

Competency Based Assessment (CBA) of Engineering Students' Product Development via Project-Based Learning (PjBL) Process

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Abstract

This article is written to explain an innovative engineering pedagogy related with Project Based Learning (PjBL) concept via Competency Based Assessment (CBA) in product development for subject J3102. This concept aims to improve the self-regulation rules development of engineering students in Mechanical Department at Politeknik Kota Bharu, Kelantan. This study includes both experimental instruments test and qualitative in nature. The data was analyzed using PjBL module and Competency Based Assessment (CBA). A total of four (4) groups among twelve (12) persons of SKM4A students from Mechanical Engineering Department were selected as respondents. This study finds that the students results of product development was increase, otherwise their self-regulation become improve after using PjBL:CBA instruments. The result of an interview and observation on the usage of PjBL and CBA show's the positive effect of self regulation among engineering students and produce high quality standard of the product one (1) and two (2) making parts. It is hoped that these PjBL:CBA concepts can be further developed and implemented among engineering lab and workshop at college community and polytechnics in Malaysia.

Keywords: Project Based Learning (PjBL), Competency Based Assessment (CBA), Engineering Product Development and Engineering Student Self-Regulation.

1.0 Introduction

This article is written to explain the concept of project based learning (PjBL) by utilizing the Competency Based Assessment (CBA) focusing on engineering students product development for subject J3012 (machining). This PjBL concept aims to improve the self-regulation of Mechanical Engineering Students in Kota Bharu Polytechnic, Kelantan when used Project based learning process in product development that special touch with competency based assessment in measurement and evaluation engineering knowledge and soft skills (Pintrich, P. R., 2000). Otherwise this PjBL-CBA concept will generate a collaborative learning in product development and evaluation among engineering students at Machining Lab (2), Mechanical Department, Politeknik Kota Bharu (Md. Baharuddin et al., 2009).

1.1 Research objectives

This action research was implemented to find the best solution for 21 century learning style that match with the globalization needs (Kamaruzaman Jusoff et al., 2010). It's also to find out the best solution in new learning methods that can replace the traditional learning process in product development at machining section (workshop/lab). This pilot study was implemented to full fill the quality of engineering learning process includes ; monitoring , evaluation and product producing for subject J3012 (machining section) match with PjBL and CBA catierias at Mechanical Department, PKB.

1.2 Problem statements

The konvensional process of product development become unacceptable in product evaluation by using traditional method, it look lack of process monitoring and data collection (Abd. Rahim Abd. Rashid., 2007).

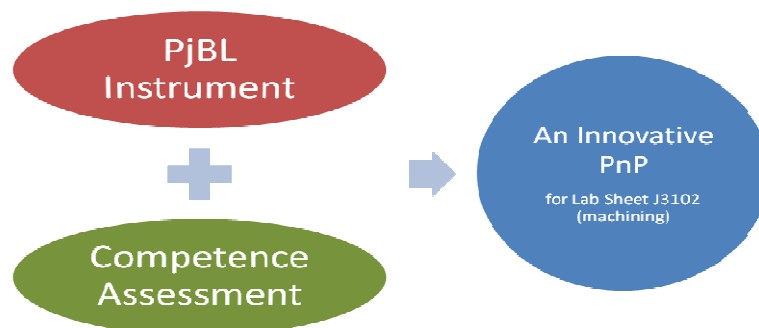
While process is running, whole process not structured as well need, otherwise the report come at the end of process become parallel submission note and data's (Boekaerts et al., 2000). This summative data procedure with conventional concept not support the quality needs (Abdul Ghafar Md Din., 2003). Some report look similar with others. So, this research was carry over to produce the process that can evaluate in right situations when process is running (Thomas, J., 2000). The formative assessment produce with PjBL concept become easy to supervisor and engineering students evaluate themselves in weekly progress (Yang, H., 2001). The way of formative assessment touch with PjBL:CBA concept become easy for supervisor to evaluate match with engineering standard needs (Md. Baharuddin et al., 2009).

2.0 Literature View

The change of vision and mobilization in industrial of humanization at Malaysia become new challenging aspects to cover socialization at developing country. The government philosophy to producing high technical skilled and global player of Malaysian community to gain the world challenging (Abdul Ghafar Md Din, 2003). The new education technical and high technical pedagogy full fill of 21 century learning will be the one can solve that philosophy (Abd. Rahim Abd Rashid, 2007). PjBL concept looks can help the country to fill up what the government need and expectation immediately. Schools and technical institutions need to recover the need of future learning concept to producing manpower that fulfill the needs of industrials and become 'global player' (Grant and Michael, M. 2002). The vision of Ministry of Higher Education Malaysia (KPTM) to generate knowledgeable and high technical skilled workers (*soft-skills*) to gain the 21 century and international globalization (Nik Aziz Nik Pa, 1997). Its need a good instrument and learning method to be catalyzed for full fill the product and develop Malaysian country (Jeyagobi, et al, 2007). Teachers or local learning pedagogy developer should full fill the scope that will match with government philosophy. PjBL concept is a part of instrument that can generate humanity to changing the technical manpower as significantly with Malaysia vision (Noor Azean Atan et al. 2006).

2.1 The Concept of "PjBL" and "CBA"

The first procedure will come up with model, theory and data survey for PjBL and Competence Based Assessment (CBA) instruments development (Md. Baharuddin et al., 2009). The dual combination of process (PjBL) and evaluation (CBA) of used as per figure below:-

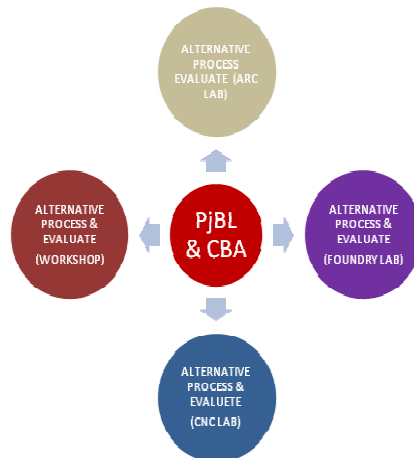


Above concept figure shown the combination of two instruments (PjBL and CBA) and become workshop learning manual/lab sheet of subject J3012 (machining). This figure is written to explain the concept of Project Based Learning (PjBL) by utilizing the evaluation of product focusing on Competency Based Assessment (CBA) cross over engineering disciplines and workshop (Kamaruzaman Jusoff et al., 2010). This concept aims to improve students self-regulation in lab/workshop habits (Boekaert et al., 2000). For the pilot process of PjBL and CBA will carry on at Machning lab and workshop Department of Mechanical Engineering. The pilot test will carries over after all instruments completed. The result will come out after it's been used, this alternative PnP of PjBL and CBA become special instruments to works as catalyzed in students project development (Brandi Allen., 2006). This project looks able to full fill the needs in engineering knowledge development match with KPTM philosophy (Nik Aziz Nik Pa., 1997).

2.2 The Special Use of PjBL & CBA as Learning Process

Above figure shown the over view of collaborative communications among four lab/workshops at Mechanical Department, Kota Bharu Polytechnics. This PjBL and CBA create students centered of learning, discussion and data evaluate of knowledge collection by using these concepts (Synteta, P., 2001, 2002, 2003). This valuable concept of PjBL and CBA will support the engineering learning methods for future 21 century learning (Kurubacak, Gulsun., 2007). The full utilizing of the students learning management via PjBL:CBA match with KPTM philosophy that significantly matches with global learning (Brandi Allen., 2006). The PjBL and CBA focusing on students project development (machining) centered by working as project making lab sheet and evaluation without limitation of knowledge full in (Jeyagobi, R. Subramaniam, S., 2007).

This concept aims to improve the self-regulation of Mechanical Engineering Students Politeknik Kota Bahru when used this dual combination instrument that special touch with the needs in engineering knowledge, otherwise this product will generate no limitation of time in measurement and evaluation (students and products) (Morsund, David., 2002).



2.3 The 21st Century Learning & Assessment Skills



Figure 1: *enGauge 21st Century Skills*

Source: www.ncrel.org/engauge/skills

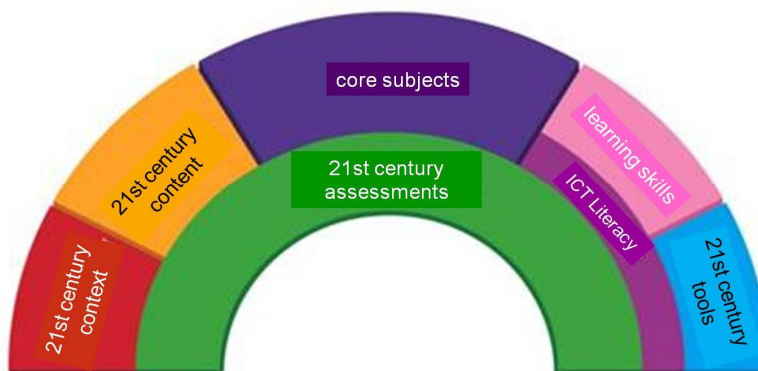


Figure 2: *The Partnership for 21st Century Skills*

Source: www.21stcenturyskills.org

3.0 The methods of PjBL: CBA implementation

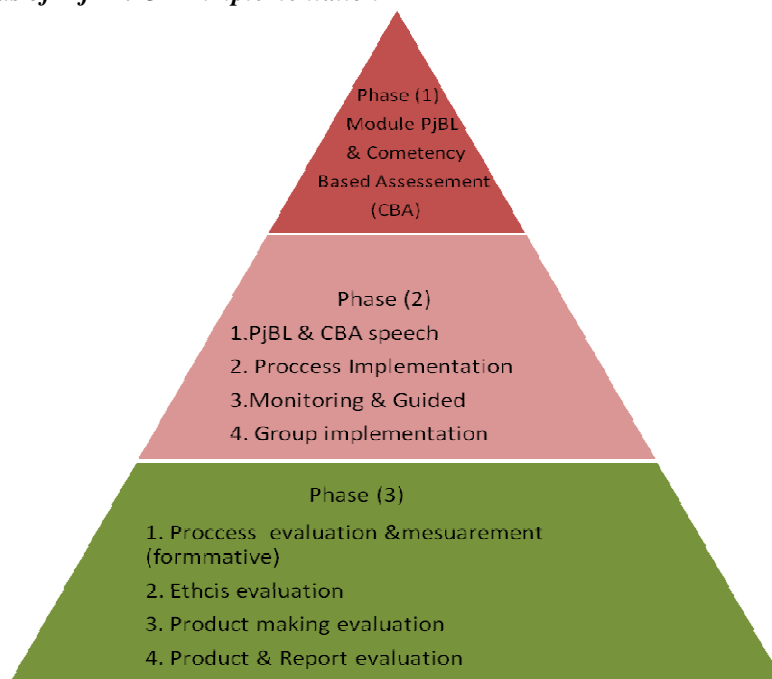


Figure 1: The 3 phase of PjBL & CBA Action Research for subject J3012

The table above showed the three (3) phase's process of PjBL & CBA implementation where; Phase 1 is the module PjBL and CBA development and selection. Then phase 2 is the process of PjBL:CBA implementation where it's includes a) The PjBL:CBA speech, b) The PjBL:CBA proccess implementation, c) PjBL:CBA monitoring and guiding, and d) Group implementation. For the phase (3) is the PjBL:CBA evaluation and mesurement, that includes Pilot Test and Survey for ethics, product making, product quality and report evaluation (Kurubacak, Gulsun., 2007). This combination concept works to inter cross discipline of used, proccess implementation where its works as collaborative engineering soft skill learning, and lastly its will be used at all lab/workshop at PKB (Noor Azean Atan et al., 2006).

3.1 The photos' and datas' while PjBL & CBA implementation



Phase1: PjBL: Briefing on CBA to Students



Phase 2: PjBL process: Monitoring Machining Product



Phase 2 : PjBL Procces Implementation

PLANNING SHEET ENGINEERING DEPT.

P007: PROJECT MAKING SHEET

OPERATION NUMBER	FULL DESCRIPTION OF OPERATION	MATERIAL(S) / WEARING (S) TOOL (S) / EQUIPMENT	NOTES
1	Melakukan design dan penggambaran matrik matrik menggunakan software AutoCAD	- belah ketupat	
2	Melakukan proses pemotongan matrik menggunakan mesin pemotong matrik	- belah ketupat	
3	Melakukan proses pengeboran pada matrik menggunakan mesin bor	- belah ketupat	
4	Melakukan proses pengamiran pada matrik menggunakan mesin amir	- belah ketupat	
5	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	
6	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	
7	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	
8	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	
9	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	
10	Melakukan proses pengaliran pada matrik menggunakan mesin alir	- belah ketupat	

PREPARED BY: _____ CHECKED BY: _____ SHEET _____ OF _____ / PTO _____

Score: / 8 Mark

Phase 3: PjBL: CBA Assessment (Formative Measurement and Evaluation)



Phase 4: CBA mesurament and evaluation



Phase 4 : PjBL: Students' Self-Evaluation and Reflection



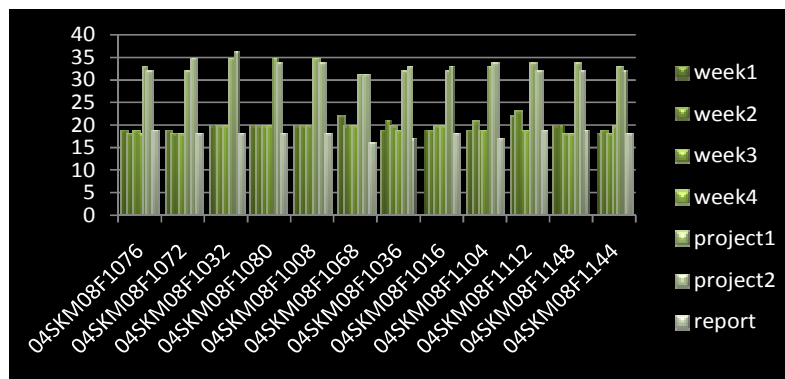
Phase 5: PjBL: Product 1 and 2



Phase 5 : Project 1 and 2 Evaluation (Results)

4.0 Results and Data's Collection of PjBL: CBA Implementation

The value point given of highest marks (5 marks) of each weekly progress where for this pilot test taken 8 week to complete 2 projects. The overall marks includes competency based evaluation, report measurement, project 1 & 2 evaluation and report summary. Highest point might be given for all members work collaboratively with follow all PjBL guide & CBA assesement cetarias. The respondents includes 12 engineering students that devided into two groups (A) and (B).each group contains 6 students within each person should completed 2 project with scheduled time given (4 weeks). The overall (4 weeks) data's as given below:-



Data collection shown that the overall marks for 4 weeks above 15 marks and the product quality and marks above 30 marks. For final report shows that overall report marks above 15 marks. Data collection shown that the overall data collection of Competency based assesement wtihin weekly proccess imlementation. Below the table shows the value of 5 impericals choosen :-

Item 1 : value point for attendance

Item 2 : ethics and competences evaluation

Item 3 : procedure and product making

Item 4 : Quality of product (project 1 and 2)

Item 5 : Machining & parts cleaning and arragemen

Below the data's collection taken for 1st week (week1):-

Data collection shown that the overall value of attendance and machining & parts cleaning for 12 students at higher points (5 marks),for value of ethics,product making and product quality are at gap between (3 – 4 marks),while for value of 3 items are at score more then 3 marks. Total marks each students carry more then 15 marks, two of them carry marks for week1 at above 20 marks.

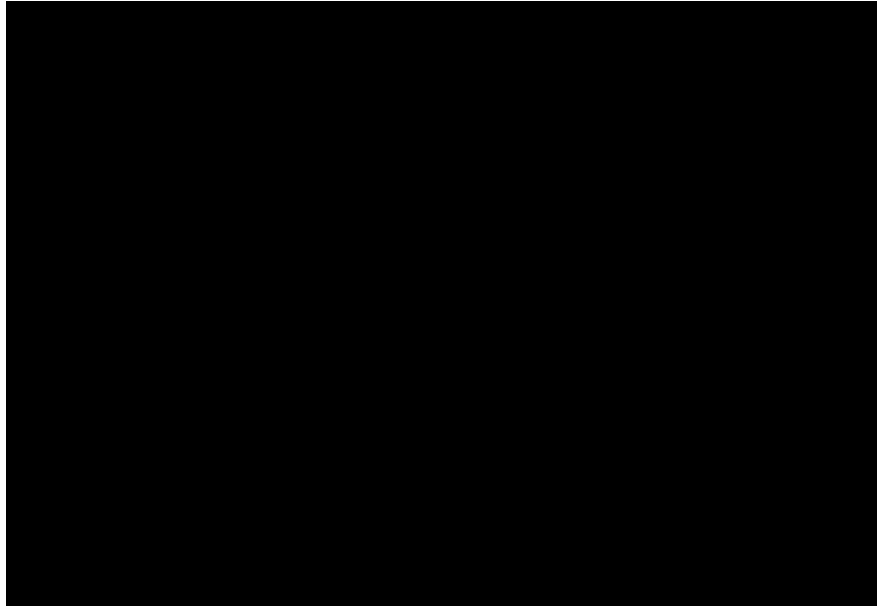


Table 1a: Case Processing Summary data's of 12 Respondents of 5 impericals evaluation (week1)

Above data's analysis shown the case of processing summary of 12 respondents to evaluate of overall marks (maximum 25 marks) details on first week.

Below the data's collection taken for 2nd week (week2):-

Data collection shown that the overall value of attendance and machining & parts cleaning for 12 students at higher points (5 marks),for value of ethics,product making and product quality are at gap between (3 – 4 marks),while for value of 3 items are at score more then 3 marks. Total marks each students carry more then 15 marks, two of them carry marks for week1 at above 20 marks.

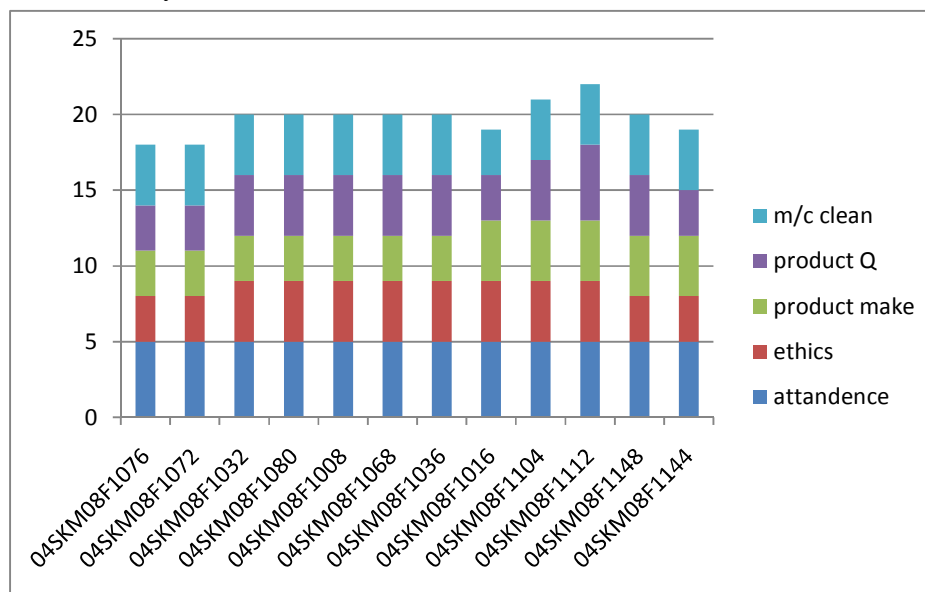


Table 1b: Case Processing Summary data's of 12 Respondents of 5 impericals evaluation (week2)

Above data's analysis shown the case of processing summary of 12 respondents to evaluate of overall marks (maximum 25 marks) details on second week. Data's analysis at table 1b shown the overall marks at value point (above 15 marks), and 6 f respondents et rich to value ponit f 20 marks,and 2 more goes above 20 marks.

Below the data's collection taken for 3rd week (week3):-

Data collection shown that the overall value of attendance and machining & parts cleaning for 12 students at higher points (5 marks),for value of ethics,product making and product quality are at gap between (3 – 4 marks),while for value of 3 items are at score more then 3 marks. Total marks each students carry more then 15 marks, seven of them carry marks for week3 at above 20 marks.

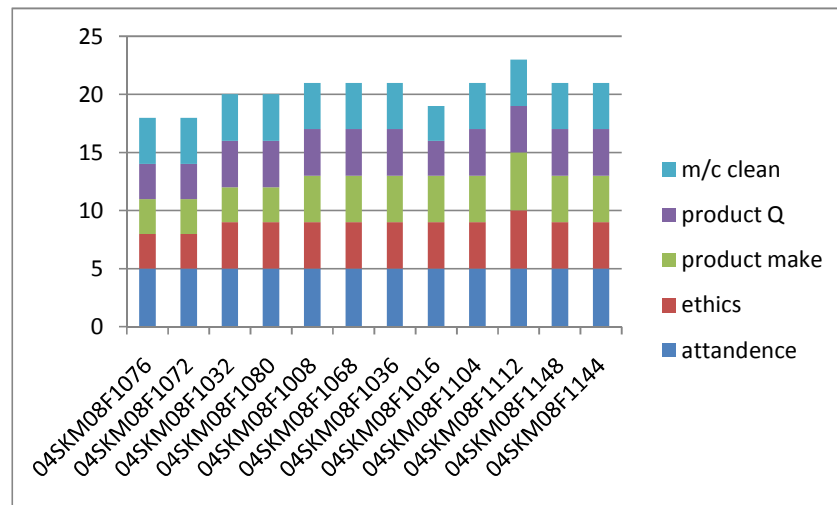


Table1c: Case Processing Summary data's of 12 Respondents of 5 impericals evaluation (week3)

Above data's analysis shown the case of processing summary of 12 respondents to evaluate of overall marks (maximum 25 marks) details on third week. Data's analysis at table 1c shown the overall marks at value point (above 15 marks), and 72 of respondents rich to value point of 20 marks,and 7 more goes above 20 marks. This data's shown the increasing of respondents quality in result while seven (7) rich the maks above 20 marks. But the point for machine cleaning become reduce might be effect of product concentration. This overall data of week 3 shown the deffirence of ethics, product make and quality of product while proccess on going. The multi-impact of impericals chosen look the repondents wave of marksnot constant and but under guide and objective aspektations.

Below the data's collection taken for 4th week (week4): Data collection shown that the overall value of attendance and machining & parts cleaning for 12 students at higher points (5 marks),for value of ethics,product making and product quality are at gap between (3 – 4 marks),while for value of 3 items are at score more then 3 marks.

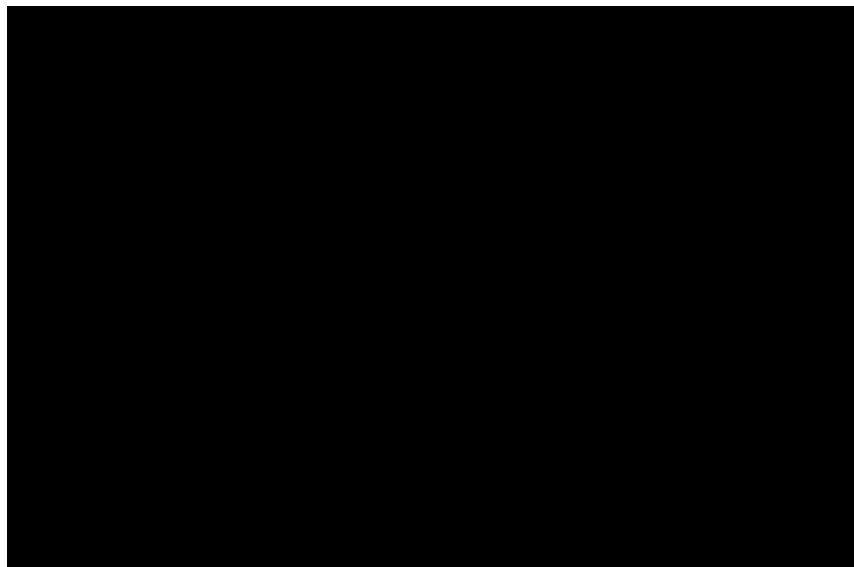


Table 1d: Case Processing Summary data's of 12 Respondents of 5 impericals evaluation (week4)

Total marks each students carry more then 15 marks, two of them carry marks for week1 at above 20 marks
Above data's analysis shown the case of processing summary of 12 respondents to evaluate of overall marks (maximum 25 marks) details on fourth week.

5.0 Conclusions

This process of PjBL make smooth operation of project 1 and 2 development and achive multi results by using CBA evaluation. Its also carry on to assess the product quality refer to students' result achievement of using PjBL concept and CBA. After PjBL and CBA completed testing, its will piloting among engineering students to access self-regulation when PjBL:CBA was introduced as new alternative engineering pedagogy in lab or workshop at Mechanical Department, Politeknik Kota Bharu. Though it is difficult to generalize the results due to the limited number of self-reported data and the absence of observational data, the exploratory study provides evidence and support for the adoption of CBA match with overall imperacials aspectations for polytechnic produce high expectation of engineering students. The overall findings in this exploratory study suggest that the PjBL module was beneficial in developing self-regulatory skills of students in a project-based learning experience. It is however recommended that this study should be replicated with a larger sample size and examine in greater detail the two major constructs, i) meta-cognition (consisting of awareness, planning/goal-setting and self-checking/monitoring) and ii) management and control of effort.

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