



ANALYSIS OF STEM-BASED PROJECT BASED LEARNING IN ENTREPRENEURSHIP COURSES TO REMIND STUDENTS OF CRITICAL THINKING

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Abstract. This study aims to analyze the application of Project-Based Learning that integrates STEM (Science, Technology, Engineering, and Mathematics) approaches in entrepreneurship courses to improve students' critical thinking skills. The research method used is a quantitative approach with an experimental research design. The subject of this research is students who take entrepreneurship courses in the economic education study program, faculty of economics and business. Data was collected through critical thinking tests before and after the application of the learning method, as well as through observation and interviews to obtain students' perspectives on the applied learning methods. The results of the study show that the application of STEM-based Project Based Learning significantly improves students' critical thinking skills. This is shown by the improvement of critical thinking skills after the implementation of learning. In addition, students also showed an improvement in their ability to analyze, solve and evaluate entrepreneurial problems in more depth. This study concludes that STEM-based Project Based Learning is an effective approach to improve critical thinking in learning entrepreneurship courses. The implication of this research is the importance of developing and implementing learning methods that integrate STEM in various disciplines to prepare students to face the challenges of an increasingly complex world of work.

Keywords: project based learning, STEM, entrepreneurship, critical thinking, higher education

A. Introduction

Higher education has an important role in preparing students to face the challenges of the increasingly complex world of work. One of the skills that is indispensable in today's modern era is the ability to think critically. This ability not only helps students in solving problems, but also in dealing with uncertain situations that require quick and appropriate decision-making. Therefore, the development of critical thinking is one of the main focuses in the learning process in higher education. Critical thinking allows individuals to analyze problems, evaluate solutions, and make informed decisions based on existing data and information. These skills are very important in the field of entrepreneurship, where students are expected to be able to identify business opportunities, develop innovations, and make strategic decisions in the face of market competition. In the context of entrepreneurship courses, critical thinking is very relevant because students are required to be able to analyze opportunities, plan business strategies, and make decisions based on data and market analysis. The use of the right learning



methods is a key factor to achieve this goal. One of the methods that is increasingly applied in the world of education is STEM-based Project Based Learning (PBL) (Science, Technology, Engineering, and Mathematics). PBL is a learning method that places students as the center of learning by actively involving them in real projects that are relevant to the material being studied. Meanwhile, the STEM approach allows students to integrate various disciplines in solving problems, so that learning becomes more contextual and in-depth.

STEM-based Project Based Learning is a learning approach that integrates four disciplines, namely science, technology, engineering, and mathematics in one project designed to provide a relevant and in-depth learning experience. The application of STEM-based PBL in entrepreneurship courses can make a significant contribution to improving students' critical thinking skills. This is because this learning model requires students to think analytically, creatively, and solutely in solving complex problems collaboratively. STEM-based PBL in entrepreneurship courses is expected to help students develop analytical skills, problem-solving, and creativity. Through projects designed to mimic real challenges in the business world, students are expected to significantly improve their critical thinking skills. In addition, this project-based learning provides opportunities for students to work collaboratively, utilize technology, and combine scientific concepts to create innovative solutions.

This study aims to analyze the effectiveness of the implementation of STEM-based project-based learning in entrepreneurship courses, especially in improving the critical thinking skills of Economics Education students at Jenderal Soedirman University. By focusing on students from this study program, this research is expected to provide insight into how more practical and integrative learning methods can optimize learning outcomes and prepare students to become critical, innovative, and ready to face global challenges. Students are also expected to not only acquire theoretical knowledge but also practical skills that they can apply in the context of real-world entrepreneurship.

B. Methods

This research is qualitative with a descriptive approach. The location of the research was taken at Jenderal Soedirman University, with a focus on students of the Economic Education study program of Jenderal Soedirman University. This study analyzes the application of *STEM-based Project Based Learning* (PBL) in entrepreneurship courses in economics education students of Jenderal Soedirman University. This research was carried out through three stages, namely the pre-research stage, the research stage, and the final stage. Data was collected from primary and secondary sources, with the criteria for respondents for Economic Education students of the 2022 and 2023 batches. Data collection is carried out through the dissemination of questionnaires, interviews and documentation, while validity and data analysis include data reduction, data presentation, and conclusion drawn.

1. Time and Place of Research

The research was carried out at Jenderal Soedirman University from August to September 2024. Research activities consist of three stages, namely the pre-research stage, the research stage, and the final stage. This study aims to analyze the cultural adaptation factors that affect the success of critical thinking of students of the Economics Education study program at Jenderal Soedirman University.

C. Results And Discussion

1. Definition of Project-Based Learning

Project-based learning is an innovative learning method, which emphasizes contextual learning through complex projects and activities. The definition of Project Based Learning according to The George Lucas Educational Foundation (2005) is a learning approach that pays



attention to in-depth understanding through analysis. Students explore, assess, interpret and analyze the information obtained in learning activities. PBL is a learning model that can help students in learning by building knowledge and skills through a project as the core of learning (Afriana, et al., 2016). PBL is also defined as a learning model that uses problems as the first step in collecting and integrating new knowledge based on their experience in real activities (Darmadi, 2018). Through PBL, students are given the freedom to work collaboratively in completing projects related to the real world. These projects are usually designed to solve problems or answer complex questions, so students integrate various knowledge and skills in completing the project.

PBL encourages students to actively learn by placing them at the center of the learning process. They are required to plan, conduct research, collect data, make decisions, and produce real products or solutions to the problems they face. This process not only strengthens students' understanding of theoretical concepts, but also develops important skills such as critical thinking, creativity, collaboration, and communication. Through the context of STEM-based learning, PBL offers an approach that allows students to use technology, science, engineering, and mathematics to design projects that are innovative and relevant to real-world challenges. In entrepreneurship courses, for example, students can apply PBL to design and develop business models supported by data-driven analysis, digital technology, and scientific methods. STEM-based PBL provides students with the opportunity to develop the entrepreneurial skills needed in today's digital and technological era. This approach is very effective in honing students' critical thinking skills, as they must evaluate information, formulate evidence-based solutions, and adapt to rapid changes in the modern business environment.

2. Definition of STEM-Based Learning

STEM is an acronym for Science, Technology, Engineering, and Mathematics. STEM learning is an educational approach that integrates four disciplines in one learning framework. STEM is an approach and effort to combine several or all four STEM subjects into one lesson that is based on the relationship between subjects and real-world problems (Moore et al., 2014). STEM as an approach to teach two or more subjects related to real practice so that it can increase students' interest in learning in the learning process (Kelley and Knowles., 2016). The STEM approach emphasizes problem-solving, critical thinking, innovation, and collaboration, which are highly relevant to the needs of a modern world that increasingly relies on technology and scientific approaches. In STEM-based learning, students not only learn theories separately, but are also encouraged to apply those concepts in solving complex and real problems through projects or experiments.

In entrepreneurship courses, the STEM approach allows students to apply scientific concepts, use technology, utilize data analysis methods, and think in a systematic and structured way in developing business ideas. For example, in the process of planning and developing products, students can use scientific methods for market research, technology for data processing, and mathematical principles to analyze risks and benefits. With a STEM approach, students are expected to become innovative entrepreneurs and be able to take advantage of technological and scientific developments in creating relevant and competitive solutions in the market. STEM also helps hone students' critical thinking skills because they must integrate various disciplines to overcome existing challenges. The main goal of STEM-based learning is to help students understand how concepts from science, technology, engineering, and mathematics are interrelated and can be applied in real life and the world of work.

3. Integration of STEM-based Project Based Learning (PBL) in Entrepreneurship Learning



PBL is a student-centered learning model, where they learn through active involvement in real projects. This learning process requires students to solve problems, plan and implement projects that are in accordance with the lecture material. In the context of entrepreneurship, PBL allows students to apply entrepreneurial theory in designing business models, analyzing markets, and developing product innovations. Economics Education students at Unsoed can apply PBL well in entrepreneurship courses, for example, given the task of developing a business idea from scratch, drafting a business plan, presenting a business idea, and conducting business operational simulations. This process helps students understand the real challenges of entrepreneurship and hone their analytical skills to assess the feasibility of a business. STEM is an integrative approach that combines science, technology, engineering, and mathematics to solve problems comprehensively. The integration of STEM in entrepreneurship learning provides opportunities for students to develop the skills necessary in the modern business world, such as data analysis, technology utilization, and a systematic approach to decision-making. For example, in STEM-based PBL assignments, students are taught to use business simulation software or data processing technology to analyze markets and consumer behavior. An understanding of STEM concepts also allows them to design more innovative and technology-based products, which fit the needs of a rapidly evolving market.

4. The Impact of STEM-Based PBL on Critical Thinking

Critical thinking is the ability to analyze information objectively and thoroughly, identify problems, evaluate evidence, and devise logical and effective solutions. Through STEM-based PBL, students are exposed to situations where they have to use a multidisciplinary approach to complete an entrepreneurial project. This process forces them to develop critical thinking skills, such as:

1. Problem Analysis. Students must be able to understand business problems or markets that are developing today.
2. Solution Evaluation. Various solutions need to be evaluated based on relevant data and evidence.
3. Decision. Students are taught to make decisions that are based on risk analysis and potential benefits.

Research shows that STEM-based PBL encourages students to be more active in critical thinking, because they are not only given theoretical materials, but also required to apply their knowledge in real projects. This has a positive impact on the development of entrepreneurial skills, so that they are better prepared to face the complex business world.

5. Application at Jenderal Soedirman University (Unsoed)

Universitas Jenderal Soedirman, especially in the Economics Education study program, has great potential to implement STEM-based PBL in entrepreneurship courses. By integrating real business projects into the curriculum, students can gain hands-on experience in entrepreneurship. In addition, the application of technologies such as digital data analysis, business simulation software, and mathematical models in business decision-making can be very effective tools in facilitating learning. For this reason, support from the campus in the form of providing technological facilities, fostering lecturers who are competent in STEM fields, and collaborating with local industries or businesses can further improve the quality of this project-based learning.

6. Challenges and Solutions

The implementation of STEM-based PBL cannot be separated from various challenges. One of them is the limited technological resources and the readiness of lecturers in facilitating



STEM-based learning. To overcome this, Unsoed can conduct training for lecturers and students related to the application of STEM in education, as well as build cooperation with the technology industry to provide access to relevant software and digital tools. In addition, students need to receive intensive guidance so that they can effectively apply STEM approaches in their entrepreneurial projects. With the right strategy, the implementation of STEM-based PBL at Unsoed can be an effective learning model in improving critical thinking skills and producing entrepreneurs who are ready to compete in the business world globally.

D. Conclusion

The application of STEM-based Project Based Learning (PBL) in entrepreneurship courses in the Economics Education study program of Jenderal Soedirman University (Unsoed) has proven to have significant potential in improving students' critical thinking skills. This approach not only allows students to be actively involved in the learning process through real-world relevant projects, but also facilitates the development of analytical, creative, and solution-solving thinking skills that are crucial in the dynamic business world. STEM-based PBL integrates various disciplines such as science, technology, engineering, and mathematics, which makes students better prepared to face the complex challenges in entrepreneurship. By involving students in projects that require them to solve business problems, they are encouraged to think critically, evaluate solutions, and make decisions based on in-depth evidence. In addition, collaboration between students in project work also hone communication and teamwork skills that are indispensable in the modern business world. Overall, the application of STEM-based PBL in entrepreneurship courses at Unsoed can be an innovative and effective learning model in developing young entrepreneurs who are critical, innovative, and ready to face the challenges of the global world. Support from the university, in the form of the provision of technology and training facilities, will play a very important role in the successful application of this method in the academic environment.

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F. References

- [1]. Afriana, J. A. (2016). The application of STEM-integrated project-based learning to improve students' science literacy is reviewed from a gender perspective. *Journal of Educational Innovation*.
- [2]. Darmadi. (2018). Optimization of Learning Strategies.
- [3]. Gijbels, D. D. (2005). Effect of The Problem Based Learning, A Meta analysis from the Angle Measurement. *Journal Review of Educational Research*, 27-49.
- [4]. Kelley, T. a. (2016). A Conceptual Framework for Integrated STEM Education. *International Journal of STEM Education*.
- [5]. Moore, T. W. (2014). A Framework for Quality K-12 Engineering Education Research and Development. *Journal of Pre College Engineering Education Research*.