The Capability of Integrated Problem-Based Learning in Improving Students' Level of Creative-Critical Thinking

Elnetthra Folly Eldy and FauziahSulaiman

Abstract—The purpose of this paper was to report andprovide evidence of positive development on physics students' thinking style focally on their critical thinking at early implementation of an integrated problem-based learning (PBL) approach. This study was performed on a cohort of 28 Physics with Electronics students from School of Science and Technology at University Malaysia Sabah. The sample was trained by the integrated PBL method for 1 semester (i.e., 14 weeks) in a Physics course (i.e., Thermodynamics). The YanPiaw Creative-Critical Thinking (YCreative-Critical Thinking) Test developed by Chua (2004) was used to identify students' level of thinking style (i.e.,*balanced thinking, criticalthinking etc.*) before and after the early implementation. Theresults show positive development in students' thinking style before to after the implementation. Additionally the relations of these thinking styles with student's age were also analysed.

Index Terms—Creative-critical thinking, critical thinking,problem-based learning.

I. INTRODUCTION

This study was formed as a result for alternative solution of criticism of Malaysian graduates lack of employers needed in industry that been keen issued recently [1]. At the same time, the deficiencies of information about the effectiveness of problem-based learning (PBL) in Physics study also encourage the formation of this study.

PBL started in Malaysia at 1981 when it first implemented in Medical Department of UniversitiSains Malaysia [2].The operational definition of PBL also act as the process of this teaching method start as cycle with students meet the problem, identify, independent study, tutorial and end with integration of learning [3]-[5]. PBL experienced positive development and can be seen as a trustful alternative teaching method to improved students' thinking abilities, problem solving skills and proficiencies not only in medic, teacher and engineering education teaching even in Physics itself [6]-[8].

The focus of this study is to see how the PBL online in Physics course affects to students' critical thinking. Tons of literature review regarding PBL online, but the study concerning the implementation of PBL and implication on Physics students' critical thinking very rare specifically in Malaysia education system [9], [10]. An example of research correlate with this focus of study was conducted by

[9] shows that the development of students' critical thinking could support with PBL that careful designed and concerns on critical elements.

This paper presents the findings of an early implementation of PBL in term of students' thinking style focally on the development of their critical thinking style.

II. METHODOLOGY

For this current study, the implementation of integrated PBL was to investigate the effects of the independent variable (PBL online) on dependent variable (YCreative-Critical Thinking score).

A. Subjects

This study was performed on 28 (i.e., 16 females and 12 males) students from second year of Physics with Electronics program who attended Thermodynamics Physics course in Semester 1 Session 2012/2013 at University Malaysia Sabah. They had been exposed by PBL method for 1 semester (14 weeks). The course led by lecturer who had 10 years of experience in PBL.

B. Instruments

Data gathering was collected by using The YanPiaw Creative Critical Thinking (YCreative-Critical Thinking) Test developed by Chua [11] to identify student level of thinking styles. In this particular test there were 4 level of thinking style that being stated which are: superior creative thinking, creative thinking, balanced thinking style, critical thinking style and superior critical thinking style.

The Cronbach's alpha coefficient for this test is .90(total score), .81(critical thinking style) and .85(creative thinking style).

III. PROCEDURE

A. The Online Platform

In order to implement the online activities, Facebook (FB) chat room was used. As widely known, FB is a freely accessible social network on the Internet which would work for anyone. FB which developed on 2004 by Mark Zuckerberg accessed by using either on computers or mobile phone [12] and this makes students easy to use everywhere and anywhere. This also make student's easy to share document or photo related to their problem anytime needed, whilst other members or facilitator can access to whatever they posted asynchronously out from their chats room's timetable [10].

The PBL process used in this implementation was summarized as shown in Fig. 1.
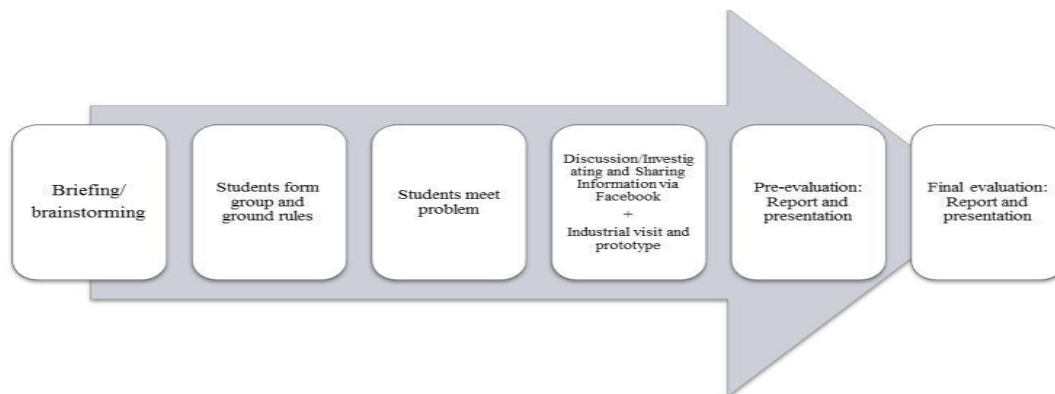

Fig. 1. Summary of PBL model.

During the first and second week before PBL implementation, students briefly introduced about course outline. Meanwhile, students formed group about 5 to 6 people in a group and set ground rules. Students were provided with lecture note and act as their main guideline to identify their own problem statement. After brainstorming, students decided their slot time for online chatting: 1 hour per week for every group as this online PBL implementation held almost 3/4 using online chatting.

Students identified their own problem statement or issue afterwards, facilitated by a facilitator. During discussions, students were encouraged to suggest and imply their own idea. They were also shared information they have gathered during the independent learning process took place. These activities had been monitored by a facilitator via online. Normally students were given with one week settling and deciding their problem statement and issue. Identifying the main objective is important where they will stick to it throughout the particular semester. Students usually gathered information from their surroundings, technology (internet), books and journals reading to come up with their problem statement.

The intervention process starts with students brainstorming and briefing about the problem with each other. Afterwards students were provided with they knew (i.e., prior knowledge) and what they do not know about the problem and objective of problem. Students searched relevant information including book, journal, magazine, notes, manual, internet and other kind of resources. All of this 'give and take' or sharing information and idea processed held via Facebook facilitated by a lecturer and facilitator.

Additional compulsory activity that the group need to do was to visit to any government or private agencies related to their problem respectively. This extra activity was needed as they will find more information on site that they will never find in books or any other printed material. The extra information gathered by interview and observation in a way for students to understand and gets more useful information. These extracurricular are important as it will make students understand more and get useful information. Some of students even make a simple laboratory experiment or prototype after the visit to gain more idea and provide deeper understanding with the member group and other classmates.

To ensure the PBL was implemented effectively, after every two to three weeks of online class in chatting room (Facebook), student's compulsory meet face to face with facilitators to exchange their confusing or dilemma. On the other hand, students also need to provide pre-report and pre-presentation at week seven or eight in front of their classmates and facilitator. This pre-evaluation provide them with experience for better communication skills and presents in front of many people. Final report and presentation also held at the end of implementation in week fourteen for final evaluation.

B. Face-to-Face Discussion

Face-to-face discussion in this study held as usual lecture, sit in a class for 1 to 2 hours and facilitator discuss the progress of each group in term of their solution. This discussion held about 2 or 3 weeks after online class. This is important as to provide students with a solid discussion in every chat and they had time to ask facilitator question they found hard to explain during the online chat class. This discussion also provide time between facilitator and students to be little closer and realize the role of facilitator in their online chat class as guide which help students to more open to ask, share their opinion and widen their rationale during online chat. In addition, this discussion also helps each member to solve their misunderstanding and misinterpretation between each other's.

At the end of every face-to-face discussion, facilitator provides some feedback to almost every group member regarding to their level of participations, contributions of opinion or comment and alternative of solving the problem. This was important in helping the students to be to more confidence with the information that they want to share.

TABLE I: FORM A OF YCREATIVE-CRITICAL THINKING TEST
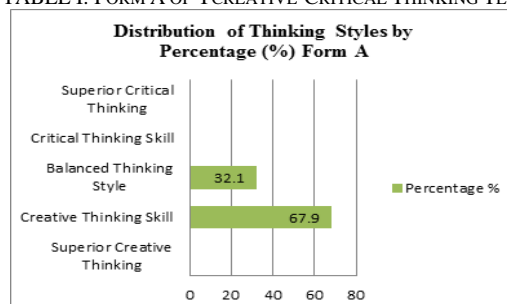
IV. FINDINGS

Form A and Form B of YCreative-Critical Thinking Test in this study was distributed on week 4 and week 14 accordingly. The findings in this study discussed separately in 2 parts i.e., overall distribution of students' thinking style and students' thinking style and relation with their age.

A. Overall Comparison of Distribution Students Thinking Styles

Table I and Table II show the comparison of overall distribution students' thinking style in YCreative-Critical Thinking Test

TABLE II: FORM B OF YCREATIVE-CRITICAL THINKING TEST
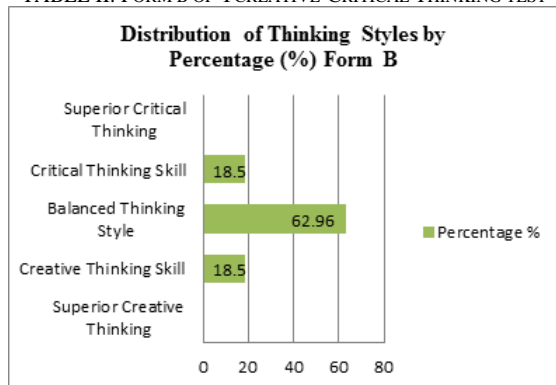

TABLE III: STUDENTS' THINKING STLE AND STUDENT'S AGE FORM A
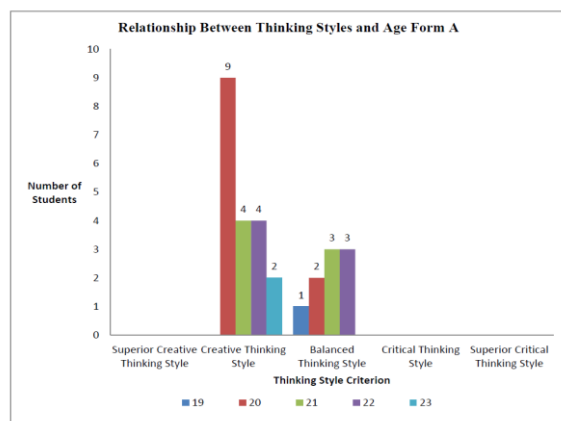

Table I shows the distribution of students' thinking style from the Form A of YCreative-Critical Thinking test. Result shows around thirty-two percent (32%; *N*=8) of students' thinking style fall on balanced thinking style, this shows that more than quarter of students has the possibilities of biased to critical thinking as Chua [11] indicates balanced thinking style as "*average creative andcritical thinking style, where students able to solve problems by using certain whole brain skills*".

On the other hand, Table II shows the distribution of students' thinking style from the Form B of YCreative-Critical Thinking test. The result shows that students' thinking style in this study has positive development as the results shows eighteen percent (18%, *N*=5) indicates that students' thinking style fall on critical thinking style. As Chua [11] indicates that critical thinking style as "*problem solving ability can be improved by enhancing the creative thinking skill*", he also indicates that individual in this style as someone "*avoid emotional reasoning, try to stick to the*

main point and the ability of asking questions, defining problems, examining evidence, analyzing assumptions and biases". Meanwhile, almost sixty-three percent (63%, *N*=17) of students' thinking style in this study falls on balanced thinking style which show increasing in both percentage and number of students as compared to Table I.

B. Distribution of Students' Thinking Style and Their Age

Table III and Table IV show the distribution of students' thinking style and the relationship with their age.

TABLE IV: STUDENTS' THINKING STLE AND STUDENT'S AGE FORM B
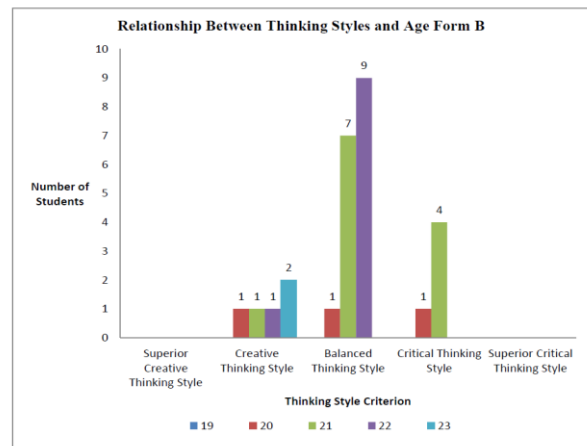
Overall student's age are ranged from 19 to 23 years old.From form A, students with age 20 years old (*N*=9) show highest number in creative thinking style compared to students with age 23 years old (*N*=2), this probably caused by the number of sample withthe age of 23 years old are lowest among the others. Meanwhile, for balanced thinking style, students with age 21 and 23 years old placed tied with 3 students. Students with age of 19 years old placed lowest with only 1 student.

From form B, students with age 21 years old show highest number in critical thinking (*N*=4) while students with age 20 years old contributed in the percentage of critical thinking style with (*N*=1), overall there are 5 students' thinking style in this study fall on critical thinking style after being intervene with PBL. Students with age 22 years placed higher in balanced thinking style (*N*=9) followed by students with age 21 years old (*N*=7) and student with age 20 years old (*N*=1). All students with age of 23 years old in this study seem fall on creative thinking style (*N*=2) followed by students with age 22, 21, 20 years old tied with (*N*=1).

V. DISCUSSION AND CONCLUSION

The role of integrated PBL in determining students' level of creative-critical thinking was being investigated in this study. The distribution of students' thinking style before and after the early implementation of integrated PBL among Physics undergraduates was reported. This paper also provides results which supported the previous study about relationship of students' thinking style with their age.

The overall distribution of students' thinking style shows some positive development mainly in critical thinking area, as there is none of the students fall in critical thinking style

at the early stage of the implementation of PBL improved to around 18% after 14 weeks of implementation. Balanced thinking style among students also seem shows improvement as either the percentage or the number of students improved from 32% to more than 60% after the implementation. This result to ascertain researcher that students' thinking style focally their critical thinking can be improved if they been exposure more with PBL activity.

On the other hand, the result of relationship between students' thinking style and their age show no difference with what (Lehman, 1953; Jacquish, 1980) previously study as mentioned by Maizam *et al.* [13]. This probably caused since all students in this study in samerange of age as either during Form A or Form B distributed.

This paper, as it was purpose to provide evidence of positive improvement of students' thinking style focally critical thinking style after being intervened with integrated PBL approach and the relationship of their thinking style and age. The results revealed a positive development of students' thinking style as it shows the increasing percentage and number of sample (N) from before to after the implementation of integrated PBL. Nonetheless age is not a significant factor at this level.

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