The needs analysis of learning Inventive Problem Solving for technical and vocational students

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Abstract. Malaysian Ministry of Education highlighted in their National Higher Education Strategic plan that higher education’s need to focus adopting 21st century skills in order to increase a graduate’s employability. Current research indicates that most graduate lack of problem solving skills to help them securing the job. Realising the important of this skill hence an alternative way suggested as an option for high institution’s student to solve their problem. This study was undertaken to measure the level of problem solving skills, identify the needs of learning inventive problem solving skills and the needs of developing an Inventive problem solving module. Using a questionnaire, the study sampled 132 students from Faculty of Technical and Vocational Education. Findings indicated that majority of the students fail to define what is an inventive problem and the root cause of a problem. They also unable to state the objectives and goal thus fail to solve the problem. As a result, the students agreed on the developing Inventive Problem Solving Module to assist them.

1. Introduction
The explosion of technology in 21st century has intensified occupational competition which in turn has influence the globalization of job markets. As such, unemployment issue has become one of the global problems faced by the developing country. This is because the employer tends to have a worker that has features that can fill the 21st century skills. The element of the 21st century learning outcomes is the knowledge, skills and expertise in which one should master to succeed in his work and life [1]. According to Nace Job Look [2], employers rated the ability to make a decision and solve problems is the utmost importance for candidate skills and quality.

The unemployment issue also arises in Malaysia. This issue often spoke as a failure of the Institute of High Education in fabricating graduate to meet the industry needs. There were five factors which lead to this issue. Lack of skills and work experience, the mismatch between the needs of industry and the field of the candidates or graduates, lack of communication skills, negative attitudes and lack of awareness of the existence of job varieties [3]. As been noticed, once again the problem-solving skills been the top caused element in today’s competition.

The important of problem-solving skills should not be underestimated and negotiated [4]. Problem solving skills is the ability to apply acquired knowledge to solve the problem [5]. However, the
knowledge that needed comes from the education system. The education system in Malaysia started with primary level. Secondary and high institution level as a continuation. Although one been gone through to this education system, it does not confirm that he adapted all element taught. As an evidence, Malaysian students have scored below the global average under the Program for International Student Assessment (PISA) [6].

PISA is a program that tests the readiness of the student to enter adulthood. It focusses on the Malaysia’s curriculum which testing the student daily problem solving ability. The questions based on the real-life situation which involves the ability to reflect, evaluate and interpret. Unfortunately, Malaysian students still weak in these skills that are important in real life [7]. This is the very frustrating situation and critical to be addressed. Thus, it has triggered Ministry of Education Malaysia (MoE) to make it as the main input in drafting the Nasional Education Blueprint 2013-2025 [8]. Nevertheless, in 2011 MoE has taken a major step by revising the primary curriculum and introduced Primary School Standard Curriculum (KSSR). The main objective is to adapt the student with problem solving skills which includes of critical and creative thinking [9]. Start cultivating good values in a very early stage is believed to be effective pace.

2. Problem background

Despite all the mechanism introduced by Malaysian Qualifications Agency (MQA) and high learning institution to ensure that graduates leave the institution suitable for employment, the fact remains that many employers complain the ability of fresh graduates, particularly in the area of soft skills [10]. Employers claim that graduates are not competent workforce who can be absorbed into the job market [11].

According to Nace Job Outlook, there were 19 attributes that employers seek on the candidate’s resume (Table 1). Even though, leadership skills have the highest percentage which is 80.1% in influencing the employer’s hiring decision but yet the problem-solving skills (70.2%) also play major roles.

| Attribute                               | % of respondents |
|-----------------------------------------|------------------|
| Leadership                              | 80.1             |
| Ability to work in a team               | 78.9             |
| Problem-solving skills                  | 70.2             |
| Communication skills (written)          | 70.2             |
| Communication skills (verbal)           | 68.9             |
| Strong work ethic                       | 68.9             |
| Initiative                              | 65.8             |
| Analytical/quantitative skills          | 62.7             |
| Flexibility/adaptability                | 60.9             |
| Technical skills                        | 59.6             |
| Interpersonal skills (relates well to others) | 58.4 |
| Computer skills                         | 55.3             |
| Detail-oriented                         | 52.8             |
| Organizational ability                  | 48.4             |
| Friendly/outgoing                       | 35.4             |
| Strategic planning skills               | 26.7             |
| Creativity                              | 23.6             |
| Tactfulness                             | 20.5             |
| Entrepreneurial skills/risk-taker       | 18.6             |

There would be a big implication if we still stay in this situation. It will jeopardise the 11th Malaysia Plan (RMK-11). Through its third pillar, the quality of education is improved to level up
student achievement. This will enhance the human capital to develop the country. Apparently, now is the most crucial time in the nation’s progress towards Vision 2020. Launched in 1991, Vision 2020 envisions Malaysia as a fully developed country, economically, politically, socially, spiritually, psychologically and culturally by the year of 2020 [12]. The risk is effortless if no action taken to overcome this issue.

The issue of problem-solving skills for student arise in many studies. The fact that remains, student been taught problem solving skills in their higher institution but yet still lacking that ability generate an alternative way to solve problem comparable to common problem solving method.

Theory of Inventive Problem Solving (TRIZ) is very structured. It is a step by step method to solve problem. Hence, the student will be guided throughout the process. This method invented by Altshuller and his team in the year of 1956 [13]. By learning this alternative method compared to the common problem solving method, one can develop his self-efficacy. Self-efficacy is vital as it impacts the readiness to face future challenges [14] as in Figure 1. It also boosts up the confident level of the student [15].

Figure 1 Development of long-term problem solving ability

Inventive problem solving is an alternate way helping students to solve the daily or academic problem [14]. Inventive problem solving has a methodical approach and constructive way. It is now been taught in several universities and global organization [16]. There are facts that our students have difficulty in problem solving [9]. Thus, it is the purpose of this study to analyze the needs of learning Inventive Problem Solving Skills among the technical and vocational students. The objectives of this study were to i) measures the level of problem solving skills ii) identify the needs of learning inventive problem solving skills in higher institution and iii) identify the needs of developing an inventive problem solving skills module.

3. Research methodology
Measuring the perception level of problem solving skills is by itself, quite an involved problem [4]. Therefore, a questionnaire which includes large amounts of information is used. The advantages of using questionnaire are that it can be collected from a number or respondent in a very short period of time and a cost effective [17]. This survey research is conducted using the quantitative method.

3.1. Population and sample
In this study, the target population was the semester eight students from the Faculty of Technical and Vocational Education, University Tun Hussein Onn Malaysia. A total of 132 students, samples as the population were involved in this research.

3.2. Research instrument
The questionnaire used as the instrument for this study was developed in such a way that data collected can answer the research questions. Other than time and cost effective, the data collected using questionnaire is far more consistent if compared with the data collected by observation [18].

The questionnaire has two parts. Part A consisted of three items related to demographic factors including gender and course. While part B consisted of 20 of ‘Yes’ and ‘No’ questions. The questions were designed to ease the respondent answering the question and to avoid confusion.
4. Data analysis and results

The finding is presented in the table format. This finding will answer the objectives of the study; i) to measures the level of problem solving skills ii) to identify the needs of learning inventive problem solving skills in the higher institution and iii) to identify the needs of developing an Inventive Problem Solving module.

4.1. The level of problem solving skills among technical and vocational student.

Table 2 showed that 84.5% of the students do not know what inventive problem is. Almost all of the students do not know ways to identify the root cause of a problem. Nevertheless, lack of knowledge in problem solving skills and not competent in the area contributes 67.3% and 62.2% respectively. In the case study section, 73.2% of students not able to identify the root cause of the problem. This result depicts that the level of problem solving skills among students is really low.

| Statement                                                   | Percentage |
|-------------------------------------------------------------|------------|
| Students not able to define what is inventive problem       | 84.5%      |
| Students do not know how to detect the root cause of a problem | 98.6%      |
| Lack of knowledge in problem solving skills                | 67.3%      |
| Students does not master in problem solving skills         | 62.2%      |
| Students fail to identify the problem root cause in given case study | 73.2%      |

4.2. The needs of learning inventive problem solving skills.

Table 3 showed that all students agreed that learning inventive problem solving skills is a must. On the other hand, 88.7% of students claimed that they have lack information on inventive problem solving, tools and expert assist. These students have little knowledge of inventive problem solving thus they need to be exposed on the right tools and must be taught by the experts.

| Statement                                                   | Percentage |
|-------------------------------------------------------------|------------|
| It is important to learn inventive problem solving skills   | 100%       |
| Lack of information on inventive problem solving, tools and expert assist | 88.7%       |

4.3. The needs of developing an inventive problem solving module.

Table 4 presented that most of the student felt that the development of inventive problem solving skills modules is crucial. They concurred that the alternative problem solving methods is needed so that they will have an option rather than the conventional methods. While, the other students (7.3%) preferred to have the introduction of inventive problem solving by an expert first. These are the students that has zero knowledge on the problem solving skills and failed to identify the problem root cause when given a case study. They claimed that an exposure of inventive problem solving is the first step before they will be able to use the module.

| Statement                                                   | Percentage |
|-------------------------------------------------------------|------------|
| Student agree on the development of inventive problem solving module | 92.7%       |

5. Recommendations

The advantages of TRIZ is due to the limitation of the common problem solving methods. TRIZ can solve problem that has psychological inertia which is when the barrier created or there is a contradiction between the objectives. By using the step-by-step process, student can cover other limitations which are lacking knowledge, wrong objectives or goal, conflict situation, and root caused
unknown because in the process of solving the problem, TRIZ helps them to identify the root cause of a problem, modelling the problem, selecting the correct tool and solve the problem based on model of solution [14].

The opportunities to expose the student to this alternative way of solving problem lay on the educators. However, the question on how to implement and how to teach the methods has been an issue in much discussion and study [15]. Nevertheless, the educators himself has zero or lack of knowledge about TRIZ. Therefore, a tool must be established to assist educators in implementing this method. A module is proposed to be developed to assist the educators in their classes.

A module is self-instructional and self-paced. It caters individual’s differences in leaning abilities, interest and degree of application [19]. Hence, this module can be used by anyone either the educators himself or the student.

6. Conclusion
The study conducted indicates that technical and vocational students do have an issue on problem solving skills. Almost all of them are not able to define what is inventive problem. This is because they have never heard and never been exposed to this theory. As mentioned earlier, Theory of Inventive Problem Solving (TRIZ) is mainly used by engineers, inventors and scientists in technical and engineering fields. However, it can be extended into social science fields which include psychology, sociology, political science, and anthropology. Since it can be applied in any areas, hence, there is no reason why Inventive Problem Solving should not be learned and exposed to technical and vocational students. Overall, students found that the module is relevant to be used as to expose the theory. This provides positive support to the development of module towards enhancing problem solving skills among high institution students.

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