, standard deviation, Mann Whitney U test and Kruskal Wallis Test were employed to analyze the gathered data. Results showed that the level of critical thinking and problem solving skills of students for the three main subskills (Ability to Identify and Analyse Problem in Complex or Ambiguous Situation and Develop Justification Evaluation; Ability to Improve and Develop Thinking Skill as Explain, Analyse and Discussion Evaluated; Ability to Generate the Ideas and Alternative Evaluation) were at a moderate level. As the conclusion, the MOHE, education institutions and students must work together in order to enhance the acquisition for critical thinking and problem solving skill of graduates through the modification of teaching strategies, strengthening academic programs and others intervention programme.

Keywords: Critical thinking, problem solving skill, subskills, technical graduates

1. Introduction

Most of the job market not only focus on academic achievement as the main criteria for employee selection, but also emphasize on soft skills among graduates as the criteria for the employment. Having an excellent academic achievement does not guarantee the employment for a graduate due to highly competitive in the job market. Graduate unable to mastery the soft skills because the learning process from school level to the university level is emphasizes on "rote learning" rather than to think and practice. In a results, graduates facing difficulty to get a place in the job market due to the low level of their generic skills despite of their excellence in the academic achievement (Hassan, 2004). In other words, they fail to meet the employers' expectations in generic skills. Graduates should have a generic element to enable themselves facing the highly competition in the global marketplace and turn Malaysia into a competitive nation.

Low level in the soft skills among the graduates has been proven through a survey conducted by Jobstreet.com in 2010. A total of 250 government and private companies found that university-leavers failed to highlight four basic soft

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skills during the interviewed session, namely communication skills, values and ethics, leadership and critical thinking & problem solving skills (Kosmo, 2010). Among these four soft skills, critical thinking and problem solving is the utmost important. This statement is in line with Hong Leong Bank's Human Resources Chief in a interview by Sinar Harian. He mentioned that many new graduates emerging from Malaysia's education system have no critical thinking skills which is needed to compete in an ever-changing world and make them become more competitive. New methods and technologies used in work place force people to complete the given task outside their comfort zone (Bernama, 2012).

Moreover, Abdullah (2004) in his speech during the Education Summit held in Kuala Lumpur said that among the significant weaknesses among the graduates today are lacking of communication skills, critical thinking and problem solving skills, initiative and confidence that contribute to the increasing of unemployment rates in the country. Graduates are an important asset in building the future of nations. Therefore, every student should prepare themselves before leaving the institution to meet current job market demands. Consequently, Ministry of Higher Education Malaysia was launched The Soft Skills Development Module for Higher Education Institutions (IPT) on 22 August 2006 with the aims of producing quality and skillful human capital in order to create the competitive manpower for the job market. Seven elements of soft skills (KI) have been identified as attributes that need to be mastered by graduates of IPT are as follows:

- Communication Skills
- Critical Thinking and Problem Solving Skills
- Teamwork Skills
- Life Long Learning and Information Management Skills
- Entrepreneurship Skills
- Professional Ethics and Moral
- Leadership Skills

Realising the important of critical thinking and problem solving (CTPS) skills for the graduates' marketability, this study was conducted on bachelor's degree in UTHM to identify their CTPS skills level. This findings of this study could help students to understand better their critical thinking and problem solving skills, thereby raising awareness about importance in mastery CTPS skills. Additionally, it also provided the opportunity for graduates to self-assess of their skill level. This study contained two objectives to be achieved: (i) Identify the critical thinking and problems solving skills level among the final year undergraduates; (ii) Identify the significant differences in critical thinking and level problems skills among the final year undergraduates from the aspects of faculty, CPA and gender.

Critical thinking and problem solving skills (CTPS) is the skills that involve critical thinking, creativity, innovative, analytical, and ability to apply from theory into practice in new or different situation. According to Ministry of Higher Education (2006), critical thinking and problem solving is divided into two categories, which are Essential Soft Skills (KIM) and Additional soft skills (KIT). KIM is the soft skills that every student must to have. If these skills are not mastery, the students are considered incompetent in the relevant aspects. Whereas, KIT is considered as value added to students. If this skill is mastery by the student as well as KIM, the student's competence in the relevant aspect is considered excellent. Nevertheless, this study only emphasized on KIM. KIM consists of three subskills that are Ability to Identify and Analyse Problem in Complex or Ambiguous Situation and Develop Justification Evaluation; Ability to Improve and Develop Thinking Skill as Explain, Analyse and Discussion Evaluated; Ability to Generate the Ideas and Alternative Evaluation. This study is significant to provide the current scenario to the TVET Empowerment Committee in order to develop TVET policy especially from the aspect of industrial needs that emphasize on real-world problem solving skills. In addition, there is no any comprehensive study that have been done on Essential Soft Skills (KIM) and Additional soft skills (KIT) stated by Malaysia Ministry of Education. Furthermore, the findings also provide ideas to higher learning institutions to design their instruction or training module that able to produce future workers to meet the industrial needs.

2. Methodology

The research design for this study was employed a survey method. A total number of 341 technical final year undergraduate in Universiti Tun Hussein Onn Malaysia were strata randomly selected as sample. The instrument used for this study was adopted from the Watson-Glaser Critical Thinking Skill Appraisal (WGTC) and developed a set of achievement test to investigate the three main subskills in CTPS skills among the undergraduate. The details of the instrument is showed in Table 1.

Demographic in this study focus on gender, faculty and CPA. The faculty was divided into two group, which is engineering and non-engineering. Meanwhile, CPA was divided into three group, which were first class (3.75 – 4.00), second upper class (3.00 – 3.75) and second lower class (2.00 – 2.99). In order to analyse the collected data, mean, standard deviation, Mann Whitney U test and Kruskal Wallis Test were applied. Pilot test was conducted through 20 samples to determine the reliability value of the CTPS achievement test. Kuder Richardson 20 (KR-20) was employed to analyse the reliability of the instrument and the result showed that r value = .65. This showed that the developed instrument is reliable and able to gather the CTPS skills level of the selected respondents.

Table 1 : Details of Instrument

No	Part	Item
1	Part A : Respondents' Demographic	
	i.	Gender
	ii.	Faculty
	iii.	CPA
2	Part B: Critical Thinking & Problem Solving Skill Achievement Test	
	i.	Ability to Identify and Analyse Problem in Complex or Ambiguous Situation and Develop Justification Evaluation
	ii.	Ability to Improve and Develop Thinking Skill as Explain, Analyse and Discussion Evaluated
	iii.	Ability to Generate the Ideas and Alternative Evaluation
Total		30

3. Findings and Discussion

3.1 The Critical Thinking and Problem Solving Skills Level among the Undergraduates

The CTPS skills level among the technical undergraduates was determined through three subskills, namely Ability to Identify and Analyse Problem in Complex or Ambiguous Situation and Develop Justification Evaluation (CTPS-1); Ability to Improve and Develop Thinking Skill as Explain, Analyse and Discussion Evaluated (CTPS-2); Ability to Generate the Ideas and Alternative Evaluation (CTPS-3). The mean score and standard deviation were used to analyse the data as showed in Table 2. Results showed that respondents tend to have highest score in CTPS-3 (M=6.46, SD=1.65), followed by CTPS-2 (M=5.02, SD=1.73) and CTPS-1 (M=4.03, SD=1.50). This finding showed that undergraduates at final year who will join the job market soon are still weak in CTPS skills. These three subskills are the KIM, which are the subskills must be mastery by students by the end of the programme. This situation must be taken seriously especially those educator and policy maker in university level because Critical Thinking and Problem-Solving skills is in the list of for the top 10 skills 21st Century Learner need to thrive in the fourth industrial (World Economy Forum, 2016).

Table 2 : The CTPS skills level among the undergraduates

CTPS Subskills	Mean score (M)	Standard Deviation (SD)	Level
Ability to Identify and Analyze Problem in Complex or Ambiguous Situation and Develop Justification Evaluation	4.03	1.50	Medium
Ability to Improve and Develop Thinking Skill as Explain, Analyse and Discussion Evaluated	5.02	1.73	Medium
Ability to Generate the Ideas and Alternative Evaluation	6.46	1.65	Medium

3.2 The Difference in Critical Thinking and Problem Solving Skills from the aspect faculty, CPA and Gender

In order to identify the difference in CTPS skills between Engineering and Non-Engineering undergraduates, Mann-Whitney U Test was used to analyse the data. The result showed that there was no significant difference in all three subskills of CTPS between Engineering and Non-Engineering undergraduates as showed in Table 4 (CTPS-1: U=10951, p>.05; CTPS-2: U=10627, p>.05; CTPS-3: U=11305, p>.05). However, the Engineering undergraduates tend to have higher mean rank (172.70) than Non-Engineering (166.34) undergraduates in CTPS-1. In contrast, Non-Engineering undergraduates tend to have higher score in CTPS-2 and CTPS-3 than the Engine In order to identify the difference in CTPS skills between Engineering and Non-Engineering undergraduates, Mann-Whitney U Test was used to analyse the data. The result showed that there was no significant difference in all three subskills of CTPS between Engineering and Non-Engineering undergraduates as showed in Table 4 (CTPS-1: U=10951, p>.05; CTPS-2: U=10627, p>.05; CTPS-3: U=11305, p>.05).

However, the Engineering undergraduates tend to have higher mean rank (172.70) than Non-Engineering (166.34) undergraduates in CTPS-1. In contrast, Non-Engineering undergraduates tend to have higher score in CTPS-2 and CTPS-3 than the Engineering undergraduates as illustrated in Table 3. The situation may be due to the difference in

focus and learning in the discipline of Engineering and Non-engineering students. Engineering by nature focus more on logic and fact in finding solutions, and solutions for the problem are usually constant. Furthermore, engineering students need only find answers to specific problems, solutions and solutions that are unchanged and this makes them difficult to accept other possibilities that can solve their problems. On the other hand, Non-engineering is more focused on methods to find solutions and tend to have dynamic responses. Additionally, for Non-Engineering students, each problem may have multiple solutions as long as the methods can to solve the problems (Lee & Wan Adam, 2016). This argument is in line with Difference Between.Net (2019) saying that Non-engineering is the study of systematically arranged fact that can be logical explained, however the Engineering is a branch of science that deals with the discipline of gaining and using practical knowledge to desing and produce solution to mankind’s used. Also, National Academy of Engineering (2018) clearly mention that engineering graduated needs to obtained the technical knowledge and skills that associated with professional skills, but non-engineering graduated doesn’t needs this “Engineering Skills” from the industry.

Table 3: Mean Rank for CTPS Subskills between Engineering and Non-Engineering Faculty

CTPS Subskills	Faculty	Mean Rank
CTPS-1	Engineering	172.70
	Non-Engineering	166.34
CTPS-2	Engineering	168.01
	Non-Engineering	179.22
CTPS-3	Engineering	170.72
	Non-Engineering	171.77

Table 4 : Mann-Whitney U Test for Engineering and Non-Engineering Faculty in CTPS Subskills

	CTPS-1	CTPS-2	CTPS-3
Mann-Whitney U	10951.00	10627.00	11305.00
Wilcoxon W	15137.00	42002.0	42680.00
Z	-.539	-.945	-.088
Asymp.Sig.(2-tailed)	.590	.345	.930

For the purpose of comparing the three subskills of CTPS among the three different groups of CPA undergraduates, Kruskal Wallis Test was employed to analyse the gathered data. The results showed that there is a significant difference in CTPS-1 ($\chi^2=10.16, p<.05$), CTPS-2 ($\chi^2=15.78, p<.05$), and CTPS-3 ($\chi^2=25.32, p<.05$) among the first class, second upper and second lower undergraduates as showed in Table 6. Obviously, those who have first class tend to have higher score in both CTPS-1 and CTPS-2 than second upper and second lower undergraduates as showed in Table 5. Surprisingly, Second lower undergraduates tend to have higher score in CTPS-3 compare to second upper and first class undergraduates, which is the subskills of ability to find ideas and alternative solutions. This situation may due to the cognitive level difference among the undergraduates. Critical thinking and problem solving is something deal with the mind. Therefore, those who have higher achievement in cognitive tend to have a better score in CTPS. The relationship between cognitive performance and thinking abilities was proofed by a lot of previous studies, for example American Dental Education Association (2019), Cano and Martinez (1991), ASHE-ERIC Higher Education Report (1988).

Table 5: Mean Rank for CTPS Subskills among Three Groups of CPA

CTPS Subskills	Groups CPA	Mean Rank
CTPS-1	First Class	205.85
	Second Upper	168.96
	Second Lower	148.60
CTPS-2	First Class	215.58
	Second Upper	167.87
	Second Lower	144.30
CTPS-3	First Class	143.59
	Second Upper	162.74
	Second Lower	226.27

Table 6 : Kruskal Wallis Test for Engineering and Non-Engineering Faculty in CTPS Subskills

	CTPS-1	CTPS-2	CTPS-3
Chi-Square	10.159	15.783	25.324
df	2	2	2
Asymp.Sig.	.006	.000	.000

- a. Kruskal Wallis Tes
- b. Grouping Variable : CPA

On the other hand, Mann-Whitney U Test was used to analyse the data to determine the difference in CTPS skills between male and female undergraduates. The result showed that there was a significant difference in all three subskills of CTPS between male and female undergraduates as showed in Table 8 (CTPS-1: $U=8532.50$, $p<.05$; CTPS-2: $U=9692.5$, $p<.05$; CTPS-3: $U=9719.5$, $p<.05$). As predicted, male undergraduates (mean rank = 191.97) tend to have higher score in CTPS-2 than female undergraduates (mean rank = 162.90). Surprisingly, female undergraduates tend to have higher score in CTPS-1 and CTPS-3 than male undergraduates as presented in Table 7. Gender always is the factor in differences on thinking skills. From the general perception, male is tend to have a better score in thinking skill and problem solving skills. Surprisingly, this study shows an interesting findings where female students tend to have a higher score in CTPS skills than male undergraduates. This findings is significant to provide information on gender study to support the UNESCO-UNEVOC policy that emphasise on a balance seeks to promote equity for genders (Paryono, 2017). In addition, gender is one of the key factor that will effect on the development of critical thinking skills (American Dental Education Association, 2019). However, some results showing that gender doesn't play any role in critical thinking and they believe that critical thinking skills can be learned and be enhanced through life experience and knowledge generation (Shubina, Ivanna & Kulakli, Atik, 2019).

Table 7: Mean Rank for CTPS Subskills between Male and Female Undergraduates

CTPS Subskills	Faculty	Mean Rank
CTPS-1	Male	137.82
	Female	183.82
CTPS-2	Male	191.97
	Female	162.90
CTPS-3	Male	150.31
	Female	178.99

Table 8: Mann-Whitney U Test for Male and Female Undergraduates in CTPS Subskills

	CTPS-1	CTPS-2	CTPS-3
Mann-Whitney U	8532.500	9692.5000	9719.500
Wilcoxon W	13092.500	40073.500	14279.500
Z	-3.954	-2.483	-2.449
Asymp.Sig.(2-tailed)	.000	.013	.014

4. Conclusion

Based on the findings of this study, it can be concluded that the level of critical thinking and problem solving skills among undergraduates in UTHM is at moderate level. However, the findings also show that there is significantly difference in the mastery level of CTPS among the undergraduates with different CPA achievement and gender. The findings also showed that there were no significant differences in CTPS between engineering and non-engineering undergraduates. Realising the importance of CTPS skills in graduates, all the responsible parties should work together to enhance the CTPS skills among students to an optimum level. High mastery level in CTPS may equip graduates with competitiveness ability to venture into the job market. Besides, graduates is the most important asset to ensure the country development and sustain to develop, the elements of knowledge, skills and values must blended together in order to create a high quality of human capital to ensure the future of country.

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