Web-based Creativity Assessment System

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Abstract—Lack of creativity has caused a growing number of graduates to be unemployed in most developing and underdeveloped countries. Institutions have faced problems in enhancing creativity as well as assessing creativity quickly to initiate remedial programs. Most creativity measures require tedious assessment procedures and are time-consuming. A web-based assessment system will facilitate assessment anywhere with Internet connection. This research reports an intelligent web-based Creativity Assessment System (CAS) which provides instant feedback and information for further intervention in enhancing creativity and employability. It measures three most common dimensions of creativity vital for global competitiveness. They are Originality, Fluency and Flexibility. The validity of CAS was tested using university undergraduates. Scores were also hand-scored based on the manual to obtain the actual Fluency, Flexibility and Originality scores. Both sets of scores were correlated for each component to obtain the reliability indices and compared statistically using *t*-tests. The results show that CAS is a highly reliable and valid measure of these three components. CAS can help educators and curriculum planners design activities and content that will enhance students' creativity and subsequently their global competitiveness.

Index Terms—Creativity assessment system, fluency, flexibility, originality.

I. INTRODUCTION

The problem of unemployed graduates has affected many countries both economically, socially and politically. Many reasons have been given for the increase in unemployment among graduates. Other than economic and political factors, the reasons given are the graduates' lack of skills required by the industries. They also lack motivation and most prominently creativity and problem-solving abilities highly sought after by most companies and industries. The infusion of creativity and problem-solving skills in universities have generally been unsuccessful especially because of the focus on content and prescribed text books which has left no room for creative thinking and problem solving either from the instructions of teachers or through the initiative from the students themselves. One of the reasons is the lack of knowledge of creativity and the skill to teach it especially in institutions of higher learning. This could also be due to the fact that it is very difficult to find instruments that measure creativity that will enable instructors to quickly and validly assess individuals high on creativity to provide the environment to nurture their creativity. Such instruments will also prove invaluable in identifying individuals who are low on creativity so that suitable programs and experiences can be

tailored to enhance their creativity. Hence, this paper intends to address this issue by presenting the results of a web-based software developed to assess creativity, called the Creativity Assessment System or CAS. This web based assessment is accessed online to enable individuals to attempt it anywhere and at anytime. It is also accessible for instructors to access their students' results anywhere and anytime to obtain information necessary to design lessons aimed at enhancing creativity among their students.

II. LITERATURE REVIEW

The relationship between creativity and academic achievement has become an important area of research ever since Getzels and Jackson (1962) found highly creative children to be superior in scholastic achievement to children with high IQ although the high creatives had 20 IQ points lower than the high IQ students. Similar positive influence of creativity on academic achievement was also found among Malaysian secondary school students (Palaniappan, 2007). J. P. Guildford's and later E. P. Torrance's work on creativity which resulted in the categorization of creativity as Figural and Verbal creativity stimulated further research on their assessment and how they influence academic achievement. Research in the area of creativity continued very vigorously in the latter half of the 20th century and studies on its relationship with education has contributed to the development of various tests to assess creativity and also programs to enhance it.

There has been several attempts at training for creativity (Clements, 1991; Tan, Lee, Baharuddin and Jamaluddin, 2010, for example), investigating influence of extrinsic rewards using either computer or non-computer based approaches (Hennessey, 1989) as well as assessment of creativity using computers (Lau and Ping, 2010; Silvia, Martin and Nusbaum, 2009, for example). Clements's (1991) study used the LOGO computer programming technique to investigate its influence on creativity while Tan, et al.'s (2010) study used the creativity enhancement approach called the Morphological Analysis Method to test its efficiency in enhancing creativity. However, very few studies attempted to assess creativity using computers or the internet and none have used the Torrance's (1974) approach exemplified by Torrance Tests of Creative Thinking to assess creativity using computers. Currently the database on which the originality scores are based is static and does not change. This may not give a more accurate assessment of creativity. Hence, it is important to develop a creativity assessment software where the database is constantly updated as more and more respondents attempt the software online. A constantly updated database on which the originality scores are

calculated will yield a more accurate assessment of ones creativity than a static database which is currently the case with most tests using the manual scoring procedures.

Hence, the main purpose of this study is to develop a creativity assessment system that will be able to assess creativity based on the theories used by Torrance (1974, 1984) and at the same time use a dynamic approach whereby the database is constantly updated and the assessment is based on the age and vocation of the test taker. And another advantage of the system is that it is web-based which will enable all respondents to attempt it online wherever and whenever they wish and also for teachers and instructors to access their students' level of creativity and use this information for lesson planning. Even employers will be able to access their employees' database for information on their level of creativity from anywhere at anytime to plan and to strategize or to build a more effective and innovative team at the workplace.

Although creativity tests were not initially designed for classifying people as being creative or non-creative, these tests in whichever form has become a important tool in education to select students into gifted programs and in business, to select creative employees for jobs that require creative talent and innovative thinking. When Torrance first developed Torrance Tests of Creative Thinking (TTCT), the aim was to understand another important faculty of the human mind other than intelligence and also to help teachers design activities that are more suitable for creative individuals (Torrance, 1966, 1974; Kim, 2006). The main aim of developing and testing this Creativity Assessment System (CAS) is to cater for these initial objectives proposed by Torrance (1966) as well as to accommodate the current need which is to be able to identify creative talents in order to design creativity enhancement programs tailored to these creative individuals.

There are many theory-based approaches to assess creativity. Among the earliest was Guilford's (1956, 1967) work on divergent thinking. Based on Guilford's ideas on divergent thinking, Torrance proposed four dimensions of creativity, namely, Fluency, Flexibility, Originality and Elaboration. The following are the Torrance's (1974) definitions which are used in this research.

III. DEFINITIONS

Fluency is assessed based on the number of responses or stimulus used in the activity. The CAS software is programmed to read the number of responses attempted. Flexibility is assessed by the number of categories the responses fall into. CAS reads these responses and checks them against a dynamic database initially created based on the manual for The Torrance Tests of Creative Thinking (TTCT) (Figural Form A). Originality is assessed by the number of statistically infrequent responses given. Frequency is based on a dynamic database that changes after each response is entered into the system by the test taker. The rarest responses get the highest points for originality as shown below:

Responses with frequencies that are: <1% are given 3 points; 1 – 3% are given 2 points; 3 – 5% - are given 1 point

and > 5% no points are given.

The CAS was developed using ASP and programmed to be uploaded on the university server which functions on the MSSQL platform so that it accessible via my website: www.ananda.um.edu.my.

IV. METHODOLOGY

The methodology involved in this research comprised three phases. The first is the briefing of the programmer, second collection of preliminary data for the calculation of originality and flexibility scores and the third is the actual study investigating the accuracy of the CAS in assessing creativity.

A. Designing and programming of Creativity Assessment System (CAS)

A competent programmer knowledgeable in programming in ASP.net and uploading on to MSSQL platform was fist engaged to program the software. Since the programmer did not know the theory behind creativity and its assessment, several sessions were held to brief her of the details and calculations involved in calculating the Fluency, Flexibility and Originality component of Creativity. The Elaboration component was deliberately left out as it would involve complex programming as well as different set of tests.

After four months, the programmer uploaded the trial version of CAS on her website so that I could check and provide feedback on the system and suggest improvements. After several suggestions on the method used to get the demographic data and the responses from the respondents, the software was then pilot tested to gain the test takers views of the ease with which they can understand the instructions (as this will be a self administered online accessed creativity test) which were in Malay and English, and also to develop the initial database from which the originality scores could be calculated.

The first introductory page of the software as can be seen from the website given above is bilingual and respondents will have to sign up first using their own username and password and other particulars and then log-in using the same username and password. The website also shows the background information requested from the respondents when they signed up.

Using the above version of CAS, a pilot study was conducted to test to what extent the system is user friendly and to collect data which will form the database from which the Flexibility and Originality scores would be calculated.

CAS was refined based on the feedback obtained in the pilot study and the final version was uploaded onto the university website: www.ananda.um.edu.my. Emails were sent out to teachers and lecturers in Malaysia to encourage their students to access this web-site and attempt the CAS.

V. DATA ANALYSES

Before the actual testing of CAS was undertaken, a pilot study was carried out to build a database for the calculation of originality and flexibility scores. This involved 139 respondents of various age groups and vocation. This paper

will report only the data obtained from students who were in secondary schools and universities in Malaysia. There were 204 secondary school students and undergraduates who attempted CAS online and provided a complete set of data. Their mean age was 16.01 (SD = 1.19).

A. Pilot Study

One of the purposes the pilot study was to form the initial database for the assessment of originality. Based on the criteria for originality, the responses were given points for originality. Hence, the first respondent's responses in the actual system testing will be added to this database and the percentage of occurrence of that response is recalculated. Hence this database is dynamic and results in a more accurate assessment of originality.

The data obtained in the pilot study also served to create the categories for the responses. These categories are used to calculate the Flexibility scores. Students who gave responses which come form many categories get high scores for Flexibility.

B. Actual Study Testing the Accuracy of CAS

In the actual study, emails were sent out to teachers of a representative random sample of secondary schools and lecturers in universities in Malaysia requesting them to invite their students to attempt the CAS online. Initially the responses from schools and universities were very slow and several reminders were sent followed by phone calls to remind teachers and lecturers. After one year, the number of students who responded was 239, but only 204 complete set of data was obtained.

Data analyses were undertaken using the administrator's website which was also accessed by me. The website enabled access to all the responses given by the respondents.

There were instances when the system was unable to recognize the items either because it was misspelled or was not in the designated categories. The system collects these items and places them in another web page called "Assign Pending Items into Categories". I access this page periodically to manually assign these items to their correct categories. This way if any other respondents who happen to give the same items, the system will automatically assign the categories without placing them in the "Assign Pending Items into Categories" page once it has already been assigned.

The system also provides the researcher with a list of pending scores which have not yet been emailed to the respondents. This happens when at least one of the items given by the respondents is not assigned a category by the system.

Web page also shows the list of respondents who have not received their email results. This happens when at least one of their items is in the pending list for the my attention.

The system also produces a list of Fluency, Flexibility and Originality scores emailed to the respondents. Using the items captured by CAS for each activity and for each respondent, I was able to correlate the scores given by CAS and the scores I got by manually scoring the items using the scoring manual provided by Torrance (1974). These two scores are correlated using Pearson Product Moment Correlation to ascertain the reliability of the scoring by CAS.

Correlational analyses between the scores from 204 students calculated by CAS and those calculated manually for all three components of creativity were ascertained using the SPSS Version 20. There is a significant correlation between the Fluency scores assigned by CAS and those calculated manually ($r = 1.00$, $p < .05$). For Flexibility, the correlation coefficients are somewhat lower but significant ($r = .91$, $p < .05$) while that for originality was significant and higher ($r = .95$, $p < .05$). The correlation coefficients are slightly higher than those obtained using the previous software IWCAS mentioned above. This shows that CAS can be used reliably to ascertain quickly the Fluency, Flexibility and Originality scores. It is also a valid measure of these three components of creativity as ascertained by the comparison of the responses given and those considered creative by criteria used by Torrance (1974).

C. Gender differences in Creativity

Gender differences analyses undertaken show that there are significant gender differences on Flexibility ($t = 2.10$, $p < .05$) while no gender difference were found in Fluency ($t = 1.88$, $p < .05$) and Originality ($t = 1.76$, $p < .05$). Male respondents were significantly higher than female respondents on Flexibility but do not differ from female respondents on Fluency and Originality. This finding seems to support the findings by Ai (1999) on secondary school students in Spain that Flexibility is a predominant characteristic of boys even when related to most areas of academic subjects. Similar findings were also reported by Mayhon (1966) and Torrance (1969) for flexibility but not on originality where boys were found to perform better than girls. This gender difference in Flexibility can be attributed to the different roles Malaysian boys and girls play in their daily lives. Boys are given greater freedom to express their views while girls who freely express their views tend to be frowned upon. Even though the gender differences between male and female respondents on Fluency and Originality did not reach statistical significance, boys obtained higher means than girls on both measures. This can also be attributed to the differences in the roles boys and girls play in the Malaysian society.

Another study (Palaniappan, 1989) undertaken among university undergraduates found male students to have significantly higher levels of Fluency, Flexibility and Originality than their female counterparts. However, in a study among Malaysian Form Four students (Palaniappan, 1994) boys were found to have significantly higher levels of originality than girls. This study found no significant gender differences in Fluency and Flexibility. Hence, it appears that age may have an influence in the nature of gender differences found in these components of creativity. Further similar replication of this study is required to confirm the factors that may influence the existence of gender differences in these components of creativity. These gender differences are also found to differ from those found by studies undertaken in other countries.

VI. CONCLUSION

A new computer based Creativity Assessment System (CAS) was developed to ascertain three components of

creativity, namely Fluency, Flexibility and Originality. Using the data obtained during the pilot study, the scores on all three components were calculated by CAS. Scores of these components were also manually scored using Torrance (1974) scoring procedure. Pearson Product Moment correlational analyses indicate that CAS is a reliable measure of these three components of creativity and hence can be used to ascertain these scores anywhere and anytime reliably. Further data are currently being collected using CAS to ascertain this reliability and validity according to vocation and age groups.

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