DEVELOPMENT OF SCORING RUBRIC TO ASSESS STUDENTS' CREATIVITY IN ENGINEERING TECHNOLOGY

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TO ASSESS STUDENTS' CREATIVITY

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by

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PEMBANGUNAN RUBRIK PENSKORAN UNTUK MENTAKSIR KREATIVITI PELAJAR DALAM TEKNOLOGI KEJURUTERAAN

ABSTRAK

Kreativiti telah menjadi sangat penting kepada Sistem Pendidikan Malaysia. Kemasukan konstruk kreativiti ke dalam Kurikulum Standard Sekolah Rendah (KSSR) menunjukkan bahawa kerajaan komited ke arah memupuk kreativiti dalam kalangan pelajar. Bagi mencapai sasaran tersebut, kedua-dua pedagogi dan penilaian perlu dipertingkatkan. Kajian ini dijangka akan menyokong inisiatif kerajaan kepada kreativiti melalui pembangunan rubrik penskoran untuk mentaksir kreativiti produk yang direka bentuk oleh pelajar. Rubrik penskoran ini telah dibangunkan berdasarkan kerangka pendidikan reka bentuk yang cenderung ke arah peningkatan kreativiti dalam kalangan pelajar yang disasarkan. Sebelum rubrik penskoran ini dibina, tugasan pelajar juga dibina berdasarkan kerangka tersebut. Rubrik penskoran yang dibangunkan itu diuji ke atas reka bentuk yang telah dicipta pelajar berdasarkan tugasan yang telah dibina itu. Dapatan kajian rintis yang sederhana telah mendorong untuk rubrik ditambah baik. Tujuan proses penambahbaikan ini adalah untuk menyelesaikan masalah pertindihan makna indikator-indikator tertentu dalam rubrik ini selain menyelesaikan masalah indikator-indikator yang dianggap tiada kaitan sebagaimana yang diulas oleh penilai daripada kajian rintis. Selain itu, penambahbaikan pada rubrik ini juga akan membantu guru-guru menentukan tahap prestasi reka bentuk yang dinilai dengan lebih baik. Proses penambahbaikan ini melibatkan tiga aktiviti iaitu temu duga dengan panel pakar, analisis kandungan lembaran markah yang diberi oleh panel pakar, dan temu bual berkumpulan dengan

dua orang guru pakar. Objektif proses penambahbaikan ini adalah untuk menambah baik definisi setiap indikator selain untuk mencari elemen-elemen serta contoh-contoh bagi setiap indikator, untuk dimasukkan ke dalam manual penskoran yang disediakan. Kajian rintis kedua dijalankan dan menunjukkan hasil yang positif. Kajian lapangan kemudiannya dijalankan dengan 10 orang guru. Penilai diberi latihan selama tiga jam sebelum membuat pemarkahan. Data daripada kajian lapangan dianalisis untuk struktur faktor, ketekalan dalaman dan kebolehpercayaan. Hasil analisis faktor penerokaan menunjukkan model empat faktor. Walaupun sedikit berbeza daripada model teori yang mendasari pembinaannya, struktur rubrik itu masih utuh. Nilai alpha adalah tinggi dengan tiga faktor mencapai 0.9. Faktor 'Novelty' walaupun mempunyai nilai alpha 0.84 namun ia masih boleh diterima. Kebolehpercayaan antara penilai untuk skor keseluruhan adalah pada tahap yang boleh diterima iaitu 0.71. Kerangka kajian kesahan rubrik ini adalah selaras dengan kerangka pembinaan ujian berdasarkan teori. Bukti-bukti kesahan rubrik ini dikumpulkan semasa proses pembinaannya dan juga dapatan kajian empirikalnya.

DEVELOPMENT OF SCORING RUBRIC TO ASSESS STUDENTS' CREATIVITY IN ENGINEERING TECHNOLOGY

ABSTRACT

Creativity has become very important to the Malaysian Education System. The inclusion of creativity construct into the Standard Curriculum for Primary School (KSSR) gives the indication that the government is committed toward the inculcation of creativity among student. To achieve such target, pedagogy and assessment must be upgraded. This research is expected to support the government initiative on creativity through the development of a scoring rubric to assess the creativity of student designed product. The scoring rubric was constructed based on the design education framework prone toward the enhancement of creativity among the targeted student. Prior to the development of a scoring rubric, performance tasks were also constructed. The design from which the scoring rubric was tested upon was created by the student based on the tasks. The modest result of the pilot study had led the rubric into the refinement process. The aim of the refinement process was to solve the redundancy and irrelevancy of the indicators as commented by the raters from the pilot study. Additionally, the refinement on the rubric should help teachers determine better the performance level of the designs. The refinement process involved three activities namely the interview with the expert panel, the content analysis on the marking sheet of the expert rating, and the group interview with two expert teachers. The objectives of the refinement process were to improve the definition of each indicator and to search for quality descriptions and examples for every indicator to be included into the scoring manual prepared for the study. A second pilot study was

conducted and showed positive result. The field study was then carried out with 10 teachers. The raters were given three hours training prior to doing the rating. The data were analyzed for factor structure, internal consistency and reliability. The result of the exploratory factor analysis indicated a four-factor model. Although slightly different from the theoretical model underpinning its construction, structural fidelity of the rubric is still intact. The alpha value is high with three factors achieving 0.9. Novelty factor though having alpha value of 0.84 is still acceptable. The interrater reliability of the total score is at acceptable level of 0.71. The framework for the validity study of this rubric is in accordance to the validation framework of a theory driven test construction. The validity evidences were collected on the process and the empirical data morf the important phases of the study.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Assessment plays a very important role in education. From the assessment of learning perspective assessment provides evidence of the skill or learned behaviour that the students have achieved. The result from the assessment can be used for decision making about certain policy and for the construction of an appropriate pedagogy. From the assessment for learning perspective assessment helps student to learn. By providing specification on what is expected from them, student will learn how to achieve it. This research is aimed to supplement the framework of creativity assessment for technological design education.

One method to inculcate creativity in children is through design activity. However without proper assessment instrument, the student's creativity in designing could not be determined, hence hindering further effort to improve it. The multifaceted characteristics as well as the exclusivity of creativity to different domain make creativity a very demanding construct to measure. Among the various way of assessing creativity, the assessment of creative product from student design activity is the focus of this study.

1.2 Background of Study

Creativity is given an emphasis based on the notion that it is arguably the most important psychological construct. It is often conceptualized as an engine of economic development as well as impetus behind technological advances, workplace leadership, and life success (Makel & Plucker, 2008a). Some authors also consider creativity and creativity development as a path to improve human condition. Creativity has been associated with maintaining healthy, loving relationships (Livingston, 1999), effective therapy (Kendall, Chu, Gifford, Hayes, & Nauta, 1998), learning to resolve conflicts effectively (Webb, 1995), combat grief (Davis, 1989), and even the use of humour to defuse potentially violent circumstances (Jurcova, 1998).

The Malaysian government has placed creativity as a very important construct for its education system. The latest transformation in the Malaysian's education curriculum has explicitly included creativity into its curriculum. The Standard Curriculum for Primary School (Kurikulum Standard Sekolah Rendah, KSSR) that has been implemented for primary school student since 2010 is integrating creativity along with entrepreneurship and information technology and communication as an added value. The objectives for the inclusion of creativity and innovation elements into the transformed education system as stated in the ministry Creativity Guidebook (Ministry of Education Malaysia, 2010) are to enable the student to:

i. possess creative personality
ii. acquire skill in creative process

iii. generate creative and innovative ideas

iv. excel in communication skill

v. apply knowledge and skill critically and creatively

Along with KSSR, the Malaysian education assessment has also been transformed. The National Educational Assessment System (Sistem Pentaksiran Pendidikan Kebangsaan, SPPK), is aimed to gather more comprehensive information about the growth and development of student through five types of assessment namely School Assessment, Centralized Assessment, Centralized Examination, Physical Activity and Co-curriculum Assessment, and Psychometrics Assessment. Psychometrics Assessment is used to gather information about the psychological trait of student, conducted through two types of testing namely aptitude test and personality test. Even though both the aptitude test and personality test is carried out only through general type of testing, the government message is clear that traits like creativity, problem solving and other psychometric constructs are now being highlighted in the education system.

In the previous curriculum transformation program, the Integrated Curriculum for Primary School (Kurukulum Bersepadu Sekolah Rendah, KBSR) and the Integrated Curriculum for Secondary School (Kurikulum Bersepadu Sekolah Menengah, KBSM), had also attempt to give focus on comprehensive potential development among student. The shifted on teachers teaching approach toward learners centered as opposed to teachers centered had shown that ways were given toward the enhancement of creative thinking among student. In the learners centered classroom, students are given room and opportunities to experience growth and

development in a healthy manner. The Creative and Critical Learning Skills (Kemahiran belajar secara kreatif dan kritis, KBKK) introduced in early nineteen nineties was another example of effort carry out by the government to inculcate creativity among students. The KBKK was designed to encourage students to tackle learning creatively and critically in addition to acquiring two other skills namely problem solving and decision making (Lee, 1996).

Despite the efforts that had been taken by the government, the current state of Malaysian student creative ability is still debatable. Research done by Aida Suraya, Ramlah, Rohani, Rosini and Sharifah (2006) indicated that Malaysian university students are lacked of generic skills in problem solving including the ability to generate alternatives which is directly related to creative ability. Their study on 3025 respondents from seven Malaysian public universities showed that even though problem solving abilities is positive, the result is only moderate. From the scale of 1 to 5, Malaysian students in the sample of the study only obtained a mean of 3.43 with standard deviation of 0.43. In their report Aida Suraya et al. (2006), concluded that the moderate level of problem solving ability among the student warrant for immediate solution. To do so they recommended further research be done on the subject.

There are many explanations for the lack of creativity among students in this country. The most obvious reason is the lack of attention given to the inculcation of creativity among school student. Both Toh (2003) and Yong (1989) agreed that creativity enhancement has not been given great attention as compared to the strong emphasis given to the development of intelligent. Though various initiatives were

carried out to improve teacher's instruction, most schools in Malaysia were inclined towards producing students who were examination oriented. The focus of education was still on memorizing of facts for examination purposes (Yong, 1989). The study by Balakrisnan (2002) also supported that the focus on examination has contributed to the low level of creativity among Malaysian students. His study on the implementation of KBKK concluded that graduate teachers poorly implement KBKK for lesson preparation and classroom instruction. They seldom applied KBKK elements such as a good questioning technique, the use of proper teaching assist material as well as appropriate classroom activities.

The problem of creativity enhancement is not only prevalent in Malaysia. A review by Cropley and Cropley (2007) shown that the problem is also affecting developed nation like the United States of America (USA), the United Kingdom (UK) and also Australia. Citing Cooper, Altman and Garner (2002), Cropley and Cropley (2007) wrote that the UK educational system is in reality discouraging creativity. The curriculum in the UK medical education for example is overloaded with factual material that discourages higher order cognitive function such as evaluation, synthesis and problem solving, and engenders an attitude of passivity. At school level the condition are not much different. Even though most teachers claim to have a positive attitude toward creativity many teachers frown upon traits associate with creativity or even actively dislike characteristics such as boldness, desire for novelty or originality (Cropley & Cropley, 2007). Children who score highest in creativity test were the one most often in trouble with teachers. Some teachers even describe creative children as being similar to the kind of student they like least (Westby & Downson, 1995)

The problem is although there are teachers who are theoretically willing to promote creativity in their students; they are uncertain of what to do in practice (Cropley & Cropley, 2007). According to Cropley and Cropley (2007) they are caught in the dilemma between traditional educational goals which emphasis on possession of large number of facts, accurate recall of memorized material and correct application of standard technique; and a creativity oriented goal which encourage discovering problems, inventing unexpected answer and linking traditionally separate areas. In the UK, studies showed that teachers were reluctant to change their practice when they established strategies in ensuring good grades for their students each year (Rutland & Barlex, 2008). In fact they seem more typically to reward those students who excel in the assessment than those who are able to show real flare and imagination. Creativity development in student therefore has been sidelined.

National Advisory Committee on Creativity and Cultural Education (NACCCE) has proposed the teaching for creativity to involve three principles namely encouraging, identifying and fostering (Joubert, 2001). Encouraging is to make young people believe in their creative potential, to engage their sense of possibility and to give them the confidence to try. Attribute such as risk taking, independent judgment, commitment, resilient in the face of adversity and motivation which contributes to the development of creative potential among children should be encouraged. Identifying on the other hand is an effort to help the student identify which area their creative strength is. Some student may easily identify their creative strength but some may not because it's falls outside the norm. To overcome this

NACCCE proposed that the concept of school achievement be widened. This will help many more young people recognize their creative strength during earlier part of their schooling period and therefore effort to foster them can be done sooner. Finally fostering involves enhancing children creativity through the process of being creative. This can be done by allowing and encouraging experimental activities in addition to other classroom practices such as respecting unusual question by student, the use of opened and closed type of questioning and so on. The classroom environment that are full of ideas, experiences, interesting materials and resources and in a relaxing atmosphere should also be set up to stimulate creativity (Joubert, 2001).

One venue where creativity can be fostered is through technology education (Lewis, 2005a). Technology education subjects such as the Design and Technology in the UK or Engineering Technology in Malaysia are not constricted to the traditional academic norm. This broadens the range of domain covered for the subject enabling the students to express multiple intelligences hence uncovering their talent (Lewis, 2008). Additionally the natures of the subjects which give freedom to the students to imagine and invent, make the subject very attractive for such a purpose (Lewis, 2008).

Hennessey and McCormick suggested that (as cited by Williams, 2000), technological knowledge taught to technology education students can be divided into conceptual knowledge which relate to the body of content, and procedural knowledge which relate to the activity of technology education classroom . However, the teaching of procedural knowledge in technological classroom is inclined toward

the development of manipulative skills (for example doing and making of things) and knowledge about material and tools. According to (Williams, 2000), the teaching of procedural knowledge that focus more on the development of cognitive skills that is suitable in the context of technology education should give the opportunity for the technology students to think and reflect and develop ideas and test their ideas in a practical context. Two most appropriate processes to develop cognitive skills through the teaching of procedural knowledge are design and problem solving (Williams, 2000).

According to Lewis (2005), technological design which is one of the content areas of technology subject is almost ideally suited to uncovering dimensions of creative potential which remain hidden in much of the rest of the curriculum. The open-ended nature of design tasks which allow more than one right answer and more than one right method of arriving at the solution make design very suitable for the inculcation of creativity in children. The creative potential of design teaching can be seen in the work of Druin and Fast (2002) where Swedish children who were included in the design of technology revealed inventiveness in their journaling. From the study on Design and Technology in the UK schools, it was found that the subject gave the opportunities for student to do something new and by doing so it helped them to improve their higher order thinking skills (Lewis, 2005a).

Despite the potential of technology education in the enhancement of creative ability among students, the actual practice of the subjects inside the classroom is questionable. Due to the difficulties involved, it is argued that there is a shortage of teachers who aimed to foster student creativity (Rutland & Barlex, 2008). The

reasons for this was that teaching for creativity enhancement involves discovery, risk taking, pushing limits, and taking steps into the unknown. According to Lewis (2005) the teachers easily lose control when they challenge their student to be creative. The technology education teachers also have to face the challenge of the subject being not considered important as compare the academic subjects like science and mathematics. While the standardized test of academic subject is being accepted as a measure for the student accomplishment and talent, the result of the technology subjects test is not. As a result technology education subject receive less attention in school as compare to subject such as science and mathematics.

In order to enable creativity to be fostered successfully through technology education, more research certainly need to be done on the area. Lewis (1998) has identified creativity in the context of the teaching of technology education as a pressing research need for the field. The pedagogy of design though some consensus has been met does still in needs for some fine tuning. The work popularized by Barlex and Trebell (2007) on the design-without-make concept for example should be researched further. So does the use of either creative method or rational method or both as a methodology of student designing.

Beside pedagogy another area of technology education which is important in fostering creativity is the assessment of the subject. There are two opposing views on creativity assessment; one views being assessment could inherently adverse to creativity, the other view beliefs that assessment could promote creativity (Eisemberger and Armelli, 1997). The researcher agrees with Eisemberger and Armelli (1997) whom has shown that giving grade could actually promote creativity

provided the instructors know the substance they are trying to promote, and students know the expextation to do differently in order to be creative.

However creativity assessment is more difficult to implement as compared to traditional assessment. In the traditional assessment, teachers in advanced produce assignment, indicate clearly and concretely in their grading when and where such material is missing or is incorrect, the necessary knowledge and skills that have been specified in advance can be acquired by diligent learning and practice and can be checked out in practice run (Cropley & Cropley in Ai, 2007). Creativity on the other hand emphasized on novelty, ambiguity, uncertainty and the like. Not only do teachers and students dislike this, it also raises the risk of disagreement over the value of answer (if they are not correct/incorrect, how is one better than another?), subjectiveness (are different in answers dependent more upon the knowledge, beliefs and values of a particular assessor than on some objective criteria, and arbitrariness (are grades affected by whim, changing moods, short term fads, and so on?). As a result it is not a surprise that the measure of student creativity achievement in the subject has not been included into the standardized test from which student accomplishment and talent is assessed and evaluated.

On assessment of design, the fact that few works have been done on the area could become bases for further research including the research done in this study. Research by Cropley & Cropley (2007) on college student designing is one of the examples. Other such as the one done by Petrosky (1998) on the type of task for student designing is also very important to the research of this area. Due to

differences in the educational framework as well as the target population, variation in the instrument to be developed is expected.

In Malaysia, Engineering Technology is an example of the subject that has technological design as one of its content area. Engineering Technology has been introduced into the Malaysian school system since 1996. It is categorized as a technical subject and is offered as an elective course to Form 4 and Form 5 students at selected academic schools all-over Malaysia.

Based on the investigation done by the researcher on the curriculum documents, the Engineering Technology framework is summarized as follows. Design education learning area is elaborated because it is the focus of this study

i. The subject is aimed at preparing students to be technically literate, productive, creative and innovative and practicing noble values harmoniously and in an integrated manner in order for them to function in daily lives and interact meaningfully with a technologically-oriented society (Ministry of Education, 2006).

ii. The objectives of subject as stated in the syllabus are to:

   a. develop basic skills in the use of material, tools and equipment
   b. develop student creativity in problem solving and produce new ideas
   c. develop the ability to plan, research, analyze and evaluate project work
   d. develop organizational skill
   e. instil the spirit of independence, confidence and brave in utilizing technology
   f. expose student to the basic and approaches in information system

g. provide opportunities to identify preferences, abilities and interests associated with specific technological field studied

iii. Engineering Technology is comprised of five major areas of study. The components for each area of study are summarized in Table 1.1.

Table 1.1:

Content of Engineering Technology

Area of study	Component
Manufacturing	Manufacturing system Tools Engineering material Manufacturing process
Electronics communication	Electronics component and basic circuitry Communication system Computer system
Power and transportation	Transportation Energy Resources Control systems (Hydraulics, pneumatics, electromagnetic and electronics)
Construction	Activities in doing construction project Management of construction activities and resources Construction of building structure
Engineering design	Definition of design and design process Recording and presenting design ideas Factors of designing

iv. The design content of Engineering Technology includes the teaching of design process and various aspects associated with each stage of the process. The process of design include clarifying problem, exploring design ideas,

expanding the ideas, evaluating and selecting design ideas, making prototype or model, and testing the designed product (Ministry of Education Malaysia, 2006a). Other than learning conceptual knowledge of design, the students are to do design project, as part of the subject requirement. The activity is assessed as part of the course work assessment which is Paper 3 of Malaysian Certificate of Education, MCE (Ministry of Education Malaysia, 2006b). The constructs and elements of design being assessed in MCE's Paper 3 are as summarized in Table 1.2.

Table 1.2:

Construct and Elements of MCE Paper 3

Construct	Element of Generic Skill
Organizing skills	Course work planning Working in group
Designing Skill	Producing brief and design specification Brief development
Investigating skills	Investigating and collecting of information Choosing suitable material
Engineering communicating skills	Using preliminary sketches as medium of communication Using development sketches as medium of communication Using working drawing as medium of communication Using presentation drawing as medium of communication
Practical skills	Measuring and marking Using tools or machines Realizing of design Presentation
Cost estimating skills	Cost estimation Time estimation

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The second objective of the Engineering Technology clearly stated that, creativity among students is hopes to be enhanced through this subject. Despite the

importance of the construct, the thorough investigation by the researcher on the subject curriculum documents revealed that the emphasis on creativity is minimal. Even though creativity can be enhanced through design activities carried out by the student, proper guidelines has not been given toward that said purpose. From the assessment perspective, the information provided in Table 1.2, indicated that only design related generic skills are included in the assessment. The evidence that assessment of creativity been carried out formally is limited to the requirement for the student to produce more than one solution for the course work of MCE Paper 3 (Minstry of Education Malaysia, 2006b). The lack of assessment in the creativity of design either it be on the process or on the product (as evidence from Table 1.2), provide the context for this study which is on the development of instrument to assess student design work in Engineering Technology.

1.3 Statement of Problem

To foster creativity through design education, both the pedagogy and the assessment of student designing must be done appropriately (Cropley & Cropley, 2009). The pedagogy of design education must be the one that allow student to think, reflect and develop ideas on the issue in hand. The assessment on the other hand should have the information so that teachers know what they are trying to promote, and students know what is it that they are expected to do in order to be creative (Eisemberger & Armelli, 1997). The instrument should include explicit criteria of creativity so that the judgment is fair and valid. Such an assessment requires an instrument that specifies how a creative design should be.

The development of a proper instrument to assess creativity in design education is still at an early stage. According to Lewis (2005), the number of assessment instruments available for measuring creativity of student designed product is still very limited. Due to that reason teachers have difficulty assigning grade to their students' work. They are basically not familiar with what they want students to do in their assignment, nor can they recognized aspect of student works that can be said as creative. As a result the teacher cannot give feedback on the outcome of the student work effectively.

As the result, most curriculums do not assess the creativity of the product designed by their student. The creativity assessment is mostly done on the process of design, disregarding the importance of creative product as being the bedrock of creativity. In cases where creative product is evaluated, teachers seldom include

criteria when assessing the student works, hence giving a message that creativity is not important to be included in their work (Randi & Jarvin, 2006).

Though there are instruments already available to measure product creativity, most of those measures are design for product done by adults (Kim & Han, 2006). Some instruments are too long and thus require a lot of time to administer. Fryer highlighted that (as cited by Craft (2001) children are not professionals and due to that criteria for assessment of their work must be different and more lenient. Furthermore, the motive for creativity assessment of adult product is different for those of children. Adult product creativity is assessed for historical or eminent creativity for the reason such as pattern application, whereas for children it is more toward personal creativity for educational purposes.

The curriculum for design education adopted by different countries or even different subjects varies from one another making the already available measures (if any) not suitable for all application. Some curriculum is biased toward craft design whereas some are more toward engineering design. For those oriented toward engineering design, the boundary limit for engineering design methodology to be implemented at school level may differ from one system to another and so does the depth of content knowledge possess by the student. All of these aspects play roles in determining the framework for the teaching of design in school and consequently give great impact to the assessment process.

Based on the facts mentioned above, an assessment instrument is therefore necessary to measure the creativity of design produce by Engineering Technology

student in Malaysia. In addition to giving a proper grade to the student, a good instrument should help the teacher to better communicate the result to the student in order to improve their performance. Regardless of the advantages, developing an instrument for such a construct is a very difficult endeavour (Asunda & Hill, 2007). The issues of validity and reliability are challenges that must be resolved before the instrument can be used for the assessment of student works. The instrument must achieve certain level of validity from all the three perspectives namely content, substantive or structural validity. It must also be reliable which mean consistence in the grade given to the student.

1.4 Purpose of the Study

To develop scoring rubric to assess the creativity of student designed product

1.5 Research Objectives

1. To construct sample of valid performance tasks that enable student to demonstrate their creative ability in their design
2. To construct an analytical scoring rubric to assess the creativity of student designed product.
3. To examine the psychometric properties of the scoring rubric

1.6 Research Questions

From the research objectives, the primary questions that this research addresses include the following:

1. Is the performance tasks constructed valid?
    (i) Are the constructed performance tasks within the scope of Engineering Technology framework?
    (ii) Do the constructed performance tasks enable student to demonstrate their creative ability in their design?
2. What is the nature of the analytical scoring rubric developed to assess the creativity of the student designed product?
    (i) What are the creativity criteria for the rubric developed to assess the creativity of Engineering Technology student designed product.
    (ii) What are the indicators of creativity included into the scoring rubric developed in this study?
3. How are the psychometric properties of the scoring rubric developed in this study?
    (i) To what extent does the scoring rubric developed in this study valid?
    (ii) To what extent does the scoring rubric developed in this study reliable?

1.7 Significance of the Study

1. The newly developed assessment instrument will provide a methodology to assess the creativity of student technological designs which is currently an under developed field of study

2. The study will prove that creativity assessment could be done successfully on the drawing representing the student design rather than the completed product as previously done.
3. The study will prove that training improved interrater reliability of the instrument independent of teachers' education background and experience.
4. The creativity assessment on the product designed by the student could give some indicators to the Malaysia Ministry of Education on the success of the creativity enhancement effort on Engineering Technology student.
5. The rubric that is use to rate the student work, will enable teachers to communicate properly with the student on the quality of the product designed by them
6. Student will be able to improve the creativity of their work when they knew the criteria of a creative product expected from their design activities

1.8 Operational Definition

Scoring Rubrics – Scoring rubric are descriptive scoring scheme to guide the evaluation of a product or process. A scoring rubric is used to improve scoring consistency among raters. There are three consideration to be made before designing a scoring rubric; (i) Analytical or holistics scoring rubric, (ii) construct driven or task driven (iii) the number of performance level for

the assignment of score. The scoring rubric in this study is an analytical construct driven scoring rubric with five performance level. The analytical scoring rubric specified dimension/indicators to be used to rate student work. Holistic rubric is used to make judgment of an overall quality of student response. Although scoring rubric can be used as a stand alone marking scheme, the rubric developed in this study is part of perfomance assessment on student creativity in designing.

Performance Task – A performance task is a type of assignment given to student either to produce or perform something. In this study a performance task is a design brief from which the student will do the design. Design brief/ performance task is statement on what the student is to design.

Performance Assessment – Performance assessment require student to do an activity that requires them to apply knowledge and skill from certain field of study. The product or process of student activity is evaluated using scoring rubric.

Engineering Technology – Engineering Technology is an elective subject offered to to Form Four and Form Five student in Malaysia. Engineering Technology is a technical subject consisting of five major field of study namely Manufacturing, Communication, Transportation and Power, Construction and Technological Design.

Expert panel – In this context expert panel consist of a group of highly experienced Engineeering Technology teachers and one world renowned creativity expert.

Raters – The raters is this study are teachers of Engineering Technology subject from the state of Kedah

1.9 Limitations of Study

The following are some of the identified limitation:

i. It is important to note that this group of teachers who were the respondence of the study was not representative sample of Malaysian teachers. However the result of the research could be generalized to the total population of Malaysia Engineering Technology teachers because all the teachers are having the same background and experience as the sample population. They are trained under the same system and the fact that Malaysia's centralized education practice makes teachers homogeneus regardless of where they are posted.

ii. The designs from which the scoring rubric was tested are limited to a design from a single performance task. However effort has been done to ensure that the selected designs are representative to the construct being measured as well as appropriate to the target population.

1.10 Conceptual Framework

The purpose of this study is to develop a scoring rubric to assess the creativity of student designed product. Based on the motivation to enhance student creativity through design education, the literature on creativity and design (Chapter 2) and the literature on performance assessment (chapter 3), the conceptual framework for the study is generated and is as shown in Figure 1.1. The framework incorporated seven elementsof the research namely:

i. Re-conceptulization of Engineering Technology design education framework for creativity enhancement
ii. Conceptualization of framework for the instrument and the establishment of assessment specification
iii. Construction of the performance tasks
iv. Production of the designs by Engineering Technology students
v. Development of scoring rubric for product creativity assessment
vi. Testing the psychometrics properties of the rubric
vii. Validation process which occurs at every important stages of the instrument development
viii. Testing the psychometrics properties of the scoring rubric

The framework follows closely the process of developing a performance based assessment suggested by Lane and Stone (2006). Even though the framework seems linear, iteration of the process could happen if the result of the validity study is not acceptable. The validity study which involved both process and post-hoc validation follows theory-driven approach to test construction popularized by

(Loevinger, 1957), Simms and Watson (2007), Wassermann and Bracken (2013) and many more. Additional element namely Re-conceptualization of Engineering Technology design education framework for creativity enhancement is added to the normal instrument development process to emphasis the changes required in the curriculum in order to foster creativity among its student.

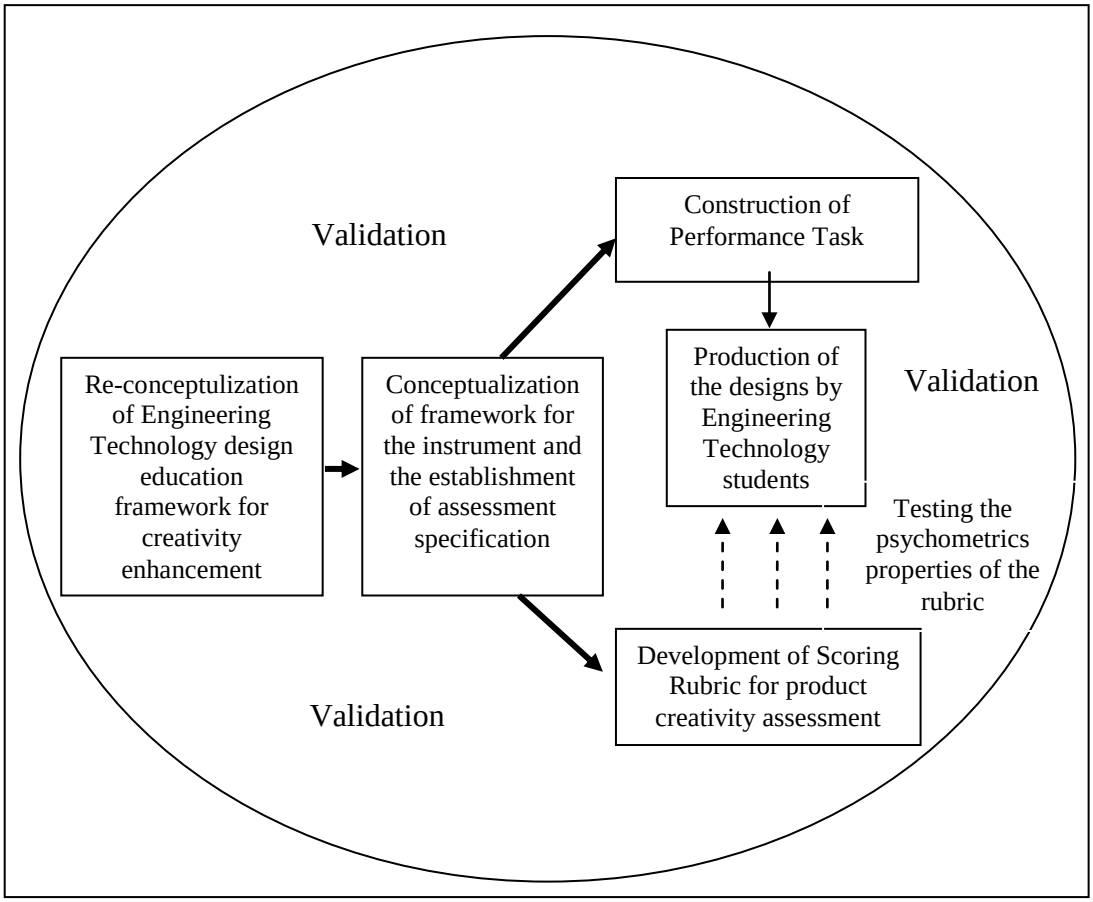

Figure 1.1: Conceptual framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The development of an instrument for the assessment of creativity for design education requires a properly defined theoretical framework for the construct involved. It also requires in depth understanding on the concept of design and how it is being taught in school. This chapter reviews common definition and theories of creativity, the assessment of creativity particularly the assessment of creative product, the concept of design, as well as design education and its assessment. It also summarizes research studies on the available instrument for the assessment of the construct particularly on designed product creativity.

2.2 Creativity

Most researchers defined creativity as the production of new and useful ideas by individual or groups of people. Among them are Sternberg (2001) who defines creativity as the potential to produce novel ideas that are appropriate to the task and high in quality, Lubart (1994) who asserted that being creative mean able to produce product that is both novel and fulfilled the task constraint, and Amabile and Tighe (1993) who added solution path to be heuristic to their definition of creative. Additionally, Bruner (1962) added the surprise reaction element to the novel product characteristic.