

Pyrolysis of Biomass Waste as The Project Based Learning in Community Assistance Course

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ABSTRACT: Community assistance course is a unique course for undergraduate student level, which need to be finished before doing final thesis project. This course aims to apply the student knowledge, which is gained during six semesters in the class. This course is followed by forty-eight students from different department, e.g., science, engineering, psychology, law, medicine, and also Islamic studies. We applied a pyrolysis of biomass waste as the tools for project based learning in community area. We divide forty eight student into eight teams. Each team was assigned to do some task, e.g., literature study, project design, project implementation, and project report based on the pyrolysis project. After the project was finished, we evaluate the grade of each student using the learning outcome, which was defined as the goal of the study. Forty-six students acquired grade A, while the other two students acquired grade B. This achievement related to the project based learning that we used in the Community Assistance Course.

Keywords: project-based learning, pyrolysis, community assistance course

INTRODUCTION

The up to date education is originated to convey the learning based on fundamental theory and practical application for the young learners. The young learners who has entered to the high-level education in science and engineering normally study the basic science such as mathematics, chemistry, and physics at the first year. The curriculum of the high-level education usually fully studies of fundamental theory and lack of practical application [1]. When the student steps up to the third year they are asked to study they would study more about the practical application. One of the course based on the practical application should has the student taken is Community Assistance Course.

Community assistance course is the practical application course which normally is taken by the student of the sixth semester. Community assistance course is also focused to study, analysis, and help the community to solve their daily problem based on the knowledge that the student got during their study. Practically, the team of student would stay at the community area for one to two month to implement a program that has been discussed with a lecturer. Although this course has been gained the value and benefit to the community, but many students only has limited time to prepare the program to the community. Hence the programs only solve the problem temporarily and the community area could not continue the program after the course is finished.

Many learning methods has been suggested to enhance the quality program which would be implemented to the community such as project based learning[2, 3], practice based experience[4], practice based research[5], practice based approach[6,7], and practice based education model[8], etc. The project based learning access has been achieved to enhance the student skill to apply the program recently — one of the student skill in learning approach which is enhancing the active learning strategies.

The successful implementation of project based learning has been presented by several researchers. The most impact of project based learning is to accommodate the active learning to gain the technical aspects of education[9]. The students gained the technical skills regarding communication, project management, report and presentation through implementation of the project. As a result, project based learning improved the development of lifelong learning methods.

This paper discusses the implementation of project based learning in the community assistance course. The project based on pyrolysis was applied to the sixth-semester student from Universitas Islam Indonesia. They need to finished the project within one month at the community are with the assistance

by the lecturer. The students are asked to finish the project, such as literature study, project design, project implementation, and project report for the final grading of the course. The project topic was to recycle the biomass waste from the community area to be a functional product that can be used for the agriculture purpose.

METHODS

Community assistance course was joined by forty-eight students from several department. We divided forty-eight student by eight team of students. Each team needs to follow the course regulation before and after the project. The team of students were directed to study the literature regarding the pyrolysis project. The project details can be classified as follow

1. The student team has one week to study literature through book, journal, magazine, even though internet-based study.
2. Each team need to present to the lecturer for final step before starting to design pyrolysis based project to the Community
3. After getting the approvement from the lecturer, each team discuss the find the materials to prepare and make the pyrolysis reactor
4. The lecturer help each team to improve the pyrolysis reactor and starting for use the pyrolysis together with the student
5. The lecturer write the guidance book regarding how to use pyrolysis reactor for the student
6. Each team has 1 month to finish the project including pyrolysis implementation, collecting biomass sample, using pyrolysis to produce bio-char and bio-oil, teaching the community how to use pyrolysis, help the community to use and built the pyrolysis and write the project report.
7. Each student ask to prepare the project report including introduction, methods, result and discussion, conclusion, and references
8. The lecturer evaluate the project and make the grade for each student

PROJECT DESCRIPTION

Biomass waste recycle studied to solve the environmental problem at the community area. Up to date, there is no any solutions from the community to address the biomass waste after agricultural production[10]. The community usually treated the biomass waste as a garbage, hence to gain zero waste environment they heat the biomass waste. As a result, there was many environment pollutant surrounding the community such as a hazardous smoke and toxic air pollutions[11].

In science-based education, gaining zero biomass waste usually overcome by many methods such as reducing by municipal solid waste system and recycling by pyrolysis[12]. Pyrolysis recently get huge attention due to its ability to produce functional product from the biomass waste e.g. bio-char and bio-oil[13]. The bio-char and bio-oil could be used by the community as the additive matter for their agriculture. We design the pyrolysis reactor to dispose of biomass waste into functional material as shown at Figure 1.

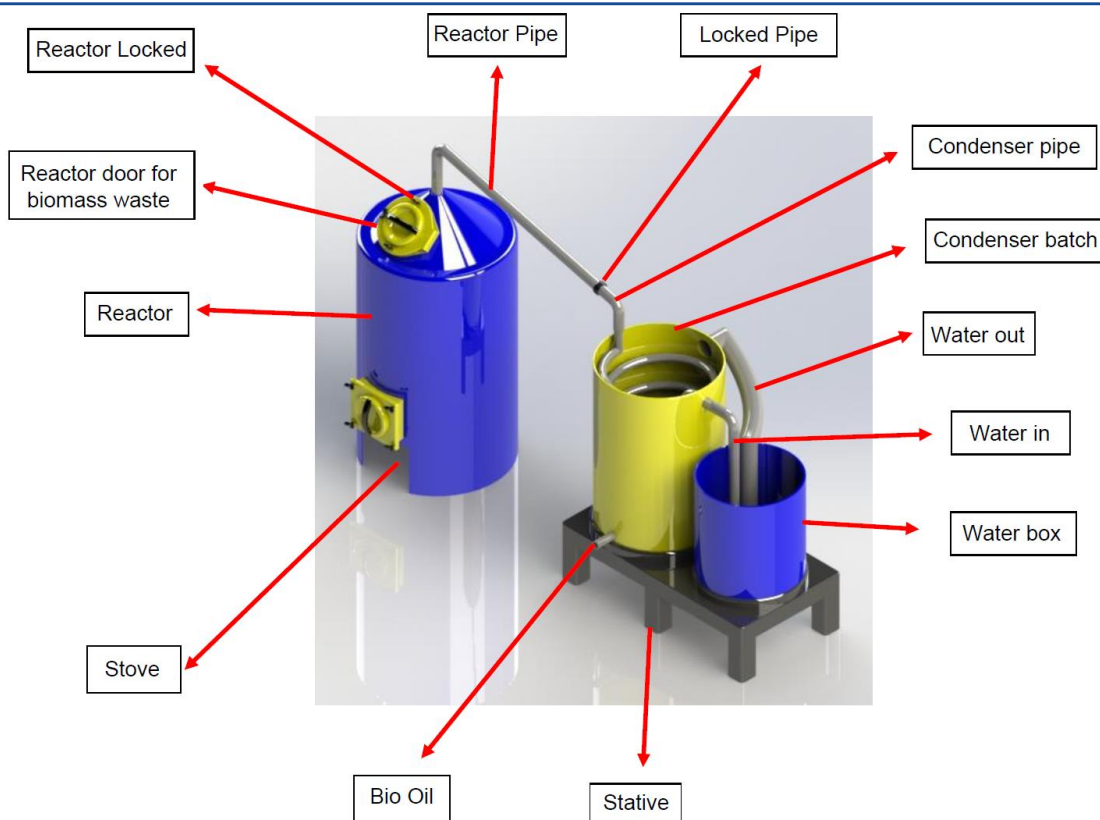


FIGURE 1. Design and fabrication of pyrolysis reactor

In the recent pyrolysis project, students are asked to search for the literature following the easiest pyrolysis technology to be applied at the community. This literature study aims to verify that the pyrolysis reactor is working as we expected before doing the project. Before starting using the pyrolysis reactor to the community, students also carried out the pyrolysis at laboratory to get the preliminary result regarding the quality of the technology. Notably, this effort also help the student to write the pyrolysis guidance book which would be used during the Community Assistance Course.

MATERIALS

Biomass waste

The biomass waste that used for the pyrolysis reaction is rice husk from agricultural residue in the community area. Biomass waste was dried before producing to pyrolysis process. This method aims due to green chemistry method, i.e. lees energy, less waste, and less chemical.

Evaluation Strategies

The evaluation of the project was defined using weight percentage that presented at Table 1. This assessment is to determine the final grade that the student will achieve after finishing the community assistance course.

TABLE 1. The weight percentage of each task for student assessment

No	Task	Weight (%)
1	Literature study	20
2	Project design	20
3	Project implementation	30
4	Project report	30

RESULT AND DISCUSSION

The final product of the pyrolysis from biomass waste at the community area are bio-oil and bio-char that presented at Figure 2. The student and the lecturer has successfully gained the support and attention from the community on bio-oil and bio-char production. During one month of the course, student can produce 3L of bio-oil and 1kg of bio-char. It is noteworthy that the pyrolysis project implementation has achieved one of the project based learning goal i.e. solving the real problem at the community using their knowledge. One of the goal of this project is also to provide the alternative strategy for active learning study method that can be used for advanced practical course.

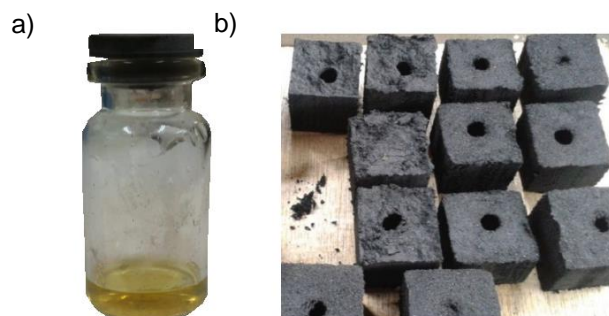


FIGURE 2. a) Bio-oil and b) Bio-char production from rice husk ash waste

The pyrolysis project for recycling of biomass waste was evaluated at numerous step by the principal lecturer and secondary lecturer. The principal lecturer was worked to monitor and assess the literature study, project design, and project report while the secondary lecturer was worked especially at the community field to evaluate the project implementation during the course was held. The literature study report was sent by the student to the principal lecturer before they are designing the pyrolysis reactor. After the design is approved the principal lecturer was supervised the project fabrication and choose the good materials for fabricated the reactor. The secondary lecturer is asked to monitor periodically in once a week for pyrolysis project implementation at the community field. He evaluated the project implementation by the student and gave the report to the principal lecturer on the student performance and achievement during applying the project. The final stage before final evaluation and grading, the students collected the project report to the principal lecturer and gave the feedback regarding the project based learning that they did at community assistance course.

The principal lecturer was evaluated the course final score which based on the course learning outcome criteria that presented at Table 2. The assessment of numerous criteria was finished according to the grade scale from A to E. The specific grade scale were ordered as very good (A), good (B), enough (C), low (D), and very low (E).

TABLE 2. Criteria of learning outcome for community assistance course

Task	Criteria				
	Very Good (A)	Good (B)	Enough (C)	Low (D)	Very Low (E)
Literature study	Student can search and review the literature regarding the project clearly and completely	Student can search and review the literature regarding the project	Student can only review the literature regarding the project	Student can only search the literature regarding the project	Student cannot search and review the literature regarding the project clearly
Project Design	Student can design the experimental	Student can design the experimental	Student can only design the	Student can only design the	Student cannot design the experimental

	project completely and clearly. Student can choose the best material for pyrolysis completely and clearly	project .Student can choose the best material for pyrolysis	experimental project completely and clearly.	experimental project.	project completely and clearly. Student cannot choose the best material for pyrolysis completely and clearly
Project Implementation	Student can use and explain of pyrolysis in the community area innovatively and creatively. Student can teach the community to use pyrolysis clearly.	Student can only use and explain of pyrolysis in the community area.	Student can only explain of pyrolysis in the community area.	Student can only use pyrolysis in the community area.	Student cannot use and explain of pyrolysis in the community area innovatively and creatively. Student cannot teach the community to use pyrolysis clearly.
Project report	Student can prepare and write the project report (introduction, method, analysis, discussion, and conclusion) clearly, completely, and perfectly.	Student can only prepare and write the project report clearly, completely, and perfectly.	Student can only prepare and write the project report clearly	Student can only write the project report clearly	Student cannot prepare and write the project report (introduction, method, analysis, discussion, and conclusion) clearly, completely, and perfectly.

The student achievement by following the project based learning at the community assistance course is presented at Figure 3. The total number of the student who follows the course is forty eight students. From forty eight student, forty six students acquired very good (A) grade (95.83%), while the other two student acquired good (B) grade (4.17%). Following the final grade result, we further analyzed the factor why the students are not totally acquired very good (A) grade for the project based learning at community assistance course.

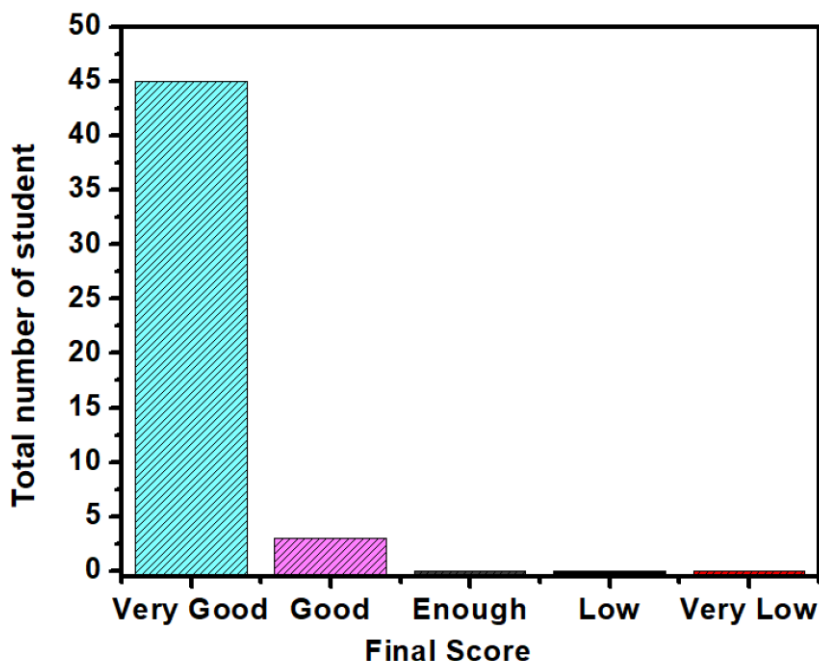


FIGURE 3. The final grade of the student in community assistance course

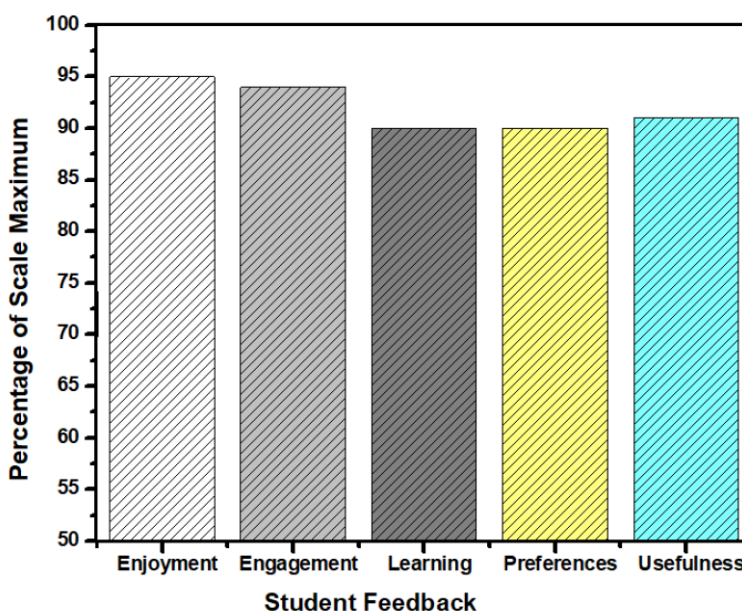


FIGURE4. Student ratings and feedback about the pyrolysis project

Figure 4. shows the student feedback following the implementation of project based learning at the community assistance course. Many students gave positive and satisfactory feedback based on the implementation of pyrolysis project. Notably, the learning and the preferences aspect were rated below 95. The reason behind this rating due to not all of the students are coming from the science and engineering based education. Fifteen percent from the total students have social-based education which they were not familiar with the science and technology approach for learning method. They lack of practicing skill in running such as science and technology project. As a result, we recommend to the lecturer to encourage them carefully and help them to do the all task for the next project based learning implementation.

CONCLUSION

The community assistance course is one of the practical application course which must be taken by the undergraduate university student at sixth-semester stage. It is essential for the student and the lecturer to use the project based learning approach to solve the community environmental problem based on the fundamental theoretical knowledge that they have. Based on the pyrolysis implementation project, we briefly summarized that from forty-eight students, 95.83% was acquired very good (A) final grade while the other 4.17% was acquired good (B) grade. The project granted a valuable event to the students for applying their knowledge to contribute dan solve the real problem at the society. This effort could be benefit for the student to face the real world challenge before they graduate from undergraduate university.

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