International Journal of Engineering & Technology, 7 (3.35) (2018) 272-275

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Critical Thinking and Problem Solving Skill Development: A Study in Malaysian Public Universities

Shazaitul Azreen Rodzalan*[1], Maisarah Mohamed Saat[2], Lily Suriani Mohd Arif[3]

[1] *Department of Technology Management, Universiti Tun Hussein Onn Malaysia, Parit Raja Batu Pahat, Malaysia*
[2] *Department of Accounting and Finance, Universiti Teknologi Malaysia, Skudai Johor, Malaysia*
[3] *Department of Human Resource Development, Universiti Teknologi Malaysia, Skudai Johor, Malaysia*
**Corresponding e-mail: shazaitul@uthm.edu.my*

Abstract

One critical measure to be hired at the workplace is the ability to think critically in problem solving. As future human capital, university graduates are urged to meet with this expectation. Hence, taking this expectation into consideration, this study aims to examine students' critical thinking and problem solving skill development before and after they undergoing the industrial training. The study also aims to examine whether the problem solving skill's development is influenced by supervisors' leadership styles. This study is longitudinal. A total of 1227 students and 485 students completed the pre survey and post survey respectively. The questionnaire used consists of items adapted from Belbin thinking roles and leadership items based on Multifactor Leadership Questionnaire (MLQ). Result revealed that there is a significant improvement in students' critical thinking and problem solving skill after undergoing their industrial training. The findings of this study provide some practical and empirical implications.

Keywords: *Critical thinking; problem solving; Malaysian undergraduate students.*

1. Introduction

Both the fast-paced technology and the changing scenarios at the workplace demand employers to be very selective in hiring new employees. In coping with these situations, todays' employers look for employees who can think critically to produce innovative products and services as to solve complex problems. However, university graduates are reported to have low critical thinking skill which have given a raise of concern among various stakeholders in education (Cheong et al., 2005; Konting et al., 2007; ManpowerGroup, 2012). Therefore, university students as the future workforces are urged to meet this demand from the industries in order to be recruited once graduated. If the issue is prolonged, it will result in a higher rate of unemployement among new graduates.

Students' learning context is said to become one of the factors that contribute to deficiency in critical thinking and problem solving skill (Othman et al., 2008). According to Rohaeti (2010) the teaching and learning process in the classroom which emphasize on rote learning is undermining the development of students' thinking skill. He further asserts that this traditional method of rote learning will hinder students ability to analyze and synthesize the exact meaning of the knowledge because they tend to memorize the knowledge learned without having the right understanding. Furthermore, technology advancement is also said to become one of the factors that contribute to low critical thinking and problem solving skill (Pumhrey and Slater, 2002). One clear example, how technology lowers student thinking and problem skills are when information needed can be accessed through internet and simply adopted without analyzing, interpreting and thinking about the information critically (Purcell et al., 2012).

Based on the abovementioned issues, this study is motivated to investigate students' critical thinking and problem solving skill development by measuring before and after their industrial training. It also aims to investigate the relationship between supervisor's leadership styles and critical thinking and problem solving skill development. It is hypothesized that students develop their critical thinking and problem solving skill after their industrial training. The findings of this study give implications to industrial training stakeholders (include students, higher learning institutions and host organizations) as they can identify to what extent students benefit from undergoing the industrial training, particularly in improving their critical thinking and problem solving skill. Moreover, the findings also make an important implication to the critical thinking and problem solving literature as well as learning outcomes of industrial training, particularly in Malaysia.

This paper is organized as follows: Begin with a discussion on Critical thinking and problem solving model and followed by reviews on key literature. Next, the research methodology employed in this study is explained. The paper ends with the findings and the discussion of the findings.

2. Literature review

A Model of Critical Thinking and Problem Solving. A model in Figure 1 describes students' thinking process which the main focus is in learning and teaching context. The model by Haller et al. (2007) proposed that students engaged with thinking process by undergoing the stages of learning, repetitive activities, memorizing, understanding and reflecting. These stages however, requires different order of thinking. For instance, at the stage of reflecting, students are required to use higher order thinking as

compared to repetitive or memorizing stage which required low thinking skill.

In addition, the model also emphasizes on four factors which may influence students' thinking process; teacher-student relationship, collective or collaborative studying, deep approach and transformational learning. In the first factor, lecturer or teacher should provides students with clear instruction and creates interesting class by actively encouraging students' participation in class discussion and providing challenging task to them (Schafersman, 1991). By having these methods, it can enhance students' ability to think critically in solving complex problems since they being taught early in teaching and learning process in the class. Meanwhile, in the second factor, students who study collaboratively with their friends will experience how to analyze and express their ideas to others (Forgarty and McTighe, 1993), whereby enhance and apply knowledge learned into understanding stage.

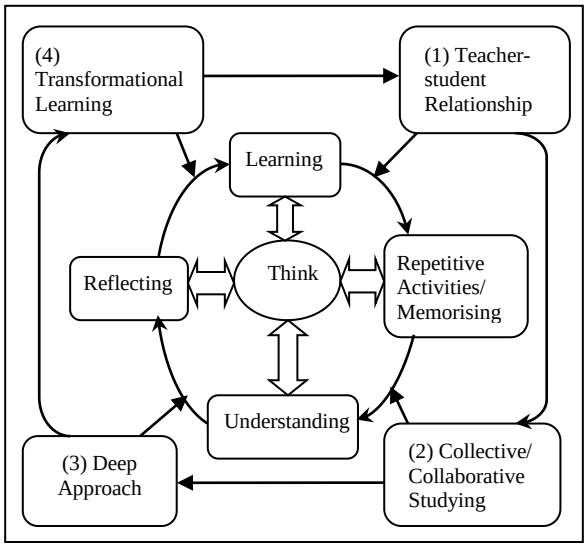

Figure 1: A Model of Critical Thinking and Problem Solving
Source: Haller et al. (2007)

Moving from understanding to refelecting stage, the model emphasize on the influence of the third factor on students' thinking process which is deep approach. Once the students make sense of the knowledge learned, they will reflect back the knowledge by making inferences, analogies, evaluations and explore deep understanding regarding the specific knowledge, and these relate to problem solving (Kitchenham, 2008). Then, the stages of critical thinking is completed when the students achieve transformational learning as the outcome of reflection process. The transformational learning is achieved when students able to have broad view on their past experience after making critical reflection on particular knowledge or ideas.

Critical Thinking and Industrial Training. In higher educational setting, university students particularly need to improve this skill in order to distinguish them from others as well as to cope with the rapid changes in today environment. Furthermore, employers seek for graduates who are able to think critically in order to solve complicated problems at workplace (Shakirova, 2007). In dealing with these situations, educational systems has taken an effort by improving higher-order thinking skills or higher-order thinking through teaching and learning process (Ganapathy and Kaur, 2014; Zohar and Schwartzer, 2005). Typically, higher-order thinking skills refer to as expanded use of mind to achieve new solutions (Rajendran, 2008). The skills include critical, logical, reflective, metacognitive and creative thinking (King et al., 1998).

Industrial training is a platform where students are able to apply their knowledge to contexts beyond education, which involve practical tasks that require some reflection on knowledge learned in university, add up with assistance from the experts (Herrington and Oliver, 2000; Smith et al., 2007). Such opportunities permit students to improve knowledge, skills and attitude as an early preparation into the future career. In assessing the improvement of critical thinking and problem solving skill towards working experience, Shariff and Muhamad (2010) conducted interviews with 12 students who had completed their training. Based on the interview sessions, students were able to experience how to solve problems effectively. Consistently, Wasonga and Murphy (2006) found that interns learned how to solve the problem wisely after analyzing 20 intern's reports.

Other past study showed the occurrence of reflection process throughout work-based experienced (WBE) module acquired by students (Smith et al., 2007). Thus, it aligns with the critical thinking model which also stressed out the reflection process where students are able to think critically, and look the problem in various perspectives (Haller et al., 2007). As they are able to think critically, it may motivate them to work harder and simultaneously increase their job satisfaction. A survey on 118 flight attendants supported the argument as the result showed positive effect of problem solving training on employees' job satisfaction (Ayres and Molouff, 2007).

Supervisor's Leadership Styles and Critical Thinking and Problem Solving Skill. The study of leadership style within the educational context is important as it may influence students' achievement (Ross and Gray, 2006). Therefore, the present study will review the Full Range Leadership Model (FRLM) in critical thinking and problem solving skills development after the industrial training period. FRLM represents three leadership styles that starts with the lowest leader interaction of laissez-faire behaviour to transactional leader behaviour and reaching the highest transformational leader behaviour These three leadership styles are represented by eight distinct factors of leadership behaviour. In particular, Bass (1985) proposed that the leader who avoids involvement in leading process is called laissez-faire leader. The laissez-faire is the most ineffective leadership style as the leader avoid to take decision, delay to deal with problems and ignore with the responsibilities and authority given (Bass, 1985). In the context of this study, trainees will become more independent in doing their tasks as being given freedom by supervisor, but it may undermine their generic skills development.

Secondly, the transactional leadership style is describe as leaders who either actively or passively monitor the work by providing followers a contingent reward for attaining targeted goals. As developed by Bass (1985), transactional leadership style has been characterized as an exchange relationship between leader and followers. Here, "exchange" means that the followers will receive rewards (such as financial benefits and promotion) for achieving targeted goals. the exchange of contingent rewards may extrinsically motivate the trainees' commitment to work in short term, which is consistent with the assertion made by Herzberg *et al.* (1959).

Thirdly, transformational leadership style consist of four main behaviours which are idealized influence, inspirational motivation, intellectual stimulation and individualized consideration (Bass, 1985). The idealized influence is the degree where the followers view their leaders as a role model to be inspired with. The leaders' ability to drive commitment of their followers in attaining the goals is known as inspirational motivation behaviour. Typically, the followers will have more confident level and passionate with their work as they are intrinsically motivated by their leaders (Trottier et al., 2008). Leaders used intellectual stimulation in order to encourage followers to think critically and solve the problems in new ways (Bass, 1985). Most of the time, the leaders will provide their followers with interesting and challenging tasks and ask them to solve in their own way (Hinkin and Tracey,

1999). Thus, if supervisor assists the trainees to think critically and find other alternatives to solve the problems, it may result in developing their critical thinking and problem solving skills. Lastly, the individual consideration refers to the extent where leaders recognize followers need by treating them individually, but all are treated equitably.

With regards to supervisors' leadership styles, a number of past studies confirmed that a leader with transformational leadership enhanced follower's thinking skill (Bass et al., 2003; Hinkin and Tracey, 1999; Kark et al., 2003). It is closely linked to one of the factors in transformational leadership, which is intellectual stimulation (Bass, 1985). Such leader always encourages and helps followers to view problems in other perspectives by stimulating them to be innovative and creative in solving the problems (Kark et al., 2003; Landrum et al., 2000). On the other hand, transactional and laissez-faire leadership styles seem to have no influence on students' critical thinking and problem solving skill. This is due to the transactional leader only intervenes when needed and provide rewards when the followers attaining goals, while the laissez-faire leader gives total freedom to the followers to complete the tasks given (Bass, 1985).

3. Methodology

The present study employed pre- and post- survey by using questionnaire as a research tool in collecting the data. The pre-survey was collected before students leave for their industrial training, while the post-survey was collected after they completing the industrial training. The population of this study is undergraduate students in Malaysian public universities. Using proportionate stratified random sampling, a total of 2000 students participated in the pre-survey, but only 1227 questionnaires was usable, meanwhile, a total of 485 usable questionnaires were received in the post-survey. The survey consists of four parts; Part A for students' demographic, Part B for supervisor's demographic, Part C for Multifactor Leadership Questionnaire (MLQ) by Bass (1985) and Part D for critical thinking and problem solving skill items using thinking roles of Belbin Team Role Self-Perception Inventory (BTRSPI) (Belbin, 2013). In analyzing the data, this study used descriptive analysis (such as frequency and percentage), paired sample t-test and correlation analyses.

4. Results and discussion

Respondents' Demographic. The number of respondents in post-survey decreased approximately 40% from the pre-survey (refer Table 1). Female students dominate the sample for both surveys while almost all respondents between the age of 19 to 24 years. In addition, the majority of the respondents are Malay, followed by Chinese, Indian and others ethnicities

Critical Thinking and Problem Solving Skill Development. Paired samples t-test results show that students who undertook industrial training have improved in critical thinking and problem solving skill in all eleven items (positive mean difference) (refer Table 2). Students improved significantly ($p<0.05$) in three items related to have creative approach to solve problem (1), feelings seldom interfere with judgement if given to work with limited time and unfamiliar people (9) and approach the problem in analytical way (10), while the other two items; able to see pattern in solving problems where others would see items as unconnected (2) and able to deny propositions that contain of invalid facts (8) were reported to have highly significant improvement ($p<0.01$). Using the paired samples t-test, it is found that students have improved significantly in critical thinking and problem solving skill after finishing their industrial training. This can be seen from the mean score of pre-training is lower than mean score in post-training (5.11 to 5.21).

Table 1: Respondents' demographic profile

Students' Demographic	Pre-Survey (T1)		Post-Survey (T2)	
	Frequency	%	Frequency	%
Gender				
Male	464	37.8	173	35.7
Female	763	62.2	312	64.3
Age				
19 – 23	980	79.8	456	94.0
24 and above	247	20.2	29	6.0
Ethnicity				
Malay	848	69.2	363	74.8
Chinese	286	23.3	96	19.8
Indian	41	3.3	17	3.5
Others	52	4.2	9	1.9

Table 2: Paired sample t-test of critical thinking and problem solving skill development

No.	Critical thinking and problem solving skill	Mean[a]		Mean difference	SD	t	Sig.
		Pre	Post				
1	In seeking satisfaction through my work, I tend to have a creative approach to solve problem solving.	5.25	5.38	0.13	1.17	2.437	.015*
2	In carrying out my day-to-day work, I tend to see pattern in solving problems where others would see items as unconnected.	5.11	5.26	0.15	1.27	2.618	.009**
3	When suddenly asked to consider a new project, I am able to take an independent and innovative look at most situations.	5.07	5.14	0.07	1.27	1.148	.252
4	I can see how ideas and techniques can be used in perceiving new relationships.	5.18	5.22	0.05	1.25	.800	.424
5	I analyse other people's ideas objectively, by evaluating both advantages and disadvantages.	5.36	5.36	0.00	1.24	.000	1.000
6	In seeking satisfaction through my work, I like to make critical discrimination between alternatives.	5.05	5.17	0.12	1.37	1.883	.060
7	When trying to solve a complex problem, I like to weigh up and evaluate a range of suggestions thoroughly before choosing.	5.33	5.35	0.02	1.26	.325	.745
8	In carrying out my day-to-day work, I can usually find the argument to deny unsound proposition (ie. propositions that contain of invalid facts).	4.87	5.03	0.17	1.35	2.722	.007**
9	If I am suddenly given a difficult task with limited time and unfamiliar people, my feelings seldom interfere with my judgment.	4.77	4.93	0.16	1.51	2.323	.021*
10	When suddenly asked to consider a new project, I approach the problem in a carefully analytical way.	5.13	5.25	0.12	1.25	2.141	.033*
11	I take considerable amount of time to make judgement but most often, the judgement made is accurate.	5.06	5.16	0.10	1.22	1.814	.070
	Overall critical thinking and problem solving skill	5.11	5.21	0.10	.087	2.482	.013*

Relationship of Supervisor's Leadership Styles and Critical Thinking and Problem Solving Skill Development. Table 3 highlights that there is a positive relationship between transformational leadership style and critical thinking and problem solving skill. However, correlation analysis for *Transactional* and *Laissez-faire* show different results as it appears that there is no relationship occurs between these two leadership styles and critical thinking and problem solving skill. This suggests that as supervisors implement more with

this leadership style, the more students will improve in critical thinking and problem solving skill.

Table 3: Correlation between supervisors' leadership styles and students' critical thinking and problem solving skill

Overall critical thinking and problem solving skill		
Transformational	Pearson Correlation	.244*
	Sig. (2-tailed)	.012
Transactional	Pearson Correlation	.111
	Sig. (2-tailed)	.166
Laissez-faire	Pearson Correlation	-.105
	Sig. (2-tailed)	.088

5. Conclusion

This study was conducted to determine students' critical thinking and problem solving skill development based on industrial training experience. The findings revealed that students have benefited from undergoing their industrial training as there is a development in the skill, which in line with the past studies (Nabi, 2013; Smith et al., 2007). Analysis of the eleven items reveals that students highly agreed that they evaluated both advantages and disadvantages of other people's ideas in solving the problems. This may be due to they have been taught to evaluate pro and cons before making decision in solving the problem. Besides, students perceived that they were able to work under pressure and unfamiliar people which give good impression to future employers as they were able to cope with real life situations (Shariff and Muhamad, 2010).

Besides, correlation analysis showed that there is a relationship between transformational leadership and critical thinking and problem solving skill. However, the other two leadership styles (transactional and laissez-faire) show no relationship with this skill improvement, This expected finding might be related the factor of intellectual stimulation of transformational leadership where supervisors stimulate their students to be innovative and creative by looking old situations in new perspectives (Bass et al., 2003). On top of that, intellectual stimulation, as part of transformational leadership is identified to help fosters subordinates' intrinsic motivation through engagement of inner interest and psychological needs (Bass and Riggio, 2006).

Based on the findings, it is important for industrial training stakeholders to fully utilize the industrial training programme as one of the platform to develop skill. Thus, it is recommended that higher learning institutions and host organizations can collaborate to plan and create an effective training, so that students can apply theories learned into practical work in real work setting. It is also recommended that supervisors in host organization shoud implement transformational leadership style, as it is proven can stimulate students critical thinking. Students itself is recommended to participate actively during meetings, so that they can stimulate their thinking in solving complex problem.

References

[1] Ayres, J. & Malouff, J. M. 2007. Problem-Solving Training to Help Workers Increase Positive Affect, Job Satisfaction, and Life Satisfaction. European Journal of Work and Organisational Psychology, 16(3): 279-294.

[2] Bass, B. M. 1985. Leadership and Performance Beyond Expectations. New York: The Free Press.

[3] Bass, B. M., Avolio, B. J., Jung, D. I. & Berson, Y. 2003. Predicting Unit Performance by Assessing Transformational and Transactional Leadership. Journal of Applied Psychology, 88(2): 207-218.

[4] Bass, B. M. & Riggio, R. E. 2006. Transformational Leadership. Mahwah, NJ: Lawrence Erlbaum.

[5] Belbin, R. M. 2013. Method, Reliability & Validity, Statistics & Research: A Comprehensive Review of Belbin Team Roles. Retrieved 1 October 2014, from www.belbin.com

[6] Cheong H., Ann T. & Hoong C. L. 2005. Fostering Critical Thinking in a Primary School (Final Research REP. No. 32-03).Singapore: National Institute of Education.

[7] Forgarty, R. & McTighe, J. 1993. Educating Teachers for Higher Ordering Thinking: The Three-Story Intellect. Theory into Practice, 32(3): 161-169.

[8] Ganapathy, M. & Kaur, S. 2014. ESL Students' Perceptions of the use of Higher Order Thinking Skills in English Language Writing. Advances in Language and Literary Studies, 5(5): 80-87.

[9] Haller, C., Fisher, R. & Gapp, R. 2007. Reflection as a Means of Understanding: Ways in Which Confucian Heritage Students Learn and Understand Organisational Behaviour. Multicultural Education & Technology Journal, 1(1): 6-24.

[10] Herrington, J. & Oliver, R. 2000. An Instructional Design Framework for Authentic Learning Environments. Educational Technology, Research and Development, 48(3): 23-48.

[11] Herzberg, F., Mausner, B. & Snyderman, B. 1959. The Motivation to Work. New York, NY: Wiley.

[12] Hinkin, T. R. & Tracey, J. B. 1999. The Relevance of Charisma for Transformational Leadership in Stable Organisations. Journal of Organisational Change Management, 12(2): 105-119.

[13] Kark, R., Shamir, B. & Chen, G. 2003. The Two Faces of Transformational Leadership: Empowerment and Dependency. Journal of Applied Psychology, 38(2): 246-255.

[14] King, F. J., Goodson, L. & Rohani, F. 1998. Higher Order Thinking Skills • Definition • Teaching Strategies • Assessment. Retrieved on January 14, 2016, from http://www.cala.fsu.edu/files/higher_order_thinking_skills.pdf

[15] Kitchenham, A. 2008. The Evolution of John Mezirow's Transformative Learning Theory. Journal of Transformative Education, 6(2): 104-123.

[16] Konting M. M, Faryanti N, K., Azirawani N., Adam A. & Abdullah S.N. 2007. Evaluation Skills among the Students [Monograph]. Teach and Teaching.

[17] Landrum, N. E., Howell, J. P. & Paris, L. 2000. Leadership for Strategic Change. Leadership & Organisation Development Journal, 21(3): 150-156.

[18] ManpowerGroup. 2012. 2012 Talent Shortage Survey. Retrieved June 4, 2013, from http://www.manpowergroup.us/campaigns/talent-shortage-2012/pdf/2012_Talent_Shortage_Survey_Results_US_FINALFINAL.pdf

[19] Nabi, F. 2013. Management Students' Self-perception towards their Employability Skills-A Pre and Post Soft Skills Training Analysis. International Research Journal of Business and Management. IV, 1-12.

[20] Othman, H., Salleh, B. M., al-Edrus, S. M. D. & Sulaiman, A. 2008. Perlaksanaan Pendekatan Pembelajaran Berasaskan Pengalaman (PBL Dan POPBL) bagi Meningkatkan Kemahiran Insaniah Pelajar.

[21] Purcell, K., Rainie, L., Heaps, A., Buchanan, J., Friedrich, L., Jacklin, A., et al. 2012. How Teens Do Research in the Digital World: Pew Reseacrh Center.

[22] Rajendran, N. S. 2008. Teaching and Acquiring Higher-Order Thinking Skills Theory & Practice. Penerbit Universiti Pendidikan Sultan Idris: Tanjong Malim Perak.

[23] Rohaeti, E.E. 2010. Critical and Creative Mathematical Thinking of Junior High School Student. Educationist Journal, 4(2): 99-106.

[24] Ross, J. & Gray, P. 2006. School Leadership and student achievement: The mediating effects of teacher beliefs. Canadian Journal of Education, 29(3): 798-822.

[25] Shariff, S. M. & Muhamad, M. 2010. Learning in an Industrial Practicum Training Program: A Case Study in a Public University in Malaysia. World Applied Sciences Journal, 11(11): 1361-1368.

[26] Schafersman, S. D. 1991. An Introduction to Critical Thinking. Retrieved 9 March 2013, from http://facultycenter.ischool.syr.edu/wp-content/uploads/2012/02/Critical-Thinking.pdf

[27] Shakirova, D. M. 2007. Technology for the Shaping of College Students' and Upper-Grade Students' Critical Thinking. Russian Education & Society, 49(9): 42-52.

[28] Smith, K., Clegg, S., Lawrence, E. & Todd, M. J. 2007. The Challenges of Reflection: Students Learning from Work Placements. Innovations in Education and Teaching International, 44(2): 131-141.

[29] Trottier, T., Van Wart, M. & Wang, X. 2008. Examining the Nature and Significance of Leadership in Government Organisations. Public Administration Review, 68(2): 319-333.

[30] Wasonga, T. A. & Murphy, J. F. 2006. Learning from Tacit Knowledge: The Impact of the Internship. International Journal of Educational Management, 20(2): 153-163.