

Collaborating Project-Based Learning and Steam Practices at Indonesia's Universities Using Technology Support System

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ABSTRACT

The article objective of this research is to study the application of assignments in Project-Based Learning. Having used a case study method, the researcher conducted some interviews with several lectures and obtained some information on the implementation of Project-Based Learning. There were 5 resource persons in this activity from several universities in East Java. The results of this study found that in the implementation of learning activities that can be adapted to universities, the author requires supporting documents and improving outputs in the form of Appropriate Technology. The resulting output also has a use-value that is much more useful for the application of science. The combination of PJBL and STEAM in learning requires supporting documents such as SOPs for implementing PJBL, report formats, timelines, and stages and must be presented in public.

Keywords: *PjBL, Practice, STEAM, Universities*

1. INTRODUCTION

Learning in the 4.0 era refers to and leads to the realization of educational output following the demands of the 4.0 era. Educational outputs that are following the 4.0 era are individuals who have a noble character, can think critically and creatively, have good social skills including being able to work together and communicate socially, and are skilled in the field of information technology. The strategy taken to achieve the educational output is to apply a learning model that emphasizes student center learning. The results of observations of accounting learning in universities show that learning activities are still centered on lecturers, besides that students' critical thinking skills are still low. This is evidenced in the learning process in the classroom when the lecturer gives an issue for students to respond to, most of the students are passive. The thinking process of students is only based on memorization. When the lecturer gives questions that are not following the material they have memorized, students are immediately confused and cannot work on the problem. Critical thinking skills are the ability to solve problems rationally according to logical stages and provide more efficient solutions [16]. The ability to think critically trains students to make decisions from various points of view

carefully, thoroughly, and logically. Through critical thinking skills, students can consider the opinions of others and can express their own opinions. A learning model that can improve students' critical thinking skills is to apply the Project-based learning model. Project-based learning is a learning model that uses projects/ activities as a learning tool to achieve attitude, knowledge, and skill competencies [8]. The project-based learning method can develop students' thinking skills, develop students' creativity, and encourage students to work together in a team [2].

The implementation of a model project-based learning that is under the development of technology use needs to be supported by a combination of STEAM approaches. In the STEAM approach, learning is carried out using a combination of five sciences namely science, technology, engineering, arts, and mathematics, thoroughly and related to each other as a pattern of solving problems.

However, the obstacle faced by the lecturers in the class was suitability of the implementation of the model Project-Based Learning with the STEAM approach. The need for implementation guidelines for lecturers in giving assignments to students. There needs to be benchmarking on lecturers at other universities to compile an ideal guide

and assessment document for both lecturers and students. Project-Based Learning (PjBL) can develop solving skills in working on a project that can produce something [15]. The general objective of this research is to study the application of assignments in Project-Based Learning. The current era of 4.0 learning requires humans to have technology skills and information management, learn and innovate, have a career and have global awareness, and have a character to meet the high market demand for products based on science and technology [18]. The learning process in higher education must of course be able to meet these demands. The learning model applied in higher education should be based on student center learning.

This article provides an overview of learning practices using the Project-Based learning model in various universities. We are interested in the collaborative experience of lecturers in several universities in East Java because they have different characteristics and policies in the standard of learning implementation. We also investigated whether there may be differences in the implementation of learning using the Project-Based Learning model with a STEAM approach. Therefore, the research questions that guide our research are: How are the experiences of lecturers at other universities in implementing Project-Based Learning? Is there a special format/document regarding the practice guide in the field?

PBL is a learning model that involves students in developing their own conceptual understanding by working on "real world" projects independently over a long period of time [22]. Buck describes PBL as a method of teaching students to acquire knowledge and skills through long-term work to investigate and respond to real, interesting and complex questions, problems" [3].

PBL invites students to investigate "real world" problems by conducting collaborative discussions and direct investigations in the field. The guidelines used to develop PBL lead to meaningful student learning: (a) create a need for students to acquire knowledge, (b) engage students actively in building their understanding of content, and (c) help students organize content, knowledge, and their abilities. [13]. According to Krajcik and Czerniak, The PBL model is a structured procedure around questions about a real thing and focuses on learning activities. The involvement of students to develop standards-based learning products is also very much needed [14]. Buck illustrates the PBL unit as a "gold standard" which has seven main elements that can build students' content knowledge and 21st century skills [3].

Previous research has identified the application of PBL to address student motivation, academic achievement, and career planning. Other research has also found that student involvement in PBL units will lead to improved student knowledge, 21st century-

appropriate process skills, and better standardized assessment performance. [5]. Positive effects on learning are researched across different ethnicities, ages, and academic levels [13]. In terms of meta-analysis in the fields of science and technology, engineering, and mathematics, Freeman identified the advantages of PBL over traditional teaching methods for students [9]. Holmes also reinforces the previous opinion that secondary school students who take an active role in PBL in mathematics subjects have good intrinsic motivation and critical thinking skills and are valued peer tutors [11].

Sari et al. found that high school students' interest in engineering increased and believed that the skills they learning were assistance in pre-employment [20]. The recommendations state that PBL as an approach to help facilitate the exploration of careers and employability skills of secondary school students. The PBL Learning Model expects students to learn specialized knowledge and soft skills such as critical thinking, problem solving, communication, self-management, project management, and collaboration. [16]. Thus, it is expected that PBL competencies have alignment with ASCA Mindsets & Behaviors [1].

STEAM METHOD

A study in the United States of undergraduate education in science, mathematics, and engineering proposed program recommendations for interdisciplinary education [14]. STEAM was initiated, which combines the concepts of interdisciplinary, multilevel, and applied education comprehensively. STEAM has a major affect on the American curriculum, evaluation, primary and higher education, as well as student aptitude and adaptability [10]. Meanwhile, Yakman, et al. recommend interdisciplinary integration between Science, Technology, Engineering, Arts and Mathematics hereinafter referred to as "STEAM". Thus, the STEAM framework on interdisciplinary and multidisciplinary was built to encourage comprehensive student quality.

Then, how to implement the Project-Based Learning method in collaboration with STEAM in universities in Indonesia? Based on these questions, this research is expected to find various supporting documents, stages, and technical implementation of the appropriate method.

2. METHOD

This research was conducted using case study method at universities in East Java. The rationale of the object of research is that an Accounting Lecturer in East Java is a subject teacher by applying PBL. In this research, data was collecting through interviews and observation. This interview involves several lecturers in the accounting department which using PBL as the method.

Furthermore, observations were made by observing the learning process that took place in universities. This

observation aims to observe behavior in the classroom by looking at the implementation of Project Based Learning, student activity, student motivation, students' understanding of the material and application of project based learning procedures. After the observation data is collected, supporting evidence is needed in the form of information from the lecturer as a learning scenario writer about how the implementation of the lesson plan is carried out.

Then, the results of the interviews were cross-checked with observations regarding the implementation of Project Based Learning combined with STEAM. It does this by "splitting" the data, i.e. a process that focuses on some data and ignores others. [6]. Stages of analysis of the results of the comparison of observation and interview data through several phases, including data reduction, data presentation, and drawing conclusions, as well as data verification. The use of source triangulation aims to test the validity of the research results based on observation and interview data. In addition, the possibility of bias is anticipated by conducting resource checks.

3. RESULTS AND DISCUSSION

The IDDOL learning strategy has been researched Implementation of the Project-Based Learning method carried out by lecturers in lecture activities in the Accounting Department is the same as the guidelines for implementing PJBL in general. Lecturers design lectures for one semester with all activities that will be carried out by students. The selection of activities for students to do in class is always adjusted to the material to be taught and the atmosphere and condition of the class.

The lecturers who became resource persons in this study explained that it was necessary to compile in detail the implementation. This preparation process is referred to as the process of preparing learning scenarios. The learning scenario becomes a reference document for students and lecturers in carrying out each activity, including if the lecturer uses the PJBL method combined with STEAM. Lecturers also use the latest technology media intending to support the quality of learning in the Accounting Department. This is following the statement submitted by Mrs. Lala below.

"Yes, that's right, Ms. I always design learning scenarios starting from the preparation stage of materials, tools, materials, and learning media that should be used based on the topic. If possible, the latest technology, sis, let's adjust the Industrial Revolution Era 4.0."

Of the 5 interviewees, all five of them carried out learning using the PjBL-STEAM method in core accounting courses such as Auditing, Accounting Practicum, Taxation, Management Accounting, Financial Management, ., etc. Assignments are carried out by sending students to look for primary data and visiting

sources directly. At the beginning of the lecture, the lecturer explained the technicalities and guidelines for carrying out fieldwork with the rules and ethics that apply when collecting data. The lecturer also explained the need for field observations before taking data either by interview or questionnaire method.

This explanation is in line with the explanation from Mr. Danang as follows:

"If I was before the students went out in the field, it was necessary to explain in advance what the students had to do so that the students did not do anything in vain while in the field."

Students were also asked to make notes in the form of the logbook, which is a record of daily activities, and reporting to lecturers a maximum of 1 time a week. The function of the guidance activities carried out within that period is as a step of monitoring and directing lecturers to students.

The lecturer also ensures the use of technology that must be used in Project-based Learning-STEAM learning. Cross checks are carried out by lecturers by looking at the timeline and stages that have been prepared by students to ensure that everything done by students is still on track. The experience of Mr. Arisona, one of the speakers in this study stated that the Project-Based

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by students to ensure that everything done by students is still on track. The experience of Mr. Arisona, one of the speakers in this study stated that the Project-Based Learning model combined with the STEAM approach made it a challenge for both lecturers and students. He also explained that the output of student learning activities is of higher quality due to the use of the approach STEAM which requires that the output, although mathematically still looks beautiful or good, is also an appropriate technology.

At the end of the lecture, the lecturer asked the students to present the results of the fieldwork and show the output in the form of appropriate technology or the appropriate design that had been proposed by the students in the previous stage. They have to report the results of the fieldwork according to the template provided by the lecturer so that they have limits on what they are researching. In fact, if needed to be exhibited in the audience of the Accounting Department or appropriate technology exhibitions or even published in accredited journals.

Indirectly, learning using the PJBL model combined with the STEAM approach will teach students about data collection and provide their own experience for students when later taking data related to courses in the Accounting major when processing thesis.

4. CONCLUSION

Based on the above explanation, the implementation of PJBL combined with STEAM has a more targeted and measurable output. The resulting output also has a use-value that is much more useful for the application of science. The combination of PJBL and STEAM in learning really requires supporting documents such as SOPs for implementing PJBL, report formats, timelines, and stages and must be presented in public.

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REFERENCES

[1] ASCA. 2014. ASCA Mindset Behavior for Students Success: K-2 – College and Career- Readiness Standard for Every Students. Alexandria, VA: Author.

[2] Bédard, D.C., et al. (2012). Problem-based and project-based learning in engineering and medicine:

Determinants of students' engagement and persistence. *Interdisciplinary Journal of Problem-Based Learning*. 6(2). 7- 30.

- [3] Buck Institute for Education. (2019). Project based learning. Diakses 19 Desember 2019, dari <https://www.pblworks.org/>
- [4] Christensen, R., and Knezek, G. (2015). Active Learning Approaches to Integrating Technology into a Middle School Science Curriculum Based on 21st Century Skills. In *Emerging Technologies for STEAM Education*. Springer, Cham. In *Emerging Technologies for STEAM Education* (pp. 17–37).
- [5] Craig, T. T., & Marshall, J. (2019). Effect of project-based learning on high school Students' state mandated, standardized math and science exam performance. *Journal of Research in Science Teaching*, 56(10), 1461-1488, <https://doi.org/10.1002/tea.21582>.
- [6] Creswell, John W. 2016. *Research Design: Quantitative, Qualitative and Mixed Methods Approach*. Fourth Edition. First Print. Yogyakarta: Student Library.
- [7] Erford Bradley T. 2019. 40 Teknik Yang Harus Diketahui Setiap Konselor, Bandung, Reflika Aditama.
- [8] Fathurrohman, M. 2015. Innovative Learning Models: Alternatives 76 *TECHNOLOGY AND VOCATIONALITY*, VOL. 41, NO. 1, February 2018: 67-76 Fun Learning Designs. Yogyakarta: Ar-Ruzz Media.
- [9] Fathurrohman, M. 2015. Innovative Learning Models: Alternatives 76 *TECHNOLOGY AND VOCATIONALITY*, VOL. 41, NO. 1, February 2018: 67-76 Fun Learning Designs. Yogyakarta: Ar-Ruzz Media.
- [10] Freeman, S., Eddy, S., McDonough, M., Smith, M., Okoroafor, N., Jordt, H., et al. (2011). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 8410-8415
- [11] Harris A, de Bruin LR (2018) Secondary school creativity, teacher practice, and STEAM education: an international study. *J Educ Change* 19(2):153–179
- [12] Holmes, M. R., Tracy, E. M., Painter, L. L., Oestreich, T., & Park, H. (2015). Moving from Flipcharts to the Flipped Classroom: Using Technology Driven Teaching Methods to Promote Active Learning in Foundation and Advanced Masters Social Work Courses. *Clinical Social Work*

- Journal. <https://doi.org/10.1007/s10615-015-0521-x>
- [14] Ismayani, Ani. 2016. The Effect of STEM Project-Based Learning on the Mathematical Creativity of Vocational High School Students. *Indonesian Digital Journal of Mathematics and Education* Vol 3 No. 4
- [15] Kanter JW, Manos RC, Bowe WM, Baruch DE, Busch AM, Rusch LC. What is behavioral activation? A review of the empirical literature. *Clin Psychol Rev.* 2010 Aug;30(6):608-20. doi: 10.1016/j.cpr.2010.04.001. PMID: 20677369.
- [16] Krajcik, J.S. and Czerniak, C.M. (2018) *Teaching Science in Elementary and Middle School: A Project-Based Learning Approach*. Fifth Edition, Routledge, Taylor & Francis Group, New York and London.
- [17] Kofac (2017). Concept and definition of STEAM. Seoul: The Korea Foundation for the Advancement of Science and Creativity - KOFAC. Retrieved 12 April 2018 https://steam.kofac.re.kr/?page_id=11269.
- [18] Larmer, J., Mergendoller, J., & Boss, S. (2015). *Setting the standard for project based learning*. Alexandria, VA: ASCD.
- [19] Li, Weilin, et al. 2015. The Influence of STEAM Education on the Improvement of Students' Creative Thinking. *Advances in Social Science, Education and Humanities Research*, volume 232
- [20] Ministry of Education, Culture, Research and Technology of the Republic of Indonesia. 2019. *Steam Learning Model (Science, Technology, Engineering, Art, Mathematics) With a Scientific Approach*. [http://repositori.kemdikbud.go.id/18456/1/model-learning-steam-science-technology-engineering-art-and-mathematics with a-scientific%20%281%29.pdf](http://repositori.kemdikbud.go.id/18456/1/model-learning-steam-science-technology-engineering-art-and-mathematics-with-a-scientific%20%281%29.pdf). Retrieved September 30, 2021.
- [21] Park N, Ko Y (2012) Computer education's teaching-learning methods using educational programming language based on STEAM education. In: *IFIP international conference on network and parallel computing*. Springer, Berlin, pp 320–327
- [22] RT Sari and Siska Angreni.2018. "Application of Project-Based Learning (PJBL) Learning Model Efforts to Increase Student Creativity," *Varia Pendidikan*, vol. 30, no. 1, pp. 79-83, 2018.
- [23] Sari, NP, Budijanto, and Amiruddin, A. 2017. The Effect of Application of Problem Based Learning Models Combined with Numbered Heads Together on Metacognitive Skills and Geography Critical Thinking Ability of High School Students. *J. Education*.2(3):440-447.
- [24] Thomas, J.W. 2000. A Review of Research on PBL. Vol/2,). [Online]. Tersedia <http://www.bobpearlman.org/Bestpractices/PBLResearch.pdf>. Diakses 12 Agustus 2021.
- [25] Wijaya, Agusta Danang., Karmila, Nila., Amalia, Maheasy Rizqi. 2015. Implementation of Steam-Based Learning (Science, Technology, Engineering, Art, Mathematics) in