IMPROVING CREATIVITY IN ENGINEERING UNDERGRADUATE STUDENTS IN PRIVATE INSTITUTION OF HIGHER LEARNING IN MALAYSIA – A PILOT STUDY

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ABSTRACT

Creativity is an essential factor when it comes down to engineering designs. Creativity and engineering complement each other to provide useful and yet eye-opening solutions to anyone's every-day problems. Recent research conducted had indicated that creativity, which happens to be one of the vital skills for the engineers in the 21st Century that can be taught and learnt, has reduced significantly over the years. Thus, there is a need for engineering educators to address this reduction issue by introducing creative thinking as a skill to be acquired by the current generation of engineering undergraduates. This research paper presents the outcome of research conducted to improve and enhance the creativity level of local engineering undergraduates at a private institution of higher learning. Such enhancement is done through a Creative Thinking Module that features few proposed creative thinking tools such as Brainsketching, Concept Maps and Morphological Analysis. The Torrance Test of Creative Thinking Figural Forms was applied to measure the creativity level of respondents in this research. A pilot study had been conducted in a local private university, and results indicated improvement in the creative ability of the students upon completion of the Creative Thinking Module.

Keywords: Creativity, Creative Thinking Module, Torrance Test of Creative Thinking, Engineering Design.

1.0 INTRODUCTION

Creativity is the capability of a person to come up with new objects or new designs (Wang, 2007). It is one of the critical skills in a knowledge-based society in coping with problems (Terkowsky & Haertel, 2013). Unfortunately, education system and providers around the world, Malaysia inclusive, are not supportive enough in the development of creativity learning (Brand, Hendy, & Harrison, 2015; Robinson, 2013; Terkowsky & Haertel, 2013; Haertel, Terkowsky, & Jahnke, 2012; Daud, Omar, Turiman, & Osman, 2012; Beghetto, 2010; Kazerounian & Foley, 2007). The education system relied heavily on cognitive learning (Chin, Thien and Chew, 2019) resulting students more exam-based-oriented in the tertiary study that does not meet the proficiency requirement in creative thinking and problem-solving skills upon a graduate.

Malaysian engineering graduates are often reported to be equally competent in terms of knowledge when compared to graduates from overseas universities. Nonetheless, researches have shown that Malaysian graduates are lacking in terms of many other skills in communication and presentation and also when it comes to creative thinking and being innovative (Soon & Quek, 2013, Selvaraj, Anbalagan, & Azlin, 2014). Research had also indicated that Malaysian graduates do not meet the proficiency requirement in creative thinking and problem-solving skills when in job place (Safarin, Md, Khair, & Yahya, 2013). Research activities related to creativity in particular for engineering design courses are also not well documented, developed or established to date causing Malaysian norms for local engineering students are not available for better validity of the results obtained. Comparison can hence only taken with the USA norms developed by Torrance (1966, 1990) (Afida, Aini, Mohd, & Rosadah, 2012; Torrance, 1966; Torrance, 1990).

The learning of creative thinking skills is vital and should begin when the students are still at school (Romeike, 2006). In this case, for engineering undergraduate students taking engineering design module, it is an appropriate time to enhance their creative thinking skill. Apart from this, the current engineering curricula also face various challenges when it comes to introducing creativity education to engineering programmes.

The planning, implementation and evaluation of programmes to meet the requirements set out by the Engineering Accreditation Council Malaysia, also present a large number of difficulties. The curriculum planners face difficulties in planning and coordination, including curriculum structure administration, Continuous Quality Improvement (CQI) cycle, programmes review in the achievement of programme outcomes (PO), course outcomes (CO) and programme educational objectives (PEO) and weighting of different subjects. There are also situations where programmes coordinators will encounter problems in resources allocation, mainly when it involves different departments.

In addition, as outlined in the Engineering Accreditation Manual (EAC 2020) that "*The curriculum shall also provide students with ample opportunities for analytical, critical, constructive, and creative thinking, and evidence-based decision making in dealing with complex engineering problems*", and it has become evident that the engineering program providers will need to consider the inclusion of the creative thinking elements in the course designs.

Despite the requirement of the inclusion of creative thinking elements in the courses, to date, there are still limited works of literature that present the review, effectiveness and suggestions towards the inclusion of creative thinking elements in the conduct of courses. Creative thinking has hence not been given sufficient attention in the engineering programmes to be a single module in the engineering programme.

Educators also need to take the trouble to cater for students that come from different backgrounds. The course coordinator many a time need to spend more time searching for suitable teaching staff from within and outside of the department.

Serious attention should be given to reduce the Creative Thinking and Problem-Solving skills proficiency gap for better employability of our engineering graduates. Based on such problem statement mentioned above, this research is established to achieve the objective to assess the effectiveness of the Creative Thinking Skills for Conceptual Engineering Design module developed by the researcher in improving engineering undergraduates' creativity.

In the quest to achieve the developed country status, Malaysian engineers have a role to play that cannot be ignored. The National Education Blue Print 2015-2025 (Higher Education) had laid a solid foundation for the Malaysian IHLs to educate and train the next generation of Malaysia Engineers to be able to improve the living environment. To achieve this, engineers require not only technical knowledge and skills but also creativity and innovation to cater to the needs of the future generation. Fostering the engineering students' creativity ought to be during their undergraduate education. By understanding the state of creativity in engineering undergraduate students, steps can be taken to address any deficiencies through appropriate training and counselling.

This research provides the understanding of the current state of creativity of local undergraduate students taking engineering design module. The research then moves another step further in providing an alternative solution to foster and improve the students' creativity without compromising the current engineering programme structure. The effect of the proposed alternative solution is then studied and analysed.

2.0 DEFINING CREATIVITY

Creativity is not something that is gifted to selected few, but rather a skill that can be acquired (Rhodes, 1961). This set of skill can be learned by providing a properly design curriculum that comprises the following elements for learning:

1) A real-world problem that the students are tasked to solve.
2) Components that involve interactive learning activities amongst students and educators, and
3) Provide students with the opportunity to explore other options for solutions, as mentioned by the constructivism theory.

Creativity also involves the development of tangible solutions to problems. Engineers applied their knowledge and skills to solve problems driven by the needs and changes, and these solutions often take the form of tangible artefact. After all, engineering has the most room for improvement in supporting creative skills development (Shanna, Erika, & Colleen, 2014).

Illustrated in Figure 1, creativity can be categorised into four major types (Rhodes, 1961), naming:

a. Process
b. Product
c. Person, and
d. Press

For this research, only Process component is investigated, and thus explanations only the Process component is be presented in the subsequent topics. The Person component is the personality aspect of teachers, while the Press component refers to the environment and the infrastructure that aid creative teaching. The assessment of both components requires a certified psychologist, and hence it is out of the scope of current research. On the other hand, The Product component refers to the works of art, inventions or publications as a result of creativity, since this paper focused on the students. Hence, this component is also excluded in the current study and is addressed in other researches.

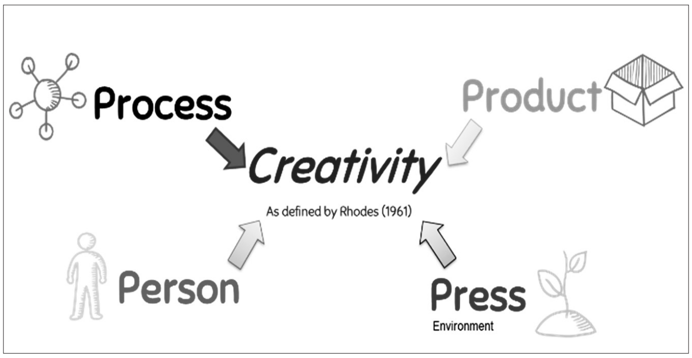

Figure 1. The 4 P's in Creativity as described by Rhodes (1961)

In this study, creativity is defined based on Torrance's (1974) definition:

"a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficult; searching for solutions, making guesses or formulating hypotheses about deficiencies; testing and retesting hypotheses and possibly modifying and retesting them, and finally communicating the results."

From the employer survey data as well as research activity and analysis conducted by various organisations, it is clear that creativity is one of the essential tools that engineers are required to be equipped with in order to survive in the 21st-century workplace (Casner-Lotto & Benner, 2006). Engineers are directly involved with the business of innovation as their job scopes are to design, to innovate and to solve problems.

Hence, it is understood that the Process is the procedures adopted by the Person to develop the Product. Hence, it is also the thought process used by the Person instead of the methodology. The thought process here can be viewed as twofold – convergent thinking and divergent thinking. While convergent focuses on obtaining a concrete solution to a problem through analyses, judgements and decision-making, which is out of the relation of creativity, and hence the divergent thinking, which is explained in the following section, is the governing thinking process of the creative thinking.

3.0 DIVERGENT THINKING

Divergent thinking involves producing multiple or a variety of answers or solutions to problems through processes like shifting perspective on currently available information by viewing it in a new way, or even to the point of transforming it, through unexpected combinations of elements usually not regarded as belonging together. The answer that is derived may be something that had never existed. These processes definitely will assist the engineers in developing variability in their products or solutions, thus creativity. Table 1 lists the various characteristics of divergent thinking.

Table 1: Characteristics of Divergent Thinking

Typical Process	Typical Results
• Being unconventional • Seeing the known in a new light • Combining the disparate • Producing multiple answers • Shifting perspective • Transforming the known • Seeing new possibilities	• Alternative or multiple solutions • Deviation from the usual • A surprising answer • New lines or attack or ways of doing things • Opening up exciting or risky possibilities

Divergent thinking involves unique processes and strategies or thinking tactics for processing information that is favourable to the generation of variability. These thinking tactics involve Constructing Remote Associates, Building Unusual Categories, Building Broad Networks, and Accommodation Rather than Assimilation.

3.0 CREATIVE THINKING SKILLS FOR CONCEPTUAL ENGINEERING DESIGN MODULE

The Creative Thinking Skills for Conceptual Engineering Design Module developed utilised learning materials available related Creative Thinking in general as a foundation. They modified to cater to the needs of engineering design. As creative thinking skills are applicable in many fields such as poetry, language, arts and others, the content to be applied in this research will be simplified and focused in areas applicable to engineering design only.

As illustrated in Figure 2, seven creative thinking skills were selected and incorporated into the module developed, namely Brain Sketching, Mind Map, Attribute Listing, Functional Decomposition, Morphology Diagram, SCAMPER, and Synetics.

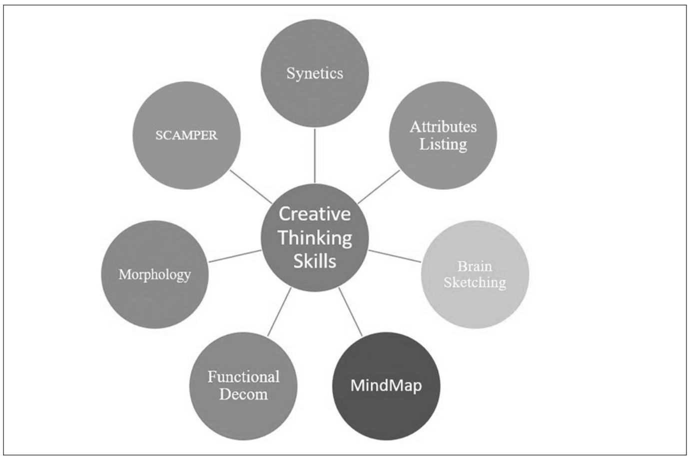

Figure 2. Content of Creative Thinking Skills for Conceptual Engineering Design Module (Chua, 2019)

4.0 TORRANCE TEST OF CREATIVE THINKING FOR DIVERGENT THINKING ASSESSMENT

In order to assess divergent thinking among students, tests have been designed and evaluated to observe divergent thinking behaviour and other problem-solving skills among students. Among these tests, the Torrance Test of Creative Thinking, which has its reliability and validity proven (Almeida, 2008; Kim, 2011) is used.

From the definition of creativity by Torrance (1974), one of the most prominent tools to measure creativity, Torrance Test of Creative Thinking (TTCT), has been adopted to be the instrument for gaining a measure of creativity as a process in this research. TTCT consists of four tests of divergent thinking and other problem-solving skills, which are scored on four scales, which are Fluency, Abstractness of Title, Originality and Elaboration. For the interest of this research, the Torrance Test of Creative Thinking (TTCT) Figural Form A and Figural Form B are adopted. The TTCT-Figural forms A and B consist of three subtests which compose a drawing, finish a drawing and compose a different drawing parting from parallel lines (Torrance, 1974). Form A is a line-based form, while Form B is a circle-based form. Both forms are aligned to assess four critical cognitive processes of creativity (Almeida, 2008):

- **Figural Fluency** or number of relevant responses. It is the ability of the respondents to produce a large number of figural images. It is a simple count of the number of different relevant responses.
- **Figural Originality** entails considering novelty responses, not familiar and unusual, but relevant. It is the ability of the

respondents to produce statistically infrequent, uncommon or unique responses that require creative strength. It is the sum of the points given for each response based on the normative list in the manual. Bonus credit is given for combining two or more figures into a single image.

- **Figural Elaboration** as referred to the number of details used to extend a response. It is the respondents' ability to develop, embroider, embellish, carry out and elaborate ideas. It is the number of details other than the initial, bare minimum responses.
- **Abstractness of Titles**. It is referred to a variety of categories or shifts in responses. Relates to the respondents' ability in synthesising and organising processes of thinking, ability to capture the essence of the information involved, to know what is important, enabling the viewer to see the picture more deeply and richly.

In this research, Figural Form A was used to assess the current creativity level of the respondents. The Figural Form B was employed after the implementation of module developed during the pilot study. The combination of both forms assesses the figural creativity among engineering students in the study.

5.0 RESEARCH HYPOTHESES

The implementation of Creative Thinking Module aims to improve students' divergent thinking skills. Through the module, students learn to different skills to implement creative solutions towards problems. Such divergent thinking skills are then assessed through four major items in TTCT. Therefore, this paper suggests looking into the following hypothesis:

H1. The Creative Thinking Module improves the Figural Fluency of respondents significantly.
H2. The Creative Thinking Module improves the Figural Originality of respondents significantly.
H3. The Creative Thinking Module improves the Figural Elaboration of respondents significantly.
H4. The Creative Thinking Module improves the Abstractness of Title of respondents significantly.

6.0 METHODOLOGY

This study employed the Pre-Test and Post-Test method. The creativity level of the students was determined first using the Torrance Test of Creative Thinking Figural Form A. The respondents then underwent a workshop using the module developed. After the completion of the workshop, the creativity of the respondents was later re-evaluated using Torrance Test of Creativity Figural Form B. Paired Sample T-Test is used to analyse the score of TTCT Figural Form A and Form B.

The selection of sample size is made based on the formula suggested by Bonnett (2012) on the determination of sample size to ensure the reliability for the selected size.

$$n = \frac{\left\{\frac{2k}{(k-1)}\right\}\left(z_{\alpha/2}+z_{\beta}\right)^2}{ln\left(\tilde{\delta}\right)^2+2}, \quad (1)$$

where n is the sample size, k is the number of components in the scale, $z\alpha/2$ and $z\beta$ are points on the standard normal distribution exceeded with probability $\alpha/2$ and β, $\tilde{\delta} = (1-\rho_k)(1-\tilde{\rho}_k)$ with ρ_k and $\tilde{\rho}_k$ are coefficient alpha and its estimator, respectively.

Based on the equation, to obtain a Cronbach alpha value of 0.7 and above, with the items in the TTCT Figural Forms, a sample size of 33 is suggested. With the inclusion of the potential 5% dropout rate, which is unlikely in this research as all students were briefed and understood on the module, the optimum sample size for this research is 35 people. This number of sample size is also supported by some studies, where sample size for the pilot study requires 10% of the total sample size of a more extensive parent study, or even as small as 10 to 30 participants (Hill, 1998; Isaac and Michael, 1995; Julious, 2005).

With the above-mentioned suggested sample, 35 respondents from 3rd-year Mechanical Engineering students at Inti International University located in Nilai, Negeri Sembilan Malaysia, are selected to participate in this pilot study. Students in this pilot study attended a 2-day workshop on Creative Thinking in October 2019. They filled the TTCT Figural Form A and TTCT Figural Form B before and after the workshop, respectively. The T-test was conducted to analyse the results.

7.0 RESULTS AND DISCUSSIONS

Various hypotheses and null hypotheses were established. A total of four hypotheses were established.

7.1 Figural Fluency

The first hypothesis looks into the effect of the module in improving the Figural Fluency of the respondents. Table 2 illustrates the results of Pre-Test and Post-Test using Paired Sample T-Test.

Research Hypothesis 1:
There is significant difference in the Figural Fluency Scores between Pre-Test and Post-Test.

Null Hypothesis 1:
There is no significant difference in the Figural Fluency Scores between Pre-Test and Post-Test.

Table 2: Figural Fluency Paired Sample T-Test Results

T-Test: Paired Two Sample for Means		
	POST_FL	**PRE_FL**
Mean	37.23	19.2
Variance	110.71	49.4
Observations	35.00	35
Pearson Correlation	0.35	
Hypothesized Mean Difference	0.00	
Df	34.00	
t Stat	10.25	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.03	

The mean of Figural Fluency for Pre-Test is 19.2 while mean for Post-Test is 37.23. According to Chua (2013), if the significant (2-tail) value is smaller than .05, the result is significant. The Paired Sample T-Test result shown in Table 2 indicated that the research result is significant ($t = 10.25$, $p < 0.05$). The null hypothesis is rejected, and thus the module improved Figural Fluency of the respondents significantly.

7.2 Figural Originality

The second hypothesis developed to look into the effect of the module in improving the Figural Originality of the respondents. Table 3 illustrates the results of Pre-Test and Post-Test using Paired Sample T-Test.

Research Hypothesis 2:
There is significant difference in the Figural Originality Scores between Pre-Test and Post-Test.

Null Hypothesis 2:
There is no significant difference in the Figural Originality Scores between Pre-Test and Post-Test.

Table 3: Figural Originality Paired Sample T-Test Results

T-Test: Paired Two Sample for Means		
	POST_OR	**PRE_OR**
Mean	16.03	12.69
Variance	46.21	35.81
Observations	35.00	35
Pearson Correlation	0.27	
Hypothesized Mean Difference	0.00	
Df	34.00	
t Stat	2.54	
P(T<=t) one-tail	0.01	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.02	
t Critical two-tail	2.03	

The mean of Figural Originality for Pre-Test is 12.69 while mean for Post-Test is 16.03. According to Chua (2013), if the significant (2-tail) value is smaller than .05, the result is significant. The Paired Sample T-Test result shown in Table 3 indicated that the research result is significant ($t = 2.54$, $p < 0.05$). The null hypothesis is rejected, and thus the module had improved Figural Originality of the respondents significantly.

7.3 Figural Elaboration

The third hypothesis was established to investigate the effect of the module in improving the Figural Elaboration of the respondents. Table 4 illustrates the results of Pre-Test and Post-Test using Paired Sample T-Test.

Research Hypothesis 3:
There is significant difference in the Figural Elaboration Scores between Pre-Test and Post-Test.

Null Hypothesis 3:
There is no significant difference in the Figural Elaboration Scores between Pre-Test and Post-Test.

Table 4: Figural Elaboration Paired Sample T-Test Results

T-Test: Paired Two Sample for Means		
	POST_EL	**PRE_EL**
Mean	5.63	4.20
Variance	10.18	3.46
Observations	35.00	35.00
Pearson Correlation	0.65	
Hypothesized Mean Difference	0.00	
Df	34.00	
t Stat	3.46	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.03	

The mean of Figural Elaboration for Pre-Test is 4.2 while the mean for Post-Test is 5.63. According to Chua (2013), if the significant (2-tail) value is smaller than .05, the result is significant. The paired sample T-Test result shown in Table 4 indicated that the research result is significant ($t = 3.46$, $p < 0.05$). The null hypothesis is rejected, and thus the module had successfully improved Figural Elaboration of the respondents significantly.

7.4 Abstractness of Titles

The fourth hypothesis was instituted to analyse the effect of the module in improving the Abstractness of the title of the respondents. Table 5 illustrates the results of Pre-Test and Post-Test using Paired Sample T-Test.

Research Hypothesis 4:
There is significant difference in the Abstractness of Title Scores between Pre-Test and Post-Test.

Null Hypothesis 4:
There is no significant difference in the Abstractness of Title Scores between Pre-Test and Post-Test.

Table 5 Abstractness of Titles Paired Sample T-Test Results

T-Test: Paired Two Sample for Means		
	PRE_AB	**POST_AB**
Mean	3.46	5.06
Variance	10.49	31.35
Observations	35.00	35.00
Pearson Correlation	0.32	
Hypothesized Mean Difference	0.00	
df	34.00	
t Stat	-1.72	
P(T<=t) one-tail	0.05	
t Critical one-tail	1.69	
P(T<=t) two-tail	0.09	
t Critical two-tail	2.03	

The mean of Abstractness of Titles for Pre-Test is 5.06 while mean for Post-Test is 3.46. According to Chua (2013), if the significant (2-tail) value is smaller than .05, the result is significant. The paired sample T-Test result shown in Table 5 indicated that the research result is not significant ($t = -1.72$, $p > 0.05$). The null hypothesis is accepted. The module, in this case, does not improve the Abstractness of Titles of the respondents significantly.

7.5 Figural Creativity

Table 6 illustrates the sum of means of all elements of Figural Creativity for Pre-Test and Post-Test values. Based on the results obtained, the respondents had shown a significant improvement in almost all aspects. Nonetheless, the improvement was not shown in the Abstractness of Title. However, the overall creativity of the respondents had increased.

Table 6: Figural Creativity – Sum of Means of Pre-Test and Post-Test Value

Elements	Post-Test	Pre-Test
Fluency	37.23	19.2
Originality	16.03	12.69
Elaboration	5.63	4.2
Abstractness of Title	3.46	5.06
Figural Creativity	62.35	41.15

The conduct of the Creative Thinking module May assist students to improve their ability to produce a large number of figural images which are unique and able to elaborate from such production. However, students' ability to synthesise and organise the data is still yet to be observed through this analysis. The education system in Malaysia, which is biased towards the examination, has trained students from a young age to focus on the examination to obtain a good result. In addition, they have also been focusing on providing a standard answer that meets the examiner's requirements to ensure that they gain marks in an examination. Besides, the education system also focuses on individual achievements rather than team performance. Hence, there are not many chances that students would acquire interactive skills, leading to improvements in creative skills.

The results also show that the implementation of a Creative Thinking Module will help students to improve their creative thinking abilities, which is much needed in the engineering designs. There are courses in the engineering programmes that require creative thinking backgrounds, such as Mechanical Design, Computer-Aided Design, Process Design, and Structural Analysis and Design, as outlined in the EAC (2020) Manual. Hence, it is indispensable to research into the effectiveness and appropriateness of the incorporation of such module into the conduct of engineering programme to ensure that those students can step up their performance in such design courses with the provision of more creative ideas in their designs.

Institutions of Higher Education in Malaysia has now shifted their focus of the conduct of engineering program with the inclusion of the engineering complexity (EAC, 2020). Such idea consists of challenging students with specialised skills required to suggest engineered solutions to some open-ended problems or even non-engineering-based problems that are faced by people every day. Such a solution of problems may also require various communication channels and techniques to ensure that people who are not expert in engineering will be able to understand and make use of the solution to address their needs. Given this, creative thinking skills become an essential skill that students will need to have as part of the professional skills to be integrated into the engineering workplace.

In order to ensure that the creative thinking skill is well developed, a series of topics could be considered to be included in the courses after the completion of Creative Thinking Module to observe students' creative skills.

7.6 Sustainable Engineering

Sustainable engineering relates to the design of operating systems that does not compromise the natural environment and not depleting the materials for future generations. It is a discipline that addresses all aspects of engineering and should be treated as an interdisciplinary approach. The inclusion of the creative skills makes engineers rethink their design from the other angle that is not only sustainable but also making the design stands out from other standard engineering designs. Of course, with the successful implementation of such idea, the Institution of Higher Education may also consider offering a postgraduate programme that combines both creativity and sustainable design as one program that would further encourage the inclusion of creativity in engineering designs. For instance, the Creative Sustainability Master's Programme offered by Aalto University, Finland, is a good example that includes both creativity and sustainable in the engineering design that also demonstrates the interdisciplinary inclusion.

7.7 Complexity in Engineering

The complexity is defined as "the measure of uncertainty in achieving the functional requirements of a system within their specified design range" (Suh, 2005). The solution towards the complexity of engineering requires both technical knowledge and creativity, where the ideas proposed would sometimes be based on the engineering theories but needed to be presented in a manner that can address the current need of the society. Sheard and Mostashari (2011) described that the attributes of complexity include non-linearity, adaptivity, decentralisations, openness, and multi-scale. These attributes make the systems to be perceived as being uncertain; difficult to understand; unpredictable; uncontrollable; unstable; unrepairable; unmaintainable and costly; having unclear cause and effect, and taking too long to build. Hence, the inclusion of creativity in the solutions is essential to solving the problem. One example where the Complexity in Engineering is included in the curriculum design is the offer of the course Engineering Complexity in the Bachelor of Engineering program in the University of Newcastle, Australia to integrate professional skills with technical skills in the engineering designs.

8.0 CONCLUSION

In this research, the researcher developed a Creative Thinking Skills for Conceptual Engineering Designs to address the issue of decline in Creativity that had been reported by other researchers regarding the capability of local engineering graduates. Based on the findings above, it can be concluded that Engineering undergraduate students can be trained or educated to be more creative when it comes to deriving various relevant design of products or solutions.

However, the research findings also indicated that the current engineering education system has not been successful in improving the ability of the undergraduate engineering student to have the ability to capture the essence of information involved. The current engineering education needs to be able to educate these future engineers to be able to identify the critical information needed, to be able to present to his/her audience more creatively and effectively. The educators must also be aware that they need to generate engineers who can come up with abstract designs or solution that will most likely bring about revolutionary changes. More attention should be given in this aspect so that the students can acquire this set of skill while still in university.

The Ministry of Education of Malaysia implemented the Primary School Standard Curriculum (Kurikulum Standard Sekolah Rendah (KSSR)) and Secondary School Standard Curriculum or Kurikulum Standard Sekolah Menengah (KSSM) in 2017. Such implementation stresses balanced knowledge and skills, including creating thinking, innovation, problem-solving and leadership. With such implementation, it is hoped that, when these students enter university in the future, they will have equipped with a better creative thinking skill that can cope with the design courses in the university. ■

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