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Project-Based Learning to Understand Students about the Application of Code 1726:2019 in Earthquake Engineering Courses

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ABSTRACT
Indonesia updated its earthquake regulations by issuing Code SNI 1729:2019 concerning Procedures for planning earthquake resistance for building and non-building structures. Likewise with SNI 1726: 2019, which contains various rules so that an engineer can design and analyze earthquake-resistant buildings. Therefore, a learning method is needed that bridges students' understanding as prospective engineers in applying this code in Earthquake Engineering courses. In this study, the Project-Based Learning method was chosen for the learning process to design earthquake-resistant structures based on the SNI 1729:2019 code. Therefore, the Project Base Learning method was applied in the Earthquake Engineering class, which involved 15 students in one class. The concept of teamwork can also emphasize the benefits to students; a group consisting of 2 students per group was created, while group 7 consisted of 3 students. Furthermore, each group must complete an earthquake-resistant building planning project based on SNI 1726:2019 regulations. The class action is carried out on the design process following the context of the study. Students feel 100% of the benefits of understanding using the PBL method. 83.7% of students find it challenging to understand the structural design concept if not applied in a project. Students are also willing to complete their soft skills in using structural analysis software to complete the project they are working on comprehensively.

Keywords: *Project-Based Learning, Earthquake Engineering, Earthquake Resistance Structure, Soft Skill*

1. INTRODUCTION

Indonesia is an earthquake-prone area. Several large earthquakes, such as the Aceh earthquake and tsunami in 2004, the Padang earthquake in 2007 and 2009, the Palu earthquake in 2018, were significant earthquakes in Indonesia. These earthquake data affect earthquake maps and codes that must be used to design earthquake-resistant structures. Therefore, Indonesia updated its earthquake regulations by issuing Code SNI 1729:2019 concerning Procedures for planning earthquake resistance for building and non-building structures. In this code, thousands of earthquake data records in a response spectrum can design earthquake-resistant buildings in Indonesia. In addition to the response spectrum, civil engineering engineers must comply with various parameters and rules in this code so that the designed structure truly meets the criteria of an earthquake-resistant building.

The articles in the code are sometimes complex for students to understand if they only read the contents of the articles even though they have to be implemented in their use. Likewise with SNI 1726: 2019, which contains various rules so that an engineer can design and analyze earthquake-resistant buildings. Therefore, a learning method is needed that bridges students' understanding as prospective engineers in applying this code in Earthquake Engineering courses. In this study, the Project-Based Learning method was chosen for the learning process to design earthquake-resistant structures based on the SNI 1729:2019 code.

1.1. Project-Based Learning (PBL) Approach

Learning outcomes from final year students should be obtained from their learning experiences, both in group and individual learning experiences. According to [1], the independent lifelong learning of the students and developing learning skills and attitudes can be

approached using PBL. Three categories of learning can be approached using PBL that are cognitive, skills, and attitude [1][2][3]. It helps students' critical thinking and allows them to have opportunities for discussion in group work. This innovation method can anticipate empowering students in their personal development. In the PBL, the core of the system is the student.

PBL has a positive correlation with the creativity of the students and lecturers [4]. In PBL, students are given an activity to explain the lecture's prospects, problems, and challenges. It means the course can afford subject matter and explain the applied benefit to the students [5]. Nowadays, civil engineering graduates should have substantial technical and scientific knowledge and good life-long learning skills such as problem-solving, creativity, and communication [6].

1.2. Context of Study

The core subject of PBL is the design project. The design project aims at enabling students to develop first-hand practical design experience before graduation. Students must apply their prior knowledge and engineering skills acquired in elementary and intermediate subjects of various disciplines of civil engineering program such as Earthquake Engineering Course.

On this subject, learning outcomes of the students that will be able to achieve are [7]:

- Apply the techniques, skills, and modern engineering tools necessary to undertake authentic engineering practice
- Identity and diverse engineering problems that influence civil engineering projects, such as economic, environmental, legislative, social, political, ethical, health and safety, sustainability, and technological considerations
- Create logical solutions to solve the problems
- Work professionally and ethically;
- Communicate logically through drawing, calculation, and writing;
- Present ideas and arguments verbally in formal presentations and informal discussions
- Negotiate informally with peers, function effectively in multi-disciplinary teams, and take responsibility for an agreed area of a shared activity;
- Recognise the need for, and develop an ability to engage in life-long learning.

2. METHODOLOGY

SNI 1726:2019 is the latest code in Indonesia in the form of procedures for planning earthquake resistance for building and non-building structures. This code must be well understood by students so that when designing or analyzing earthquake-resistant buildings, no malpractice can impact property and life losses. Understanding code will be more accessible if applied directly in a design project. Therefore, the Project Base Learning method was used in the Earthquake Engineering class, which involved 15 students in one class. The concept of teamwork can also be emphasized on the benefits to students. A group consisting of 2 students per group was created, while group 7 consisted of 3 students. Furthermore, each group must complete an earthquake-resistant building planning project based on SNI 1726:2019 regulations. The class action is carried out on the design process following the context of the study conveyed in the introduction.

3. RESULTS AND DISCUSSION

To ensure that students are fully aware that the method used in lectures is PBL, turn off the questionnaire with the question: Q1-do you realize that you are being directed to work on a building project with an earthquake-resistant concept based on SNI 1726:2019 regulations? The results of this questionnaire are shown in Figure 1. 11 students answered yes, and four students answered no. From this, it can be understood that 73.3% of students are ready to learn using the PBL method. As for 26.7% of students who are not prepared to take PBL learning, a persuasive approach is taken to participate in the learning process actively.

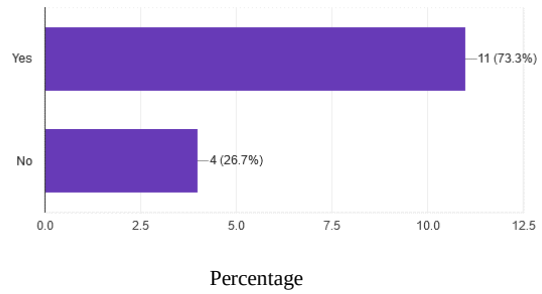

Figure 1. Students' understanding that PBL will be a learning method in Earthquake Engineering courses

The second question (Q2) is: do you find it helpful if the learning method is the theme of a project that must be completed? It turns out that 100% of students stated that the benefits are felt when learning by doing a project that must be completed (Figure 2.).

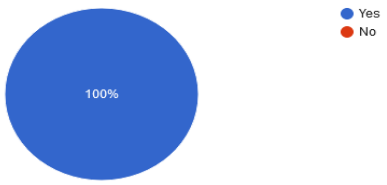

Figure 2. Q2- do you find it helpful if the learning method is the theme of a project that must be completed?

The third question (Q3) is, do you have difficulty understanding the design of concrete or steel structures because they are not directly applied to a building project? Students who answered yes were 86.7%, and those who answered no were 13.3%. This result shows that in understanding subjects that have learning outcomes in the form of design skills, PBL is very appropriate to use so that their understanding is more attached (Figure 3)

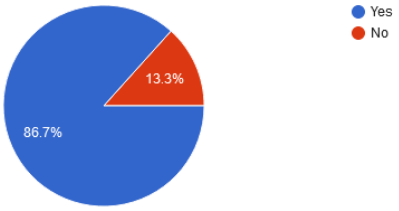

Figure 3. Q3- Do you have difficulty understanding the design of concrete or steel structures because they are not directly applied to a building project?

Additional soft skills in the form of skills to operate and understand software to model and analyze a building strongly support the integration of the correct structural design. For this reason, the fourth question (Q4) is given: do you have additional skills in operating software that supports the structural design process in civil engineering? Of the 15 students, 80% stated that they could use and understand software related to structural analysis (Figure 4).

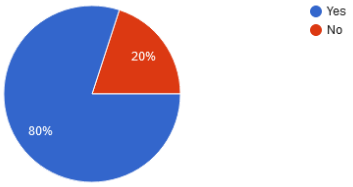

Figure 4. Q4- do you have additional skills in operating software that supports the structural design process in the world of civil engineering?

Because 20% of students do not yet have the skills to operate and understand structural analysis software, they are asked the following question (Q5): Are they willing to independently study software related to structural analysis such as SAP2000 or ETAB? 100. Because 20% of students do not yet have the skills to operate and understand structural analysis software, they are asked the following question (Q5): Are they willing to independently study software related to structural analysis such as SAP2000 or ETAB? All students who do not have the software skills stated that they are ready to learn independently about the related software.

4. CONCLUSION

SNI 1726:2019 is the latest code in Indonesia used to design earthquake-resistant buildings and non-buildings. For the design concept to be understood quickly and correctly by students, the PBL method is very suitable for learning. Students feel 100% of the benefits of understanding using the PBL method. 83.7% of students find it challenging to understand the structural design concept if not applied in a project. Students are also willing to complete their soft skills in using structural analysis software so that the completion of the project they are working on can be completed comprehensively

ACKNOWLEDGMENTS

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