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# Agricultural product development by implementation of Project Based Learning module at Politeknik Kota Bharu Malaysia

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### ABSTRACT

This article provides a short introduction to Project based Learning (PjBL) that are significant in the mechanical engineering students project MR02/07 development for agricultural product and typical of socio-constructivist of student approaches. The objectives of using PjBL module is producing innovative product by implementation PjBL concept. These project methods will describe deeply the process of development chopper machine with specified code MR02/07. By using PjBL module the process will drive directly from first to the end. Guided with BIE approach and reference models, PjBL module create new 21 century learning era with guided in project development to meet engineering standard and completed on time. It's works smoothly with guided forms at PjBL module instrument. Engineering students will fulfill the mastery learning in engineering project development methods when use PjBL module for their product development. Please, see project-based learning (PjBL) module that develop for engineering project development at Mechanical Department, Politeknik Kota Bharu, Malaysia.

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### Introduction

Based on project development for proceeding real engineering product match with international standard, its should be parallel touch with sosio- constructivism (Wilson, B. and M. Lowry, 2001). Project Based Learning (PjBL) looks significantly match with actual international engineering requirement standard activities of Technical works and procedures. Project development always prefer for the engineering process including planning, engineering drawing, technical works or activities and the formulation of engineering problem solving (Dym et. al., 2004). The engineering project development become easily with PjBL module guide under comprehensive technical engineering solving via PjBL process (Dori, Y. J., 2003). Its works by counter back the overall process monitoring and formative assessments with PjBL module. The systematic rules and process for students follow become a vital part of student self- motivation in project development (Barron, B., 1998). This PjBL Module develop for support module Project Management (J5012) and will be works as a catalyze or turbo charge to insure students will completed an innovative product with success at on time. The implementation at Mechanical Department, Kota Bharu Politeknik as a piloting process of PjBL module by researcher. Project Chopper Machine MR02/07 as a pioneer project will be tested the used of this PjBL module.

Based on that philosophy, on 20th Jul 2007 one project team with 3 members of engineering students from agriculture unit, JKM, PKB has been created. This project team was supervised by Mr. Md. Baharuddin b. Ab. Rahman for developing Chopper Machine via using PjBL module (Mergendoller et. al., 2003). The survey have been taken to inforce high technical standard design with low cost need. This

to ensure local farmers can buy the product and increase their productivity. After implementation more than one design and analyzed the advantage of product design (van Merriënboer, et. al., 2003). A Good Chopper machine design with code MR 02 / 07 has been chosen. This code stand for 2nd design of chopper machine will be developing on year 2007. This machine develops to ensure Malaysia farmer will increase their productivity with good machine support at low cost. At same time this product will reduce farmer cost. Compare with international product with same quality, in machine reduce almost 50% of actual cost of chopper machine at sealing price. The Machine cost below RM1, 500 compare with actual price RM 2,000.00 above at local Markets and equipments shop. This process of development started with literature study and price survey to ensure the product will support local farmer and match with government philosophy.

This Project Based Learning (PjBL) module deeply touches with constructs below:-

1. Focusing on multi disciplines on engineering students centered.
2. Related with actual engineering works, experiences, technical skills, technical & vocational theory and engineering knowledge.
3. Engineering learning implementation with advance sketches, technical software for technical drawing and advance approach (engineering language) in communicate with international engineering design.
4. A comprehensive learning to support curriculum in specified detail product development, working progress, detail monitoring process, formative assessments, technical problem solving each steps of product producing.
5. A systematic procedure and process guided including final product testing and presentation.

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6. Touch wit future engineering approach in project development including project management, development, technical solving and create innovative product with fully high technical knowledge of engineering students (experiences students). (Moursund and David, 2002; Markam and Thom, 2003)

#### Problem statement

Graduates students from agriculture unit in mechanical department should fulfill the solution of agriculture effort. Especially generate technical machines to up grade local farmer's productivity (Thomas et. Al.,1999). Almost imported agriculture machines sell on high cost. Depends on local market needs and agriculture demands all equipment and mechanical parts take high cost to do maintenance cause its need to order from out side country. Based on this technical problem faces and high demands, polytechnics students must produce an innovative product in agriculture as per local farmer expectation (low cost with high technical values) (Thomas, J. W., 2000). At mean time the good technical agriculture product will support the local farmer to deduct their fit cost by buying machinery from out side country. We have strong enough of technical knowledge in engineering student at polytechnics in development of machinery to support production in agriculture. Due of PjBL module implementation, the best solution to cover up the machinery to use for local farmer will be solve. Local manufacture will get benefit by producing all high value of machinery development by polytechnics students. Government always support for local product that match with international standard and local needs. A lot of funding and grant will be given to insure local product always support of local demands.

The project names MR 02/ 07 one of new an innovative product producing from polytechnic students by PjBL module guided. This product will support agriculture equipment to gain imported equipment with low cost and high quality standard. Its will helps local farmer to reduce fit cost and increase their productivity.

#### The vital of project MR02/07 development

This MR 02 / 07 works as chopper equipment to make small cutting of grass for food mixing in additional weight of local fidlot business. The development of machinery with high productivity becomes potential value of local agriculture product. Supported with technical knowledge with standard guide of PjBL module, MR02/07 looks can fulfill the needs and local market request. The development of local product like this, significantly match with government policy in agriculture development to fill up local demand. At same time, the engineering product making with local factory (Prototype producing by Politeknik Kota Bharu) will helps local farmers to buying good product with high value. The win-win business will occur with this potential project. Fist, local engineering student will exploring new project based learning for producing an innovative product (Shapiro, B. L., 1994). Second the farmer will get benefit with the product. at the mean time our local manufacture can producing batch production by cut off cost and selling at low cost to our local farmers. The philosophy to generate high productive with low cost overhead cost we helps Malaysia for becoming agriculture exporter soon. At time being, this project (PjBL module) works as catalyze to support increasing high technical product to our local market (Markham and Thom, 2003). Good value of local product by match with international product can helps all local farmers to success. This

project runs with valuable objectives and government philosophy.

The benefit of MR 02 / 07 are, cutting grass at flexible value (small to big size) for animals food mixing, small product not to heavy, removal and easy of carry. 2 types of power transmission selection (electrical or engine petrol). Design and production methods match with engineering quality and standard (Md. Ramzam et. al., 2000). Warranty for up to a year product. Analyzed data and testing at lab (Polytechnic lab), data survey before selling at local market.

#### Project Objectives

Below the objectives of project MR 02 / 07 development for:-

1. Implementation Project Based learning concept via PjBL module to complete students final project.
2. Develop project by using standard specification in chopper machine producing.
3. Produce Chopper machine at low cost with high quality standard.
4. Support local farmers by producing machinery attach with agriculture productivity.
5. Produce high standard of skilled for Polytechnics students by producing an innovative product.

#### Scope of project MR02/7 development

##### Below the scope of project development:-

1. Area of Project development at Politeknik Kota Bharu Workshop and Local area of workshop (parts fabrication).
2. Time Period of Project Development: 1- 16 weeks
3. One supervisor and three engineering students from agriculture unit, JKM, PKB.
4. cost estimation below RM1,500
5. project design (manual ) and engineering software (ACAD, NX, ProEng, ect)
6. Project piloting: test by end user (local farmers;-2 weeks)

#### Machinery survey and literature view

To ensure this project success and match with end user need, local machinery survey has been taken. Below agriculture equipments specification and cost RM 2000 above at local market are Kelantan.

#### Chopper Machine for Napier grass cutting



#### Machine specification

- Capacity : 3 kw/hr
- Dimension : 160x85x120 cm
- Frame : U shape
- Body material : Stainless steel
- Power output : Diesel Engine 10 PK
- Cutting parts : 2 pcs
- Transmission : Pulley and V – belt
- Cost : RM 2,000 above

#### Compos Machine



**Machine specifications**

Capacity	: 300 kg / jam
Materials	: Mild Steel
Cutting parts	: Static – Dinamis
Power output	: Engine Diesel 6,5 hp
Cost	: RM 2,500.00 above

**Organic compos chopper machine****Machine specifications**

Capacity	: 150-200 kg / jam
Material	: Mild Steel
Out put	: 16 PK
Dimension	: 115x100x125 cm
Cost	: RM 2,400.00 above

**Project Methodology**

This Project fully used PjBL Module focusing in engineering standards of an innovative project development. The project management subject utilizes standardized forms provided by the PjBL module (Wilson, B and M. Lowry, 2001). These guided PjBL forms generate consistently and process monitoring by weekly progress. (Markam and Thom, 2003; Moursund and David, 2002; Thomas et. al., 1999; Barron, B., 1998)

**The forms of PjBL module embedded in the module are as follows:**

Form P001 - Project discussion and proposal, Form P002 - Project sketches and design, Form P003 - Supervisor's review and confirmation, Form P004 - Final technical project design and making methods., Form P005 - Project planning of each stage development and fabrication process, Form P006 - detailed drawings for each component measurement and workshop fabrication methods, Form P007 - project procedures and fabrication methods, Form P008 - writings of each team member for workshop selection that conforms to the standard planning form (P005) each process should draft consistently at each stage to avoid delays, Form P008 - provide inputs for machines selection and present the calculation sheet for each components of the product making, Form P009 - final design of additional component and testing, Form P010 - evaluation and confirmation form for the components, Form P011 - evaluation and testing of any added value or component to innovative products produced and finally, and Form P012 - submission and evaluation of the power point for final presentation.

The roles of actors are also particular in PjBL module development. Project-based learning module is structured to transform teaching from "lecturers/supervisors telling" to "engineering students doing". Engineering students become active problem-solvers, and effective decision-makers rather than passive listeners. They collaborate or cooperate in groups, organize their activities, conduct research, solve problems, synthesize information, organize time and resources and reflect on their learning. Teachers change their role "from sage on the stage to guide on the side" and assume the role of cognitive and meta-cognitive coach (by asking, monitoring, probing, managing, group regulating, keeping moving) rather than knowledge-holder and disseminator. Project serves as the initial challenge and motivation (appealing to be explored, setting up

the context of learning). The monitoring and evaluation of this project development subject is monitored through PjBL forms and this provides weekly marks on the progress of the project teams. The formative (weekly progress evaluation) and summative (final report evaluation) assessment facilitate the successful attainment of the project objectives (Wilson et. al., 2001).

**Project Planning and Making**

Before project making, planning of each stage of parts development will carry over. PjBL module will guide engineering students to make arrangement in parts planning by using P005 forms, this important to ensure all process development will work with smooth operation and project complete at on time (Moursund and David, 2002).

**Product making discussion**

Weekly meeting with team member and supervisor for progress report should be taken. Discussion will bring out each stage of part development and problem faces (Synteta, P., and 2001:2002). Any suggestion and ideas for ensure process of making parts will produce on schedule. Each stage of process will carry over, at same time supervisor will bring data of project development status (Thomas et. al., 1999). Progress report that matches with palling will carry higher marks (weekly marks given from supervisor). Discussion all about engineering project development method and equipment use will carry over. Some input and idea form students based on product that they make, some new technology that carry in for project acing will show the added value of students for exploring global technical knowledge (Mergendoller et. al., 2003). With PjBL concept, engineering students will not static only from what they learn at workshop, but this concept will force them to learn new technical knowledge when process development on progress. This valuable experience with PjBL concept will bring the technical standards and follow international product development specification (Synteta, P., 2003).

**Parts sketches and design**

To ensure all parts match with engineering standard. Design of each component should prefer engineering drawing standard (Md. Ramzan et. al., 2000). Engineering students should entering all design subject include, engineering drawing design, Acad, NX, or ProEng. All components and parts should have detail design in Isometric or orthographic view. Overall dimensions will cover up. Supervisors as experineces in technical design will checked all design before product entering workshop for fabrication (Mergendoller et. al., 2003). The standard design will match with engineering language when team members communication with outside fabricator. An innovative desing will produce with high quality of product (van Merriënboer et. al., 2003). All detail drawing of overall part will cover up schedule planning after schedule palanning completed and get approval form supervisor and fabrication process will carry over. Proccs marking and evaluate of product making will carry up start from 1st week to the end (18 weeks). Refer to PjBL forms P001-P010.

**Safety aspects**

Safety aspect as first issue to cover before product makes. Here designer will discuss with supervisor from sketches by considering safety aspect. If overall mechanism parts cover up with safety precaution. That design will proceed to further as standard design (Md. Ramzam et.al. 2000). Fabricator will check the overall function by making prototype. All engineering parts will consider its safety aspects. While process on going,

developer will discuss the results with supervisor by weekly meeting. The products that cover overall safety aspect only proceed for fabrication.



**Figure 1 : Final product of MR02/07 by implementation PjBL module**

#### Product MR02/07 Testing

While product making on going, each stage will carry over with internal inspection and testing. All parts should enter inspection with supervisor and specialist. This to ensure the operation of product at high standard and good quality standard (Dym et. al., 2003). Testing of used also carry over after overall testing cover up. Below the stage of inspection methods of each parts of product. Refer to PjBL forms P009-P011

1. Testing of electrical circuit
2. Cutting blade testing
3. Motor / power output testing
4. End user testing and satisfied (farmers)
5. Grass cutting and final data (result of output)

#### Testing of electrical circuit

By using PjBL form P009, electrical circuit will test part by part. If any problem faces in circuit, designer will re-design and re-built. After testing and success result taken. Its will final satisfied by project supervisor before final testing. The circuit will check including leaking electrical current. If all success, approval from tester will be taken. (Barron, B., 1998)

#### Cutting Blade Testing

Cutter blade will test the strength, tough and tight with high standard. The material quality also will be checked; this to ensure good cutting result will take. Tester will test the used and smooth operation of cutting blade. Supervisor should give approval after success testing result taken (Dori, Y. J., 2003). Overall testing process should cover up the safety aspect when it operation. The testing including the dimension of cutting size need includes: - 1, 2, 3 cm and the width around 0.5 cm, 1.0 cm and 6 cm.

#### Motor / power output testing

Power input for machine testing will carry over or ensure product can cutting with high performance. The quality of cutting depends on heavy duty of motor or output motor taken. Testing result will show the final result will take (Thomas et. al., 1999). Supervisor should check the function of motor output. This powerful output mechanism will carry over the process of grass cutting. An approval will be given after success of testing.

#### End user testing and satisfied (farmers)

#### Product operation manual

1. Blade checking and electrical wiring check.
2. Power Supply connection; on power supply then push start button.
3. Checking blade speed, ensure cutting blade under smooth operation.
4. Checking in put cover in safety condition.
5. Put in grass slowly, checked out let cutting grass.
6. checking final result (product of cutting grass)

7. Turn off switch after completed process of cutting.



**Figure 2: Product briefing to user (farmers) : testing purpose**



**Figure 3: Customer satisfied and product approval from end user**



**Figure 4: Cutting result : End product of testing Grass cutting and final data (result of output)**

Final data and testing result will consider the success of product making by team members. This PjBL module will carry over the quality standard of engineering work for agriculture product producing (Morsund and David, 2002). Below the final result of product testing.

#### Students conclusion and discussion

This PjBL module show effective in support engineering students to get success in product development with high quality standard. An innovative product will carry out as local make product and will be used directly to local customer (Local farmers). This engineering project based learning methods has fulfill the needs of end user, its also match with government policy to create an innovative product producing internal institutions. Engineering students also cover almost motivation and extra experiences in project based learning. Below the result from team members qualitative survey from researcher (module developer).

The following are the salient points of the students' outcome during the interview.

"We have fun and confidence when we use this PjBL module for our project development. It works smoothly with a nice guided and totally easy to understand and highly motivated us to directly go further and on schedule. Overall process is covered with this PjBL module and generates full internal and external motivation". After understanding PjBL concept and using PjBL module, our project planning becomes easy, progresses and completed on time. Our self-confidence and self-regulation increases. The process that covers overall stages helps us in doing engineering works easily with confidence. PjBL forms helps us to generate our ideas on paper easily, at the same

time there are improvements on the project management and development. At the beginning, we never thought that this PjBL Module ease us to produce innovative project on time and enable us to successfully work within the engineering standards. Going through such a cognitive experience with this PjBL module, it helps us a lot in the technical problem solving. Our knowledge in exploring new engineering product increases. This PjBL module helps us to get involved in engineering critical thinking and always generate alternative problem solving throughout the process”.

Researchers have investigated the impact of project-based learning (PjBL) and related instructional approaches in a wide variety of engineering educational contexts ranging for agriculture course. These approaches have generally been shown to be effective in increasing students’ motivation by engaging them in their own learning, in improving student problem-solving and higher order thinking skills (Mergendoller et al. 2003). It promotes meta-cognition and self-regulated learning by asking students to generate their own strategies for problem definition, information gathering, data-analysis, and hypothesis-building and testing, comparing these strategies against and sharing them with other students' and mentors' strategies. Teaching with the project-based learning method enables engineering students to work cooperatively with peers and supervisors in a student-centered environment where learners are encouraged to explore various topics of interest. The collaborative nature of the investigation enhances all of these valuable experiences as well as promotes a greater appreciation for social responsibility (Synteta, 2003). Hence, this PjBL module provides opportunities for interdisciplinary of engineering learning, aspecially in an innovative product producing with success.

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**Table 4.1: Cutting output**

Input (kg)	Time (minit,second)	Tolerance (cm)	Result	Size
5 kg	5 min 25 second	2.5 cm	3 kg – left 2 kg – right	3.5cm long – right 2cm short – right 1.2cm long – left 0.6cm short - left
3 kg	3 min 48 second	1.8 cm	2 kg – left 1 kg – right	3.2cm long – right 1.6cm short - right 1.2cm long – left 0.9cm short – left