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Research paper

Assessing Critical Thinking Skills in Polytechnic

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Abstract

The level of critical thinking skills and its relationship to CGPA is investigated in this study. 80 men and 21 women from two engineering department at Polytechnic Ibrahim Sultan participating in this investigation. This research utilized The Malaysian Critical Thinking Skills Instrument-MyCT which consists of 60 items. Data analysis were performed using SPSS 22.0 for descriptive and inferential statistics. Comparative findings across studies revealed that the critical thinking level of engineering students at Polytechnic Ibrahim Sultan was intermediate (47.42%). The Mann-Whitney U test determines the variables between four categories in critical thinking skills and obtained no significant differences. The correlation of commuting between critical thinking skills as calculated with Spearman's rho is not statistically significant. There was a negative weak correlation for analytical and logical (r=-0.098). Analysis of the computed findings revealed that the critical thinking is at a moderate level but weak in analytical and logical and disposition skills. In conclusion, lecturers must be more sensitive to this phenomenon, in which the emphasis on analytical and logical and disposition are important in teaching and learning.

Keywords: *Critical thinking; polytechnic; engineering, mathematics; students.* .

1. Introduction

Ministry of Higher Education has present a model for seven types of soft skills that are to be implemented which included critical thinking (MOHE, 2006). The National Education Blueprint (2015-2025) highlighted the importance of critical thinking ability in the nation's education agenda for the next decade (MOE, 2012). Students ought to be instructed to express their own thoughts, think innovatively and be critical in learning (KPM, 2013). Outcome based education implementation in Malaysian polytechnic has highlighted critical thinking skills as an important skill in a program learning outcome1. Critical thinking skill is a noteworthy and continuing part of tertiary education and the improvement of criticality in students has for consistently regarded. The culture of thinking that should be honed by the lectures must be based on the idea of the 21st century It is the key part in advanced education which is result based and the dominant part of the learning is accomplished by creativity, analysing skills, and evaluation. These are advanced through various philosophies and is subject to instructor capacity and abilities. There is much prominence in advanced education research and arrangement on the significance of preparing students with critical thinking skills 3. One of the vital intuition aptitudes related to advanced education is critical thinking and persuasive in scholarly accomplishment 4. Students now should be outfitted with critical thinking skills to adjust to the new complexities and the requests of a testing world. The classroom, as a position of adapting, along these lines, should likewise work as a place for the readiness of students for the outside world

According to the Malaysian Curriculum Development Division (KPM, 1996), the importance of critical thinking ability are as follows:

i) to produce Malaysians who can think critically to achieve the goals of Vision 2020;

ii) to develop individuals who are intellectual, spiritually, emotionally and physically balanced and harmonious; and

iii) to develop students "capacity to think critically and creatively additionally to make decisions and clarify issues.

2. Literature Review

Colleges take part in various endeavours to impart critical thinking into the educational module6. Unfortunately, most universities try not to comprehend that they don't have a substantive thought of critical thinking, trust that they enough appreciate it, and expect they are currently indicating students it 7. Chalk talk, repetition retention and here and now examine propensities are yet the standard in the polytechnic guideline and adapting today. The most imperative are that students are not urged to end up distinctly free masterminds from an early age 8. An education system that took place in institutions of higher learning is now more 'exam oriented' compared on which requires students to apply the skills they have.
The previous study has reported that teachers are more focused on memorization and recall of various concepts, theorems and formu-

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las in mathematics and the results to be achieved by the students are the correct answer in solving math problems without understanding the concept and experience the process of using the knowledge10. Furthermore, limited activities involving math problems in the teaching and learning of mathematics 11.

The most incessant elements referred to for unemployment of Malaysian graduates are the absence of correspondence and critical thinking skills 5. The findings showed that the mean attitude of critical thinking is at a medium level among UKM students9. However, recent evidence found that the levels of critical thinking are still principally at the inferior levels in an IPTA in northern Malaysia12. In addition, the critical thinking levels for high-performance students are significantly higher than low and moderate students between universities in final year bachelor in accounting throughout universities in Malaysia13.

In fact, for critical thinking and problem solving, there are employers who suggest that polytechnic students are unable to generate ideas to solve work-related problems14. The researcher found that student in Islamic Studies program college maintains the average level of critical thinking and it is not a prediction of academic achievement15. The study among premier polytechnic students in Malaysia shows that men students are more critical in thinking about learning the Islamic Education course 16. Furthermore, the critical thinking sub-skills levels among undergraduate students were reported at the medium level 17. In contrast, a study by others researcher indicated that students perceived they have high critical thinking and problem solving skill among Malaysian undergraduate students.

Feeble critical thinking skills prove themselves from various perspectives; hazardous and expensive blunders, rehashed botches, awful choices, fizzled frameworks, in action when activity is required, the giving off terrible exhortation, off base suppositions, the poor outline of preparing projects, the poor assessment of instructive educational module, the absence of foreseen activity19. Surveying critical thinking is vital because it sets instructional needs, as well as because the information can give important input to partners on student learning. Critical thinking information can be utilized by instructors to enhance guideline, by directors to settle on educated program choices, and by guardians and voters to survey the results from their speculations to enhance student learning

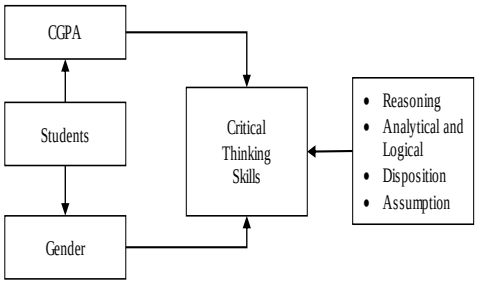


Figure1. Conceptual Framework

2.1 Research Objectives

This article has three objectives.

To evaluate the level of critical thinking skills in polytechnic.

To determine the significant differences on the level of critical thinking skills across gender.

To investigate the relationship between the level of critical thinking skills and CGPA

3. Methodology/Materials

This study is a survey research through a quantitative approach. The goal of this research to review the level of critical thinking skills among polytechnic students and its relationship with CGPA. The study population consisted of second-semester students majoring in engineering at the Polytechnic Ibrahim Sultan enrolled in Engineering Mathematics 2 course. The Malaysian Critical Thinking Skills Instrument–MYCT 21 was used in collecting data for this study with Cronbach's alpha 0.809. The instrument is divided into Part A and Part B. Part A consists of demographic information, while part B consists of 60 items divided into four sections.

The four sections are based on four sub-constructs to be measured in the domain of critical thinking reasoning, analytical and logical, disposition and assumptions. Questionnaires were distributed to the students during the class. The students were studying at the Department of Mechanical Engineering (JKM) and Department of Electrical Engineering (JKE). The data analysis utilized the IBM SPSS Statistics for analyzing mean, Mann-Whitney U test and Spearman 's Rho.

4. Results and Findings

Table1. Respondent Demographics

Demography	N	Factor	Frequency	Percent (%)
Gender	101	Men	80	79.2
		Women	21	20.8
Faculty	101	JKM	51	50.5
		JKE	50	49.5
CGPA	101	3.51-4.00	16	15.8
		3.01-3.50	62	61.4
		2.51-3.00	22	21.8
		≤ 2.50	1	2

Table 1 shows a total of 101 engineering students who participated in this study in which the number of men was 80 (79.2%), while the number of women was 21 (20.8%). The findings show that students involved JKM were 51 students and JKE involved were 50 respondents. The majority (61.4%) is made up of engineering students who have achieved their CGPA (3:01 to 3:50), namely 62 students and 1% of the students were the least are those who have achieved CGPA (≤ 2.50) of one (1) students only.

Proficiency is measured by the score range by the Ministry of Education as in table 2.

Table2. Score Range Determination Mastery Level Skills

The range of marks (%)	Level of proficiency
80-100	Excellent
60-79	Good
40-59	Medium
20-39	Weak
0-19	Very Weak

This finding describes the distinctions in the level of critical thinking in all four sub constructs, namely (reasoning, analytical and logical, dispositions and assumption). Full marks for each sub-construct Malaysian Critical Thinking Skills Instrument-MyCT is reasoning (36), analytical and logical (10), disposition (100) and assumption (4).

Table3. Critical Thinking Skills Mastery Level

Skills	Mean	Maximum Marks	Percent (%)	Level	Total
Reasoning	20.09	36	55.81	Medium	
Analytical and Logical	3.90	10	39.00	Weak	
Disposition	36.85	100	36.85	Weak	47.42% (Medium)
Assumptions	2.32	4	58.00	Medium	

Based on the findings in Table 3, provides evidence that overall level of critical thinking skills of students is at medium level (47.72%). There are two skills, reasoning and assumptions are in the medium level with 55.81% and 58.00% respectively, in the range (40%-59%). The average score for reasoning skills is 20.09 compared to the maximum 36 marks, while assumptions are 2.32 compared to the maximum four (4) marks. The minimum marks for reasoning skills are eight (8) and assumptions skills are zero (0).

Among the four skills studied, students have a weak mastery level in analytical and logical (39.00%) and disposition (36.85%).

These skills are in the range (20% to 39%). The average score for analytical and logical is 3.90 compared to the maximum marks ten (10) marks. The minimum score for analytical and logical skills are one (1), while for the disposition skills is 36.85 compared to the maximum score is 100. The minimum score for disposition skills is 19. This result describes significant differences on the level of critical thinking skills between men and women.

Table4. Differences Mean Rank Critical Thinking Skills Across Gender

		Ranks		
Skills	Gender	N	Mean Rank	Sum of Ranks
Reasoning	Men	80	51.62	4129.50
	Women		48.64	1021.50
		101		
Analytical and Logical	Men	80	51.36	4109.00
	Women	21	49.62	1042.00
		101		
Disposition	Men	80	50.46	4037.00
	Women	21	53.05	1114.00
		101		
Assumptions	Men	80	50.54	4043.50
	Women	21	52.74	1107.50
		101		

Table 4 demonstrates the mean rank critical thinking skills of men are higher than women for reasoning skills (M: 51.62, W: 48.64), analytical and logical skills (M: 51.36, W: 49.62). While for dispositions skills (M: 50.46, W: 53.05) and assumptions skills (M: 50.54, W: 52.74) which the mean rank critical thinking skills of women is higher than men.

Table5. Mann-Whitney U Critical Thinking Skills Across Gender

		Rank of Analytical and Logical	Rank of Disposition	Rank of Assumptions
Mann-Whitney U	790.500	811.000	797.000	803.500
Wilcoxon W	1021.500	1042.000	4037.000	4043.500
Z	-.415	-.248	-.361	-.333
Asymp. Sig. (2-tailed)	.678	.804	.718	.739

a. Grouping Variable: Gender

Table 5 presents the results of tests analyzed using the Mann-Whitney U test to evaluate if there were significant differences for the four sub-construct critical thinking skills between men and women. Overall, the test results showed no significant difference on the level of critical thinking skills across gender. The following are the results; reasoning skills ($z = -.415$, $p>0.05$), analytical and logical ($z = -.248$, $p>0.05$), disposition ($z = -.361$, $p> 0.05$) and assumption ($z = -.333$, $p>0.05$).

Table6. Differences Mastery Level Critical Thinking Skills Across Gender

Skills	Gender	N	Mean	Percent (%)	Level of proficiency	Total
Reasoning	M	80	20.25	56.25	Medium	Medium (55.18%)
	W	21	19.48	54.11	Medium	
Analytical and Logical	M	80	3.94	39.4	Weak	Weak (38.5%)
	W	21	3.76	37.6	Weak	
Disposition	M	80	36.73	36.73	Weak	Weak (37.03%)
	W	21	37.33	37.33	Weak	
Assumptions	M	80	2.30	57.50	Medium	Medium (58.50%)
	W	21	2.38	59.50	Medium	

According to Table 6, it was found that reasoning and assumptions skills are at the medium level, by 55.18% and 58.50%, respectively for men (80) and women (21). However, the analytical and logic and dispositions skills are at the weak level of 38.5% and 37.03% respectively for both men (80) and women (21). The analysis showed that the level of proficiency in the reasoning skills for men and women are both located on the medium level (men, 56.25% and women 54.11%). In addition, the maximum mark obtained by men is 36, while marks from women are 31, while the minimum score of men is eight (8) and women are 14.

Furthermore, the level of proficiency in the analytical and logical skills for men and women are both weak, (men 39.4% and women 37.60%). This shows that there is no significant difference in the level of analytical and logical skills across gender. In addition, the maximum score obtained by men 10/10 and women is 7/10, while the minimum scores of men and women are 1/10.

The trend in the level of disposition skills for men and women are both at the weak level, M: 36.73% and W: 37.33%. This shows no significant difference in disposition skills across gender. In addition, the maximum score obtained by men is 55/100 and women are 53/100, while the minimum marks of men and women are same 21/100. Finally, the level of proficiency in the assumptions skills for men and women are both located on the medium level where men 57.50% and 59.50%. In addition, the maximum marks obtained by the men and women were the same, 4/4 marks, while the minimum scores of men are 0/0 and women are 2/4.

Table7. Correlation Spearman's Rho Critical Thinking Skills Students With CGPA

			CGPA	Reasoning	Analytical Logical	Disposition	Ass tion
Spearman's rho	CGPA	Correlation Coefficient	1.000				
		Sig. (2-tailed)	.				
		N	101				
	Reasoning	Correlation Coefficient	-.167	1.000			
		Sig. (2-tailed)	.094	.			
		N	101	101			
	Analytical Logical	Correlation Coefficient	-.098	.113	1.000		
		Sig. (2-tailed)	.329	.261	.		
		N	101	101	101		
	Disposition	Correlation Coefficient	-.070	.064	-.078	1.000	
		Sig. (2-tailed)	.484	.522	.436	.	
		N	10	101	101	101	

			1				
	As-sumptions	Correlation Coefficient	-.080	.124	.256**	-.040	1.000
		Sig. (2-tailed)	.426	.218	.010	.693	.
		N	101	101	101	101	101

Correlation is significant at the 0.01 level (2-tailed)

Table8. Correlation Spearman's Rho Mastery Level Critical Thinking Students With CGPA

Correlation Type	Variable	N	r	Sig
Spearman's rho	CGPA	101	1.000	-
	Reasoning	101	-.167	.094
	Analytical and Logical	101	-.098	.329
	Disposition	101	-.070	.484
	Assumptions	101	-.080	.426

Table 7 and 8 show the results of Spearman's Rho ends correlation where there is no correlation between the CGPA with the students' critical thinking skills at 0.01 level. The analysis shows there is no significant difference the sig. (2-tailed), $p<0.01$ for all four skills, namely Reasoning ($p=0.094$), analytical and logical ($p=0.329$), disposition ($p=0.484$ and assumptions ($p=0.426$). Overall, these findings indicate there is no relationship between student achievement with the latest CGPA among the four skills; reasoning, analytical and logical, dispositions and assumptions. This means a higher the student achievement of the CGPA has no relationship with the level of critical thinking skills. However, there are significant differences between assumptions with analytical and logical skills. The findings also revealed that the correlation coefficient showed a very weak positive in for reasoning ($r=0.167$), and negative weak correlation for analytical and logical ($r=-0.098$), dispositions ($r=-0.070$) and assumption ($r=-0.080$) showed a very negative weak correlation in table 8.

Table9. Mastery Level Critical Thinking Skills Across the CGPA Student Achievement

Skills	CGPA	N		Percent (%)	Level	Total
Reasoning	3.51-4.00	16	20.88	57.99	Medium	Medium (53.95%)
	3.01-3.50	62	20.58	57.17	Medium	
	2.51-3.00	22	18.23	50.63	Medium	
	≤ 2.50	1	18.00	50.00	Medium	
Analytical and Logical	3.51-4.00	16	4.44	44.38	Medium	Weak (39.82%)
	3.01-3.50	62	3.85	38.55	Weak	
	2.51-3.00	22	3.64	36.36	Weak	
	≤ 2.50	1	4.00	40.00	Medium	
Disposition	3.51-4.00	16	36.69	36.69	Weak	Weak (37.42%)
	3.01-3.50	62	37.24	37.24	Weak	
	2.51-3.00	22	35.73	35.73	Weak	
	≤ 2.50	1	40.00	40.00	Medium	
Assumptions	3.51-4.00	16	2.38	59.38	Medium	Medium (56.25%)
	3.01-3.50	62	2.31	57.66	Medium	
	2.51-3.00	22	2.32	57.96	Medium	
	≤ 2.50	1	2.00	50.00	Medium	

Based on Table 9, one (1) engineering students achieved CGPA ≤2.50, while 22 students achieved the CGPA between 2:51-3:00, 62 students achieved CGPA between 3:01-3:50 and 16 students achieved CGPA between 3:51-4:00. This shows that majority of engineering students have CGPA between 3:01-3:50 (62 people), and the least is students who achieved CGPA ≤ 2:50 which is only one (1). According to the results, the four skills critical thinking across the CGPA students, available skills reasoning, and assumptions are in the medium level by 53.95% and 56.25%, respectively, while the analytical and logical and disposition is at a weak level of 39.28% and 37.42% respectively. for students with high CGPA between 3:51-4:00 their level of critical thinking skills was at the medium level for reasoning, analytical and logical, and assumptions while the dispositions skills showed that the critical thinking skills are at weak level. Disposition skills also found that students who gained low and average CGPA 2:51 -3:00, 3:01-3:50 and 3.51-4.00 showed weak mastery of the critical thinking skills but, CGPA $\leq$2.50 demonstrate mastery at the medium level (40.00%).

5 Conclusion

The results of this investigation show that of critical thinking skills among engineering students at the polytechnic are at a medium level. From the Mann-Whitney U analysis, the level of mastery of critical thinking skills across gender showed no significant difference. The mastery level of critical thinking among engineering students in Polytechnic Ibrahim Sultan is at a moderate level in the range of 47.72% (40-59) %. The finding is consistent with findings of past studies by 9, 17. Spearman's Rho correlation analysis showed there is no relationship between student achievement and latest CGPA among the four skills. In fact, the reasoning, analytical and logical, disposition, assumption showed a very negative weak correlation.

These results indicate that engineering students have the skills analytical and logical dispositions skills at a weak level. This indicates engineering students are weak in mastering the ability to generate evidence to support comprehensively and accurately for an opinion. Another important finding was that that engineering students have the skills reasoning and assumption at a moderate level. The analysis results of the study researchers between the four critical thinking skills across the CGPA students, available skills reasoning and assumption is located at a medium level of 53.95% and 56.25%, while analytical and logical and disposition is at a weak level of 39.82% and 37.42% respectively.

The results revealed that the level of critical thinking among engineering students in Polytechnic Ibrahim Sultan is at a moderate level but weak at analytical and logical and disposition skills. Dispositions are pivotal to critical thinking; without them, basic speculation does not occur or might be substandard. A further study with more focus on critical thinking is therefore suggested. Researchers suggested that the lecturers to be more sensitive to this phenomenon, in which the emphasis on analytical and logical and disposition are important in teaching and learning.

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