Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 60 (2012) 463 – 467

Procedia
Social and Behavioral Sciences

UKM Teaching and Learning Congress 2011

Assessment of Creativity in Electrical Engineering

Afida Ayob[a,b,*], Aini Hussain[a,b], Mohd Marzuki Mustaffa[a,b], Rosadah Abdul Majid[c]

[a]*Centre of Engineering Education Research, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia*
[b]*Department of Electrical, Electronic and System Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia*
[c] *Faculty of Education, Universiti Kebangsaan Malaysia*

Abstract

For a nation to achieve the status of a developed and high income country, it has to grasp innovation. Graduates therefore, have to understand and possess all the abilities directly associated with innovation such as the ability to generate, develop and implement new and meaningful ideas. Creative approaches in problem solving lead to innovation in technology. A study has been done to assess the creativity level of the Electrical and Electronics Engineering undergraduates from the Faculty of Engineering and Built Environment. The Torrance Test of Creative Thinking (TTCT) has been administered to students who represented Universiti Kebangsaan Malaysia (UKM) in a national competition for robotic design. The test provides assessment of five main creativity dimensions as well as scores for evidence of thirteen creative strengths. As a conclusion, the study has identified the creativity level of the students. 67% of the students have Average Standard Score more than 100. The creative potential is then indicated through an index value, which serves as an overall indicator of creative potential. The results from this study can be used by the faculty to plan the best and more effective method of delivery for electrical engineering curriculum to fulfill the aspiration of innovation-led nation.

Keywords: Experiential learning; creativity; Torrance Test for Creative Thinking; engineering education

1. Introduction

Creativity is very important and viewed as life-sustaining forces of civilization (Toynbee, 1934). According to Torrance (Torrance, 1963), creativity is the most important weapon to cope with everyday life stresses and problems. Therefore, creativity can be viewed as the most desired quality in a person.

Creativity can be defined in many different ways. According to Anderson (1965), creativity is the emergence of something unique and original. Torrance (1974), a distinguished researcher in the field of creativity, defined creativity as 'the process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies and so on: identifying the difficulties, searching for the solutions, making guesses or formulating

* Corresponding author. Tel.: +6-03-8921-6942; fax: +6-03-8921-6146.
E-mail address: afida@eng.ukm.my.

1877-0428 © 2011 Published by Elsevier Ltd. Selection and/or peer reviewed under responsibility of the UKM Teaching and Learning Congress 2011
Open access under CC BY-NC-ND license. doi:10.1016/j.sbspro.2012.09.407

hypotheses and possibly modifying and retesting them; and finally communicating the results'. It is this definition that is being used in this study.

1.1. Torrance Test for Creative Thinking (TTCT)

Torrance objective was to develop a reliable and valid test for creative thinking abilities that could be administered from kindergarten to childhood (Torrance, 1996). Torrance concludes that creative achievements can be predicted by general mental abilities. The scales in TTCT act as indicators of creative potential that can be translated as creative behavior. However, high scores in TTCT do not actually guarantee creative accomplishment.

More than 1500 studies in 16 countries used TTCT tests to measure creativity (Torrance, 1996). In Malaysia, TTCT has also been used such as in studies to find out figural creativity and cognitive preferences among Malaysian undergraduates (Palaniappan, 1998) and also in assessing secondary school students thinking and learning styles for effective teaching and learning (Chua, 2011). However, all these tests used the normalized values provided by TTCT, which are obtained from the American population. Normalised values obtained from Malaysian sample, if available, should have been more appropriate to increase the validity of the tests conducted here.

In this study, the creativity level of second and third year undergraduates are measured using the standard Torrance Test for Creative Thinking (TTCT).

2. Method

2.1. Participants

The participants for this study were 2nd and 3rd year undergraduates (N=18; 15 male; 3 female; age range 20 – 23 years old) from the Department of Electrical, Electronics & Systems Engineering, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM). These students participated in the ROBOCON competition, a national competition which involved students from institutions of higher learning. Participants are expected to design and build robots, and then compete in a game with the game theme defined by the organisers.

2.2. Measures

The main instrument in this study is: Thinking Creatively with Pictures: Figural Form A (Torrance, 1966, 1990). As the students were already familiar with the English language in teaching and learning, the test was conducted in its original language, English.

This test is composed of three activities (or pictorial questions) involving different forms to be completed through drawings. The scoring system used in this study was based on the procedures developed by Torrance (1966, 1990). The scoring system presents a broad understanding of the cognitive and the affective process involved in figural creativity. Through the scoring system, it is possible to identify 18 indicators of creativity based on each student's drawing.

The five main creativity indicators in this study were fluency, originality, abstractness of titles, elaboration, and resistance to premature closure. The test also provides a checklist of creative strengths which are emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines, unusual visualisation, internal visualisation, extending or breaking boundaries, humor, richness of imagery, colourfulness of imagery, and fantasy.

The TTCT scripts were scored. The direction manual and scoring guides in the manual were strictly followed. Generally, students will score points for any creativity indicator that appears in the drawings.

Overall indicator of creativity potential is found by means of an index. The index is calculated by pooling all creative strength ratings and the average standard score from the profile.

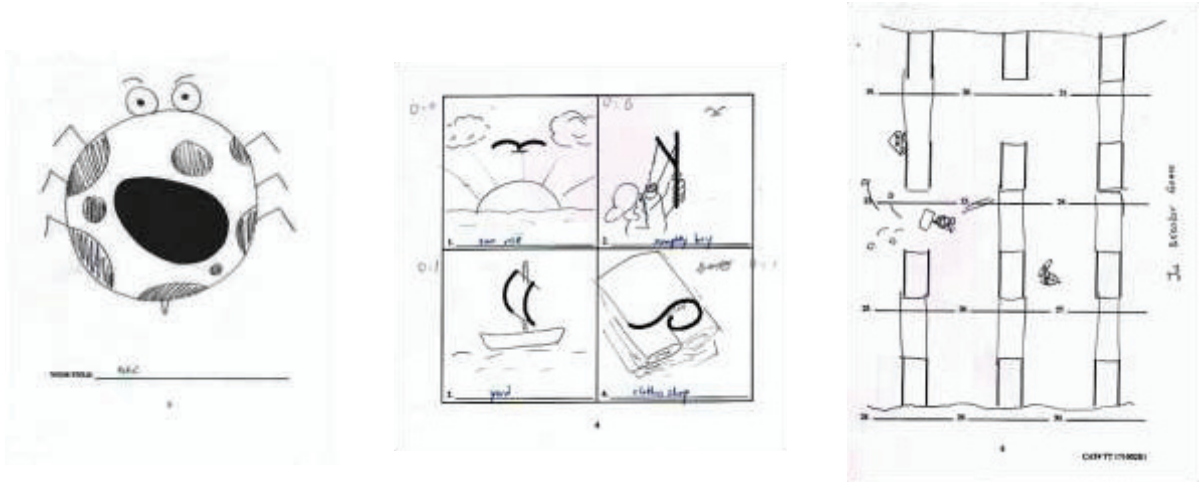
3. Results and Discussion

The data collected for this study provided scores for figural creativity and its components. As the study measures the creativity level among undergraduates of an institution of higher learning, the age-based norm is used. The

discussion of this study is based on age-based norm. Standard scores are provided for total scores in each dimensions of creativity assessed by TTCT, and are reported with a mean of 100 and a standard deviation of 20.

Fluency is perhaps one of the most critical scores, since it represents the students' ability to produce a large number of meaningful figural images. To score points, the responses must be relevant. Therefore, nonsense and inappropriate responses are not counted. The originality score represents the ability to produce specific use of the stimulus given. For elaboration, scoring is when a student produces a relevant detail to the original stimulus to enable the response to be meaningful. Another creative strength is abstractness of titles where points are given depending on the level of abstraction given to the title of the pictures drawn. Resistance to premature closure is when the student demonstrates a 'keep open' mindset in processing information and considers a variety of information.

Examples of some of the best student responses which score points for the 5 main creativity dimensions mentioned above are given in Figure 1.



(a) (b) (c)

Figure 1. (a) Example response for Activity 1; (b) Example response for activity 2; (c) Example response for Activity 3

The following diagram (Table 1) is an example of a profile for Student No. 3. In the diagram, the percentile ranks associated with such standard scores in a normal distribution are given as a guideline.

Table 1. Profile for student No. 3

Student No. 3		AGE BASED		
Creativity Dimension	Raw Score	National percentile age	Standard score age	Standard score scale for age 60 80 100 120 140
Fluency	21	46	98	
Originality	15	39	94	
Elaboration	12	98	141	
Abstractness of Titles	19	93	130	
Resistance to Premature Closure	10	22	84	
Average			109.4	

From the profile shown in Table 1, the average standard score for the 5 creativity dimensions for Student No. 1 is 109.4. This is slightly above average. It was also found from the study that the student scored above average for elaboration and abstractness of titles. Student No. 3 scored 14 points for showing evidence of creative strengths. This is not indicated in the profile, but noted on a separate checklist.

An index value, which serves as an overall indicator of creative potential is then found through pooling the average standard score for age and the creative strengths ratings from the profile. Table 2 shows the individual student's average standard score and creativity index values for the whole sample.

From Table 2, a total of 12 students obtain an average standard score above 100. Therefore, these students can be concluded to have an above average creative ability. The highest creativity index is with Student No. 12 at 79, and the lowest creativity index is with Student No. 1 at 5.

Table 2. Students' average standard score and creativity index values

Student No.	Age	Sex	Average Standard Score	Creativity Index
1	21	F	82	5
2	22	M	92	15
3	21	F	113	58
4	21	M	113	58
5	20	M	113	58
6	22	M	114	60
7	22	M	117	68
8	20	M	120	75
9	23	M	121	78
10	20	F	102	31
11	20	M	93	16
12	22	M	122	79
13	20	M	116	65
14	21	M	91	13
15	21	M	93	16
16	20	M	104	35
17	20	M	96	20
18	20	M	101	28

4. Conclusions

In conclusion, this study has allowed lecturers to measure and assess the students' creativity, based on a standardized test. This result indicates that more than half of the students have above average creativity scores. Further opportunities of the study would be to involve interrater or interscorer to improve the reliability of the scoring.

Also, since TTCT is a behavioral test, measuring the behavioral aspects of creativity, other aspects such as personality or biographical aspects of creativity could be included to obtain a better estimate of a students' level of creativity.

The sample used in this study is predominantly consisted of male participants. Another improvement to this study would be to include more well-balanced samples with a larger sample number. The scoring in this study was based on the scoring of the figural tests on norms developed by Torrance (1966, 1990) by working with American participants. To achieve a higher validity, Malaysian norms should be used, if available.

This study is beneficial to the Faculty of Engineering and Built Environment in particular, as it can be used to plan the best and more effective method of delivery for electrical engineering curriculum to fulfill the aspiration of innovation-led nation.

Acknowledgements

We would like to thank UKM for providing the research grant (PTS-2011-011).

References

Anderson, H.H. (1965). On the meaning of creativity. In H.H. Anderson (Ed.), *Creativity in Childhood and Adolescence* (pp. 46-61). Palo Alto, CA: Science and Behavior Books.

Chua, Y.P. (2011). Establishing a Brain Styles Test: The YBRAINS Test. *Procedia Social and Behavioral Sciences*, 15, 4019-4027.

Palaniappan, A.K. (1998). Figural Creativity and Cognitive Preference Among Malaysian Undergraduate Students. *The Journal of Psychology*, 132 (4), 381-388.

Torrance, E.P. (1963). *Creativity and intelligence*. Minneapolice: Minnesota Beureau of Educational Research.

Torrance, E.P. (1966). *Torrance Tests of Creative Thinking*, Lexington, MA: Personnel Press.

Torrance, E.P. (1974). *Torrance Tests of Creative Thinking*, Lexington, MA: Personnel Press.

Torrance, E.P. (1990). *Torrance Tests of Creative Thinking: Figural and Verbal A*, Benseville, IL: Scholastic Testing Service.

Torrance, E.P. (1996). *Cumulative Bibliography on the Torrance Tests of Creative Thinking* (Brochure). Athens: Georgia Studies of Creative Behaviour.

Toynbee, A.J. (1934). *A study of History*. London: Oxford University Press.