

## Transformative Strategies in Higher Education: SWOT Analysis for Project-Based Learning Models

L. Virginayoga Hignasari <sup>1</sup>, Gusti Ayu Made Arna Putri <sup>2</sup> & I Komang Wisnu Budi Wijaya <sup>3\*</sup>

<sup>1</sup> University of Mahendradatta, Denpasar, Indonesia

<sup>2</sup> University of Mahasaraswati Denpasar, Denpasar, Indonesia

<sup>3</sup> University of Hindu Negeri I Gusti Bagus Sugriwa, Denpasar, Indonesia,  
wisnu.budiwijaya240191@gmail.com

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### ABSTRACT

This research aims to determine the appropriate strategy for implementing the Project Based Learning (PjBL) model in Mathematics courses at the Higher Education level. This research is qualitative with case study method. The samples in this research were lecturers and students of the Industrial Engineering Study Program at Mahendradatta University for the 2022/2023 academic year. The method for determining internal and external strategy factors is through interviews and observation. Meanwhile, the IFAS and EFAS scores were obtained from the results of the questionnaire. The SWOT matrix is used to determine the appropriate strategy based on the IFAS and EFAS that have been obtained. The results of the analysis are then described descriptively. As for the results of this study, based on the results of IFAS and EFAS calculations, IFAS = 5.037 and EFAS = 4.407. Based on this value, the IFAS and EFAS intersection point is in quadrant II, so the strategy that suits these conditions is the S-T strategy, which means a diversification strategy. Based on the SWOT analysis matrix above, strategies that can be implemented to maximize the implementation of the PjBL model in mathematics subjects are making PjBL-based teaching guidelines and modules, select relevant and challenging projects, form effective learning teams, provide support and guidance, integrate with the curriculum, comprehensive performance-based evaluation, collaboration with industry or the community. The combination of IFAS, EFAS and SWOT analysis results provides a comprehensive understanding of the factors that influence the success of PjBL implementation.

### 1. Introduction

The journey of education in Indonesia has not escaped the influence of the changing times which have caused a shift in the goals of national education (Junaidi, 2020). Education must be at the forefront in responding to challenges to win competition in all fields (Iskandar, 2023). The curriculum is the lifeblood of a learning program so that its existence requires dynamic design, implementation and evaluation in accordance with the times, the needs of Science, Technology and Arts (IPTEKS) and the competencies needed by the community, as well as users of college graduates (Junaidi & Wulandari, 2020). Higher education institutions in compiling or developing curricula must refer to the IQF and the National Higher Education Standards. The challenge faced by tertiary institutions in developing curriculum in the Industry 4.0 era is to produce graduates who have new literacy

skills including data literacy, technology literacy, and human literacy with noble character based on an understanding of religious beliefs (Mariati, 2021). According to Law No. 12 of 2012 Article 35, the curriculum for the Higher Education Study Program refers to the National Higher Education Standards (SN-Dikti). Furthermore, the Directorate General of Higher Education states that the higher education curriculum is defined as a set of plans and arrangements regarding objectives, content, and teaching materials as well as the methods used as guidelines for organizing learning activities to achieve the goals of Higher Education (Junaidi, 2020).

Policy in the learning process in higher education determines mathematics courses as subjects that must be taken by students in every study program that is part of engineering and formal sciences, on the grounds that mathematics courses make students' thinking patterns more comprehensive in looking at a problem (Prayogo,

2018). Mathematics subjects are prerequisite courses that must be met in order to take courses at the next level. To equip students with competencies according to their field of knowledge, mathematics subjects must be packaged in an integrated manner. Not only learning about theory, but it must also be applied in an applicable way to solve problems in accordance with the scientific field. Realistic mathematics learning by utilizing culture and integrating technology can be used as an ideal starting point for learning (Nuryadi et al., 2022). The selection of learning forms and methods is an effort to find the right strategy so that students can fulfill their learning achievements, by developing active interactions between students, lecturers, and learning resources.

Based on national education goals and referring to national standards of higher education, undergraduate graduates must fulfill Graduate Learning Achievements (CPL) which consist of elements of attitude, general skills, specific skills, and knowledge (Junaidi & Wulandari, 2020). To produce graduates who have both academic and non-academic competencies, learning that can be done is student-centered learning, teamwork, and learning related to the context of students' daily lives. Problems encountered in everyday life can be used as learning topics that will be solved by utilizing the knowledge concepts that have been obtained by students. One learning approach that meets the above criteria is the constructivism approach. The popular learning model in the constructivism approach is the project based learning model. In an effort to improve the quality of education and learning services, higher education curricula continue to be innovated to achieve SDGs goals. Outcome-based Education (OBE) and the Project-Based Learning (PjBL) model are innovative learning strategies to improve education and learning in higher education (Muis & Dewi, 2022).

Project Based Learning began in the 1970s at the higher education level in engineering at the Universities of Aalborg and Roskilde, Denmark (Mayasari et al., 2016). According to Morgan project based learning is not just a method of learning about techniques, but is a curriculum design that can raise fundamental questions about the nature of higher education (Morgan, 1983). The educational psychology theory that underlies the development of project based learning includes John Dewey who states that the importance of learning comes from experience, Jerome Bruner who states that learning is an active process in which students transform information so as to generate motivation, retention and personal development, Carl Rogers who mentions humanistic learning theory, Lewin who states that effective learning is learning in groups) (Andreasen & Nielsen, 2013).

Based on the results of previous research, the project based learning model was reported to be able to train 21st century skills in the era of globalization

(Wagner, 2010; Slough, S. W., & Milam, 2013). Haight, Kelly, R., & Bogda, B. stated that project-based learning has the potential to improve higher-order thinking skills, namely analysis, synthesis, and evaluation (Haight, W., Kelly, R., & Bogda, 2005). This is supported by the results of the EdVisions report which revealed that more than 70 schools that applied project-based learning showed an increase in 21st century skills, and an increase in students' self-concept and students' higher-order thinking skills (EdVisions, 2007). Through project-based learning, students use their communication skills and skills to convey ideas, organization and time management, inquiry skills, self-assessment and reflection skills, participation in groups, and leadership skills (Mayasari et al., 2016).

Learning mathematics courses in the Mahendradatta University Industrial Engineering Study Program has a very important role in preparing students to become competent professionals and able to face challenges in the industrial world. In this context, mathematics courses are not only an academic obligation, but also a strong basis for understanding the technical concepts and analytical skills required in industrial engineering. Understanding mathematical concepts is the initial foundation for achieving other learning goals (Agustina et al., 2021). Previously, the learning process had led to project-based learning, but not yet optimally. The learning carried out refers more to solving mathematical problems than the concepts discussed. In reality, mathematics learning in the Industrial Engineering Study Program often faces a number of problems that can become challenges. Students still have difficulty seeing the relationship between the mathematical concepts taught and the real world, especially in the context of industrial engineering. This is one of the factors that reduces their motivation to study mathematics. Motivation is one of the psychological factors that has a big influence in determining the success of every human activity, including learning activities (Kamaluddin, 2017). Apart from that, based on the results of interviews, most students have not been able to see the real benefits of mathematical concepts in solving problems in the field of industrial engineering.

To make learning more meaningful and applicable, project-based learning is an alternative that can be implemented. Based on research conducted by Anjarsari PjBl, it can improve mathematics learning outcomes (Anjarsari & Kamaludin, 2021). Apart from that, based on research conducted by Zakiah, by completing a project, students' creativity abilities and mathematical creative thinking abilities can be improved (Zakiah et al., 2020). PjBL is a learning approach that focuses on authentic and contextual projects or assignments. In the context of "Merdeka Belajar Kampus Merdeka (MBKM)," this approach is a method that is very relevant and effective in achieving educational goals that are more independent, collaborative and contextual. The Independent

Curriculum has a characteristic which is defined as an emphasis on the use of teaching methods that focus attention on the learner and reduce pressure by using a teaching model based on Project-based learning (PjBL) (Pertiwi et al., 2022). Project-based learning was chosen as one of the approaches applied to mathematics learning strategy courses which is in line with Merdeka Belajar Kampus Merdeka (Pradanti & Muqtada, 2023). Overall, the incorporation of PBL in the context of "Merdeka Belajar Kampus Merdeka" can be a strong tool for improving the quality of higher education, enabling students to become more autonomous learners and engage in learning experiences that are relevant to their future lives and world of work. However, although PjBL has positive potential in mathematics learning in higher education, there are several challenges and obstacles that need to be overcome. Some of the problems that occur in implementing PjBL include teacher readiness factors, quality of projects provided, limited time, evaluation systems and other problems related to implementing PjBL.

PjBL is proven to improve students' learning abilities such as critical thinking skills, problem solving, creative thinking skills and other abilities (Zakiah et al., 2020). However, in implementing PjBL at the research location, there were several obstacles faced. The obstacles faced include the limited types of projects related to mathematics topics, not all students play an active role and the individual performance evaluations that have been carried out still cannot reflect the true abilities of each individual. So, due to these obstacles, the implementation of PjBL at the research location does not run optimally and cannot be carried out in a sustainable manner. Many studies have been conducted that state the positive influence of PjBL on students' learning abilities. Based on research by Puspasari (2018) it is stated that Project Based Learning (PjBL) is able to increase student independence and learning achievement (Puspasari, 2018). This is also in line with the results of research by Zakiah et al (2020) which states that project-based learning can help improve the development of certain 21st century skills, such as creativity and creative thinking (Zakiah et al., 2020). If previous studies focused more on the effect of implementing PjBL on students' learning abilities (Nasution et al., 2022), what differentiates this research from previous research is that this research is the result of a follow-up to the implementation of PjBL that has been carried out at the research location. This research aims to find solutions to the obstacles faced in the PjBL implementation process. Based on the obstacles faced, an effective strategy was developed in implementing PjBL looking at various factors, both internal and external, within the frame of Merdeka Belajar Kampus Merdeka (MBKM).

This research provides a new perspective in implementing a learning innovation that is seen based on the situation of the institution, students, teachers,

regulations and the goals to be achieved. Based on this, this research aims to look at strategic factors, both internal and external, that are related to and influence the implementation of PjBL. From these factors, an appropriate strategy is then formulated so that the implementation of the PjBL can be carried out optimally and sustainably.

## 2. Method

The research aimed to identify strategic factors in implementing PjBL and appropriate strategies based on these strategic factors. This research was a qualitative research with a case study method. The research was conducted at Mahendradatta University in the Industrial Engineering Study Program. Samples were taken using a purposive sampling technique with research samples taken from students and lecturers in the Industrial Engineering Study Program. The student sample used was students in semesters 1 and 2 of the 2022/2023 academic year with a total of 30 people. These strategy factors were categorized into Internal Factors Analysis Summary (IFAS) and External Factors Analysis Summary (EFAS). IFAS was a form of strategic analysis of the internal factors of the object being studied. This analysis needed to be carried out to obtain a portrait of the strengths and weaknesses of the object being studied. EFAS was a form of strategic analysis of the external factors of the object being studied. This analysis needed to be carried out to obtain a portrait of the opportunities and threats of the object being studied. Data collection methods in this research included interviews, observation, questionnaires, and literature study.

To determine the right strategy based on the IFAS and EFAS results, SWOT analysis was the appropriate data analysis to answer research problems. SWOT analysis was a systematic identification of various factors to formulate a strategy. This analysis was based on logic that can maximize strengths and opportunities, but simultaneously minimize weaknesses and threats (Rangkuti, 2006). This analysis was based on the assumption that an effective strategy will maximize strengths and opportunities and minimize weaknesses and threats (Noor, 2014). When accurately applied, these simple assumptions have a huge impact on the design of a successful strategy and industry environment analysis provides the information needed to identify the opportunities and threats that exist in a business. SWOT analysis compares external factors of opportunities and threats with internal factors of strengths and weaknesses. Internal factors were entered into a matrix called the internal strategic factor matrix or IFAS (Internal Strategic Factor Analysis Summary). External factors were entered into a matrix called the EFAS (External Strategic Factor Analysis Summary) external strategic factor matrix (Noor, 2014).

The procedures in this research were:

- 1) Determined strategic factors, both internal and external, in implementing PjBL using interview and observation methods.
- 2) Determined the weight and rating of each IFAS and EFAS factor using a questionnaire.
- 3) Gave weight values ranging from 0 (not important) to 1 (very important), so it was necessary to develop a scale that showed the level of importance of each factor (Baroto & Purbohadiningrat, 2014). The weight of each factor was obtained by dividing the score of importance by the total value of the overall score of importance formulated as follows:

$$B_i = \frac{S_i}{\sum_{i=1}^n S_i} \dots\dots\dots(1)$$

- a. Where :
- b.  $B_i$  = Factor weight i i = 1,2,3...,n
- c.  $S_i$  = Score Importance factor i

- 4) The value of each factor was determined based on the results of the questionnaire that has been given to the research subjects. The range of values used in giving a rating was a scale of 10 (very strong) to 1 (weak).
- 5) The questionnaire filled out by the respondent was then processed and the value obtained was the weight and rating for each IFAS and EFAS.
- 6) Multiply the weight and rating of each factor
- 7) Add up the IFAS and EFAS scores
- 8) Determined the location of the quadrant based on the sum of IFAS and EFAS
- 9) Developed a SWOT quadrant matrix based on IFAS and EFAS results to formulate appropriate strategies for implementing PjBL

### 3. Result

This research is a follow-up to the implementation of PjBL that was carried out previously. The implementation of PjBL learning in mathematics courses in the Industrial Engineering study program which has been carried out previously is an approach that is in line with the Merdeka Belajar Campus Merdeka policy. The following are the implementation steps that have been taken:

- 1) Identify learning objectives
- 2) Determine the learning objectives to be achieved by integrating PjBL in mathematics courses.
- 3) Selection of Relevant Projects

- 4) Select projects that are relevant to the material and industry context. Examples of such projects are related to production planning, cost analysis, supply chain optimization, or quality management.

#### Team Building

Divide students into collaborative teams that will work together on projects. Each team has members with diverse backgrounds and different mathematical skills.

- 1) Investigation and Plan

Students conduct initial investigations to understand the project challenges and plan the approach they will take. They must also identify relevant mathematical concepts to solve the problem.

- 2) Application of Mathematical Concepts

Students begin to apply mathematical concepts to their projects. They may use formulas, mathematical models, software, or other mathematical tools to analyze data or design solutions.

- 3) Collaboration and Communication

It is important to encourage active collaboration between team members and effective communication. Students must be able to explain their mathematical approach to team members who may not have the same mathematical background.

- 4) Continuous Feedback

Provide ongoing feedback to students throughout the project. This can help them refine their approach and ensure a better understanding of the mathematical concepts they use.

- 5) Presentation of Results

After the project is complete, each team presents the results of their work to the class. This allows students to share their experiences and provides a better understanding of the application of mathematics in an industrial context.

- 6) Evaluation and Assessment

Develop an assessment rubric to evaluate performance. Assessment is not only for the final outcome of the project but also for engagement, teamwork, and understanding of applied mathematical concepts. The assessment rubric used in implementing PjBL is presented in Table 3.1

- 7) Reflection in Learning.

In the final phase, invite students to reflect on their experiences in completing the project. How has this PjBL experience improved their understanding of mathematics and its application in industry? What can be improved in the future?

**Table 3.1** Performance Assessment Rubric using the Project Based Learning Model

Assessment criteria	Score 4 (Very Good)	Score 3 (Good)	Score 2 (Fair)	Score 1 (Poor)
Concept Understanding	Students understand and apply mathematical concepts very well in this project.	Students understand and apply mathematical concepts well in this project.	Students understand most of the relevant mathematical concepts in this project.	Students have limited understanding of the mathematical concepts used in this project.
Mathematical Modeling	Students are able to carefully and creatively model problems using mathematics.	Students can model problems well using mathematics.	Students can model the problem, but with some errors or ambiguities.	Students have difficulty modeling problems using mathematics.
Problem Solving	Students succeeded in identifying effective and relevant solutions to problems in the project.	Students succeeded in identifying good solutions to problems in the project.	Students identify solutions, but there are some shortcomings or not all of them are relevant.	Students have difficulty identifying effective solutions.
Presentation of Results	Students present project results in a clear, structured and interesting manner.	Students present project results quite clearly and structured.	The student presents the results of the project, but with some ambiguity or lack of structure.	Students have difficulty presenting project results clearly.
Team Collaboration	Students collaborate well in teams, contribute actively, and work together with other team members.	Students collaborate well in teams, but there may be some minor conflicts or imbalances in contributions.	Students collaborate in teams, but there are some serious problems in contribution or cooperation.	Students do not collaborate well in teams, and their contributions are limited.
Feedback and Reflection	Students provide in-depth feedback on project experiences and deep reflection on what they have learned.	Students provided good feedback and reflection on the project experience.	Students provide feedback and reflection, but there may be some completeness or depth.	Students provide limited or in-depth feedback and reflection.
Overall Project Quality	The project is of excellent quality, achieving the learning objectives exceptionally well.	The project is of good quality and achieves the learning objectives well.	The project is of sufficient quality and achieves most of the learning objectives.	Projects are of low quality and have difficulty achieving learning objectives.

In its implementation, projects are given to deepen the mathematics material that has been given previously. One example of a project given in the differential material is "Determining Production Optimization in Nearby MSMEs". In this project students will choose one MSME that produces a product. They will work in teams to determine the optimal value of the production process in the MSMEs they choose. They will use calculus concepts, such as differential and function modeling, to determine production efficiency values and determine maximum

profit. In the process, students can work outside of class in several meetings. This project provides an opportunity for students to apply differential concepts in a real-world industrial context. They will also develop analytical, problem-solving and communication skills that are invaluable in an industrial work environment.

Even though learning has been designed as well as possible, during the implementation of PjBL there were several obstacles, namely:

- 1) Limited types of projects related to mathematics and industrial fields.
- 2) At the beginning, students are still very confused and must receive intense guidance.
- 3) Not all students on the team play an active role
- 4) Evaluation based on individual performance cannot yet be implemented optimally
- To ensure the successful implementation of PjBL, the essential elements of PjBL must be contained in it. These elements are listed in Table 3.2

**Table 3.2.** Essential PjBL Feature

Essential PjBL Feature	Characteristics of PjBL Features
Driving Question	<ul style="list-style-type: none"> <li>• Feasibility: developmentally appropriate, room for students to plan and conduct own investigations</li> <li>• Worthwhile: reflects work of scientists, connects to standards and across NGSS dimensions (i.e., disciplinary core ideas, crosscutting concepts, sci- ence and engineering practices)</li> <li>• Contextualized: anchored in real world issues and consequences • Meaningful: phenomena are meaningful and important to learners; con- nects to learners’ everyday lives, reality, and culture</li> <li>• Ethical: Answering the question will not harm organisms or environ- ments</li> <li>• Sustainable: allows for pursuit of questions over time and in great detail</li> </ul>
Scientific Investigation I	<ul style="list-style-type: none"> <li>• engage with phenomena and explore ideas</li> <li>• hypothesize about phenomena</li> <li>• make predictions about investigation results</li> <li>• find information to guide planning and conducting investigations</li> <li>• design investigation procedures</li> <li>• carry out and refine procedures</li> <li>• develop and revise models based on evidence</li> <li>• develop and revise explanations based on evidence and reasoning</li> </ul>
Scientific Investigation II	<ul style="list-style-type: none"> <li>• transform and analyze data</li> <li>• make claims based upon evidence and reasoning</li> <li>• develop scientific explanations using claims, evidence, and reasoning</li> <li>• share ideas with others</li> <li>• move to the next round of investigation based on things they have learned</li> <li>• link explanations with science concepts</li> </ul>
Technology Incorporation	<ul style="list-style-type: none"> <li>• use of technology extends the boundaries of the classroom (experiences outside of school).</li> <li>• use of technology helps students enhance their understanding of com- plex, abstract ideas.</li> <li>• technology enables students to explore phenomena inaccessible by other means.</li> </ul>
Collaborative Opportunities	<ul style="list-style-type: none"> <li>• students to generate ideas, questions, conjectures</li> <li>• intellectual rigor, constructive criticism, challenging of ideas</li> <li>• sharing diverse viewpoints</li> <li>• student collaborations with more knowledgeable community members (e.g., scientists, industry professionals, etc.)</li> </ul>
Assessment Techniques	<ul style="list-style-type: none"> <li>• measure learning performance expectations.</li> <li>• includes final products that are tangible and represent a response to the driving question.</li> </ul>

Source : ( [Krajcik & CzerniakCharlene, 2018](#))

Based on the results of observations and interviews, internal and external strategic factors were formulated which were categorized into strengths, weaknesses, opportunities and threats. The following are some of the advantages of implementing the Project Based Learning model in the Industrial Engineering Study Program at Mahendradatta University:

- 1) Lecture Commitment
- 2) Development of 21<sup>st</sup> century skills
- 3) Active learning experiences
- 4) High motivation and involvement
- 5) Institutional Policies and Support

Although the Project Based Learning (PjBL) model has many advantages, there are also some drawbacks that need attention:

- 1) Time required
- 2) Difficulty in assessment
- 3) Group management
- 4) Lack of material coverage
- 5) Instructor preparation and skills

The implementation of the Project Based Learning (PjBL) model can be carried out in various contexts and levels of education. Following are some of the opportunities for PjBL implementation:

- 1) By applying the PjBL model, higher education levels can better prepare students to face the demands of an increasingly complex and changing world of work.
- 2) The PjBL model can enhance the reputation of universities in producing graduates who are competent and ready to work.
- 3) PjBL can build cooperation between universities and industry and the community, through relevant collaborative projects.

- 4) PjBL can also be adopted in professional training and development to improve the skills and understanding of practitioners in certain industries or sectors.
- 5) PjBL can also be implemented in an online learning environment so that students can work together on virtual projects, communicate effectively, and apply their knowledge in a digital environment.

Even though the Project Based Learning (PjBL) Model has many benefits, there are a number of threats that need attention:

- 1) Curriculum Imbalance
- 2) Lack of Focus on Concepts and Theories
- 3) Reliance on Unprepared Teachers
- 4) Limited Types of Projects
- 5) Challenges in Evaluation
- 6) Limited Resources
- 7) Collaboration and Communication Challenges

From the strategic factors that have been obtained, namely the strategic factors of strengths, weaknesses, opportunities and threats, then the amount of weight and rating is determined based on the results of the questionnaire filled in by the respondent. The weight value ranges from 0 (not important) to 1 (very important) and the rating value is on a scale of 10 (very strong) to 1 (weak). The weight value and rating value are then determined from the average value of each strategy factor. Then the weight and rating values are multiplied to get the score for each strategy factor. The scores for each strategy factor are then added up and this value is the basis for determining the quadrant position in determining the right conditions and strategy. The following IFAS and EFAS analysis calculations are presented in table 3.3 and table 3.4.

**Table 3.3.** IFAS Analysis Table

NO	INTERNAL STRATEGIC FACTORS (IFAS) STRENGHT	WEIGHT	SCALE	SCORE
1.	Lecture commitment	0.11	8.5	0.935
2.	Development of 21st century skills	0.12	7.6	0.912
3.	Active learning experience	0.12	7.2	0.864
4.	High motivation and engagement	0.08	6.5	0.52
5.	Institutional Policies and Support	0.1	5.3	0.53
<b>TOTAL STRENGHT</b>				<b>3.761</b>
<b>WEAKNESS (KELEMAHAN)</b>				
1.	Time required	0.1	2.3	0.23
2.	Difficulty in assessment	0.11	2.2	0.242
3.	Group management	0.08	3.5	0.28
4.	Lack of material coverage	0.07	3.4	0.238
5.	Instructor preparation and skills	0.11	2.6	0.286
<b>TOTAL WEAKNESS</b>				<b>1.276</b>
<b>VALUE OF X (S-W)</b>				<b>2.485</b>
<b>TOTAL IFAS</b>				<b>5.037</b>

From the IFAS calculation results, the total value between strengths and weaknesses is 5.037. This value will determine the quadrant which is a description of current conditions and the appropriate strategy based

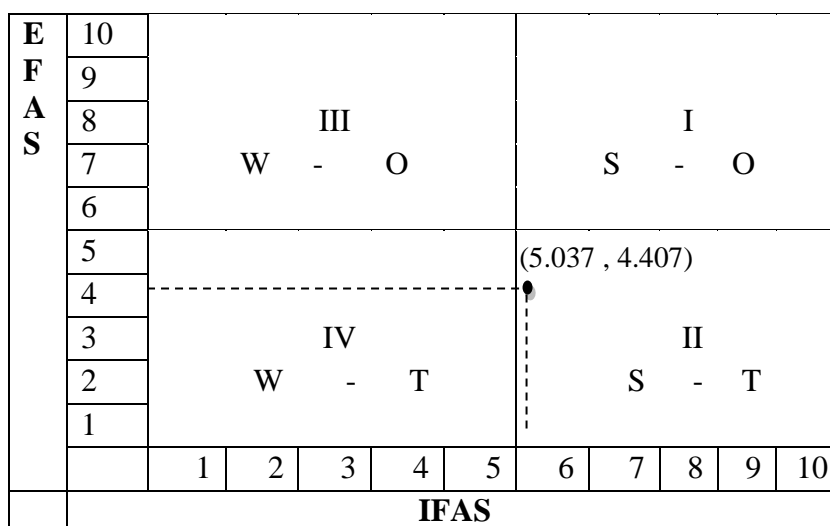
on these conditions. Based on this value, seen on a scale of 0-10, it can be concluded that the strength factor is still superior to the weakness factor.

**Table 3.4** EFAS Analysis Table

NO	EXTERNAL STRATEGIC FACTORS (EFAS)	WEIGHT	SCALE	SCORE
<b>OPPORTUNITIES</b>				
1.	By implementing the PjBL model, higher education levels can better prepare students to face the demands of an increasingly complex and changing world of work.	0.11	7.7	0.847
2.	The PjBL model can enhance the reputation of tertiary institutions in producing graduates who are competent and ready to work.	0.11	7	0.77
3.	PjBL can build cooperation between universities and industry and the community, through relevant collaborative projects.	0.12	6.8	0.816
4.	PjBL can also be adopted in professional training and development to increase the skills and understanding of practitioners in certain industries or sectors.	0.08	6.3	0.504
5.	PjBL can also be implemented in an online learning environment so that students can work together on virtual projects, communicate effectively, and apply their knowledge in a digital environment.	0.1	4.8	0.48
<b>TOTAL OPPORTUNITIES</b>				<b>3.417</b>
<b>THREATS</b>				
1.	Lack of Focus on Concepts and Theory	0.09	2.3	0.207
2.	Limited Types of Projects	0.11	1.9	0.209
3.	Challenges in Evaluation	0.08	1.7	0.136
4.	Resource Limitations	0.11	1.8	0.198
5.	Curriculum Imbalance	0.08	3	0.24
<b>TOTAL THREATS</b>				<b>0.99</b>
<b>NILAI Y (O-T)</b>				<b>2.427</b>
<b>TOTAL EFAS</b>				<b>4.407</b>

From the EFAS calculation results, the total value between strengths and weaknesses is 4.407. This value will determine the quadrant which is a description of current conditions and the appropriate strategy based on these conditions. Based on this value, seen on a scale of 0-10, it can be concluded that the threat factor

is still superior to the opportunity factor. Based on the results of IFAS and EFAS calculations, IFAS = 5.037 and EFAS = 4.407. These values are then represented in the SWOT Quadrant Matrix according to the following figure.



**Figure 3.1.** SWOT Quadrant Matrix

The results of the IFAS and EFAS analysis are then represented in the SWOT matrix quadrants. Based on this value, the IFAS and EFAS intersection points are in quadrant II, so the strategy that fits these conditions is the S-T strategy. This condition illustrates that despite facing various threats, the implementation of this PjBL still has internal strength. The strategy that must be implemented is to use strength to take advantage of long-term opportunities by way of a

diversification strategy. One strategy that can be implemented is strategy diversification by looking for new opportunities that have not been touched before.

Based on the results of PjBL implementation and analysis results of IFAS and EFAS analysis, an appropriate strategy is then determined using the SWOT analysis matrix. The SWOT analysis matrix is presented in the following table.

**Table 3.5** SWOT Analysis Matrix

<b>IFAS</b>	<b>Strength</b> a. Lecture commitment b. Development of 21st century skills c. Active learning experience d. High motivation and engagement e. Institutional Policies and Support	<b>Weakness</b> a. Time required b. Difficulty in assessment c. Group management d. Lack of material coverage e. Instructor preparation and skills
<b>EFAS</b>	<b>Strategy SO :</b> 1. Collaborate with several instructors, especially teachers in mathematics subjects to comprehensively design PjBL learning activities in class. 2. Collaborate with partners outside the university to maximize student experience in PjBL implementation by providing problems/projects that they have to work on in the field. 3. Improve the quality of the project used to gain a more complex understanding	<b>Strategy WO</b> 1. Inviting PjBL experts to provide education in preparing PjBL learning tools and their learning activities. 2. Allocating PjBL implementation time in stages and educating and motivating students regarding project-based learning activities. 3. Develop Assessment and Evaluation Tools which consist of process and outcome assessments so that the assessments carried out are truly able to measure student abilities.
<b>Opportunity</b> a. By implementing the PjBL model, higher education levels can better prepare students to face the demands of an increasingly complex and changing world of work. b. The PjBL model can enhance the reputation of tertiary institutions in producing graduates who are competent and ready to work. c. PjBL can build cooperation between universities and industry and the community, through relevant collaborative projects. d. PjBL can also be adopted in professional training and development to increase the skills and understanding of practitioners in certain industries or sectors.		

<p>e. PjBL can also be implemented in an online learning environment so that students can work together on virtual projects, communicate effectively, and apply their knowledge in a digital environment.</p>		
<p>Threats</p> <ol style="list-style-type: none"> <li>Lack of Focus on Concepts and Theory</li> <li>Limited Types of Projects</li> <li>Challenges in Evaluation</li> <li>Resource Limitations</li> <li>Curriculum Imbalance</li> </ol>	<p>Strategy ST :</p> <ol style="list-style-type: none"> <li>Create PjBL Implementation Guidelines and PjBL-based teaching modules that are in accordance with the current curriculum.</li> <li>Choose projects that are relevant and challenging: Choose projects that have direct relevance to the student's field of study and challenge them to apply the knowledge and skills they have learned. These projects should encourage problem solving, collaboration and critical thinking.</li> <li>Form effective study teams: Organize students into effective study teams to work together on projects. Ensure that the team has members with diverse skills and promote harmonious teamwork.</li> <li>Provide support and guidance: Provide adequate support and guidance to students during the PjBL process. Lecturers and facilitators must be available to assist students in overcoming challenges and directing them towards achieving project goals.</li> <li>Integration with the curriculum: Integrate PjBL into the overall curriculum. Ensure that these projects support and complement the material taught in class, so that students can relate their learning to a wider context.</li> <li>Comprehensive performance-based evaluation : Use performance-based evaluation methods to assess student progress and achievement in PjBL. Focus on understanding and applying knowledge, skills, and teamwork, not just on written tests.</li> <li>Collaboration with industry or community: Collaborating with industry or local communities to develop quality PjBL projects</li> </ol>	<p>Strategy WT :</p> <ol style="list-style-type: none"> <li>Conduct workshops on PjBL regularly so that all teachers have a complete understanding.</li> <li>Design PjBL-based learning activities that are able to provide real experiences and benefits for students so that they will be motivated.</li> <li>Conduct regular evaluations, so that the weaknesses and shortcomings of each process can be corrected to make it perfect.</li> </ol>

Based on Figure 3.1, the intersection point of IFAS and EFAS is in quadrant II, so the strategy that suits these conditions is the S-T strategy. From the results of the SWOT analysis matrix with a combination of strength and threat factors, several strategies are obtained, namely:

- 1) Create PjBL Implementation Guidelines and PjBL-based teaching modules that are in accordance with the current curriculum.
- 2) Choose projects that are relevant and challenging
- 3) Form an effective learning team

- 4) Provide support and guidance
- 5) Integration with the curriculum
- 6) Comprehensive performance-based evaluation
- 7) Collaboration with industry or community

#### 4. Discussion

The successful implementation of the learning model is an important challenge in improving the quality of education in this modern era. An effective learning model not only includes knowledge transfer, but also encourages the development of students'

critical, creative and social skills. In an effort to achieve this goal, a holistic and integrated approach to various aspects of learning is the main key. Many factors influence the success of implementing a learning model, both internal and external factors. The PjBL model is recommended as an effort to improve learning outcomes in higher education. The PjBL model provides input and follow up to improve students' soft skills and hard skills (Nasution et al., 2022).

The learning model that provides scope to support communication, collaboration and cooperation skills is project-based learning (PjBL) (Eriza & Hadi, 2023). Based on this, it can be seen that the PjBL model has a positive effect on learning ability, but apart from this positive impact in the implementation of PjBL there are several things that are of concern. The success factors for implementing PjBL are not only implementation in the classroom, but preparation of teaching materials, institutional support, readiness of human resources, implementation and evaluation techniques are factors that also influence the success of implementing PjBL.

#### 4.1 Identify Strategy Factors in Implementing the Project Based Learning Model

In the context of Higher Education, Project Based Learning (PjBL) is a learning approach that involves students in real projects that require problem solving, collaboration, and application of knowledge in relevant contexts. The Project Based Learning (PjBL) model or project-based learning can be used in learning to overcome student boredom in the learning atmosphere in the classroom, so that students can feel a different atmosphere and can learn directly through the environment around them (Nusa, 2021).

To maximize the implementation of PjBL, there are several factors that influence both internally and externally. The following is an explanation of the strengths in implementing PjBL.

##### 1) Lecture Commitment

With the Merdeka Belajar Kampus Merdeka Policy, teachers in the Industrial Engineering Study Program are able to design innovative learning and provide students with real experience in implementing the theories they have gained in solving problems.

##### 2) Development of 21st century skills

PjBL helps students acquire the skills necessary to succeed in the real world. Students learn to collaborate, communicate effectively, think critically, solve problems, manage time, and take initiative during these projects (Zakiah et al., 2020). In addition, they improve their abilities in presentation and complex problem solving, which are highly valuable skills in the modern work environment.

##### 3) Active learning experiences

Students are the core of the PjBL learning process. They are involved in their own projects by investigating, planning and executing them. In this process, various resources are used, such as research, interviews, experiments, and data collection. Through direct experience, students become active learners and are responsible for their learning processes and outcomes. Students also felt that PjBL encouraged their collaboration and negotiations within the group (Guo et al., 2020).

##### 4) High motivation and involvement

Students have an intrinsic desire to learn more when they are involved in projects that are relevant to the real world (Pradanti & Muqtada, 2023). Involvement in this project makes them more involved in the learning process because they see the practical value of their lessons. In addition, PjBL gives students the opportunity to explore and discover independently, which can increase their interest in a particular field of study.

##### 5) Institutional Policies and Support

With the Independent Merdeka Belajar Kampus Merdeka Policy, the institution provides support for teachers who innovate in learning. Meaningful learning will of course have an impact on achieving the predetermined learning outcomes of graduates.

According to Lesmana et al. (2015) PjBL's orientation is more towards inquiry-based learning opportunities, namely structured experiences based on the belief that learning occurs when individuals are asked to investigate the problem (Lesmana et al., 2015). Although the Project Based Learning (PjBL) model has many advantages, there are also some drawbacks that need attention:

##### 1) Time required

PjBL takes longer to complete significant projects. Compared to conventional learning approaches, the process of collecting data, investigating, and implementing problem solving requires more time. This can lead to stress on a congested curriculum or reduced time spent on other material that needs to be taught.

##### 2) Difficulty in assessment

PjBL may be more difficult to assess than conventional learning methods. In the evaluation, not only the end result of the project but also the processes carried out by students during the project must be considered. Setting fair and unbiased standards for assessing ability, teamwork, and problem solving can be a challenge for Educators.

### 3) Group management

Management problems can arise because PjBL often involves group work. Among group members, there can be differences in ability, personality, and level of motivation. This can make it difficult to maintain a good work balance. Overall project results may be affected by conflicts among people or lack of participation of some group members.

### 4) Lack of material coverage

In PjBL, the main focus is on specific projects carried out by students. This can cause some important topics or concepts to be missed because the material is limited. Teachers must ensure that learning through projects remains linked to the established curriculum.

### 5) Instructor preparation and skills

Instructor specific skills are required to implement PjBL successfully. Teachers must select appropriate projects, establish clear guidelines, provide adequate support, and manage and direct group discussions. They should also provide constructive feedback to students.

The implementation of the Project Based Learning (PjBL) model can be carried out in various contexts and levels of education. Following are some of the opportunities for PjBL implementation:

- 1) By applying the PjBL model, higher education levels can better prepare students to face the demands of an increasingly complex and changing world of work.
- 2) The PjBL model can enhance the reputation of universities in producing graduates who are competent and ready to work.
- 3) PjBL can build cooperation between universities and industry and the community, through relevant collaborative projects.
- 4) PjBL can also be adopted in professional training and development to improve the skills and understanding of practitioners in certain industries or sectors.
- 5) PjBL can also be implemented in an online learning environment so that students can work together on virtual projects, communicate effectively, and apply their knowledge in a digital environment.

Even though the Project Based Learning (PjBL) Model has many benefits, there are a number of threats that need attention:

#### 1) Curriculum Imbalance

Excessive implementation of PjBL can result in an imbalance in the curriculum. If projects become dominant in learning methods, then the core and basic material of the curriculum can be forgotten. It is

important to strike a balance between PjBL projects and more traditional conceptual learning.

#### 2) Lack of Focus on Concepts and Theories

In PjBL, there is a risk that students may be too focused on projects and practical experiences, thus neglecting to understand the underlying concepts and theories. PjBL must continue to ensure that students acquire the necessary basic knowledge and are able to relate it to the project they are working on.

#### 3) Reliance on Unprepared Teachers

Effective PjBL implementation requires professional preparation and development for the Instructor. However, if the teacher is not well prepared in designing and implementing PjBL projects, then student learning can be disrupted. Teachers need to get adequate support and training to properly implement PjBL.

#### 4) Limited Types of Projects

If the projects given to students are not well designed or less relevant, then the resulting learning may not be effective. It is important to ensure that the project has clear learning objectives, is adequately challenged, and can spark critical thinking and student collaboration.

#### 5) Challenges in Evaluation

Assessment in PjBL can be complex and subjective. If there are no clear assessment guidelines or effective assessment instruments, the evaluation of students' skills and understanding can be inconsistent. It is important to develop valid and reliable assessment methods to measure student achievement in PjBL.

#### 6) Limited Resources

PjBL projects that require abundant resources such as special equipment, advanced technology, or access to employment can become obstacles in implementation. Resource constraints can affect a student's ability to carry out projects effectively or access relevant hands-on experience.

#### 7) Collaboration and Communication Challenges

PjBL projects that involve group work can present challenges in collaboration and communication between students. Differences in abilities, personalities, or roles within a group can affect team effectiveness and project outcomes.

In the implementation of Project Based Learning (PjBL), IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) are strategic analysis tools that help educational institutions or teachers to evaluate internal and external factors that influence the success of the PjBL approach. IFAS is used to analyze internal factors such as teacher commitment, student skills development, active learning experiences, motivation, and institutional

support (Guo et al., 2020). This helps in identifying internal strengths and weaknesses that can support or hinder PjBL implementation. Meanwhile, EFAS is used to analyze external factors such as policy support, relationships with industry, environmental challenges, and changes in educational approaches. This helps in identifying external opportunities and threats that may impact the success of PjBL.

The combination of IFAS and EFAS provides a comprehensive understanding of the factors that influence the success of PjBL implementation (Condliffe et al., 2017). With this information, educational institutions or teachers can identify the strategic steps needed to maximize the benefits of PjBL and overcome obstacles that may arise in the process.

#### 4.2 Strategy for Implementing the Project Based Learning Model

The project-based learning model (Project based learning) is a learning model that uses the project as the core of learning. PjBL can be described as an inquiry-based collaborative teaching method that encourages integration, application, and construction of knowledge (Guo et al., 2020). PjBL utilizes problem-based learning situations in the real world to develop students' skills. and also learner-centered and collaborative learning (Na et al., 2023). The main keys to project-based learning are student involvement, authentic problems, scaffolding, collaborative learning, and product creation (Condliffe et al., 2017). In this activity, students explore, assess, interpret, and synthesize information to obtain various learning outcomes such as knowledge, skills and attitudes (Wahyuni, 2019).

Project-based learning is an in-depth investigation of a real-world topic, it will be valuable for students' attention and effort. Given that each student has a different learning style, project-based learning provides opportunities for students to explore content (material) using various ways that are meaningful to them, and conduct experiments collaboratively (Wahyuni, 2019). The PjBL model is recommended as an effort to improve learning outcomes in tertiary institutions. The PjBL model provides input and follow-up to improve students' soft skills and hard skills (Nasution et al., 2022).

In general, the learning steps using the Project Based Learning model can be explained as follows:

- 1) Project Determination
- 2) Design of Project Completion Steps
- 3) Preparation of the Project Implementation Schedule
- 4) Completion of Projects with Facilitation and Monitoring
- 5) Preparation of reports and publication presentations

- 6) Evaluation of project processes and outcomes (Hosnan, 2014)

PjBL learning is said to be a learning method that focuses on the process of achieving project completion which can encourage students to actively participate in the writing and information gathering stages (Eriza & Hadi, 2023). In this model, the value of togetherness in finding a solution to a problem can be resolved. So, students can produce a product and also a kind of design that can obtain added value and show that mathematics learning is not only based on grades (Eriza & Hadi, 2023). Project Based Learning emphasizes three pillars, namely contextual, collaborative and learner autonomy (Puspasari, 2018). Learner autonomy implies the concept of independent learning, which in this research emphasizes independence in completing projects. Furthermore, collaborative is emphasized on synergistic cooperation between group members in achieving goals. Students carry out contextual learning by going directly into the industrial sector to search for data and complete projects. The six key aspects of Project Based Learning include driving questions containing problems, focus on learning objectives, participation in educational activities, collaboration between students, use of scaffolding technology, and creation of tangible artifacts (Krajcik & Shin, 2014).

From the results of research conducted by Sumarna and Rushiana, it is stated that implementing PjBL by adopting six learning steps consisting of determining basic questions, designing project plans, preparing schedules, monitoring project activities, testing results, and evaluating experiences can improve students' critical thinking abilities (Sumarna & Rushiana, 2023). Assessment of project-based learning outcomes is one of the important points that determines success. In fact, the main method of assessing project-based learning outcomes is through evaluation of project learning products (Barak, 2005). Evaluation of the finished product only looks at the results, this ignores the role of project members, implementation progress, and other important information. It is important to assess procedures and make modifications to effectively monitor and evaluate progress (Helle et al., 2006). Portfolios have been proposed as an alternative assessment tool in project-based learning, because they can provide a more comprehensive and authentic representation of student learning outcomes (Jaeger & Adair, 2015). Utilizing technology can also help in evaluation systems using portfolios. Mobile e-portfolios on the Google Sites Platform can be an effective tool for enhancing project-based learning (Anh & Truong, 2023).

Students' perspectives on learning readiness, interests, their profile in learning, students' perspectives on learning, motivation and their performance are indicators of the effectiveness of learning (Trisnowati & Ismawati, 2018). By providing students with the opportunity to take ownership of their

learning, project-based learning fosters intrinsic motivation, enthusiasm, and high levels of engagement, all of which contribute to improved learning outcomes (Na et al., 2023). From the research results, PjBL has a positive impact on student learning experiences, motivation and performance. Thus, the implementation of PjBL can be developed in more depth (Pradanti & Muqtada, 2023).

Based on the SWOT analysis matrix above, the strategies that can be implemented to maximize the implementation of the PjBL model in mathematics subjects are:

- 1) Create PjBL Implementation Guidelines and PjBL-based teaching modules that are in accordance with the current curriculum.
- 2) Choose projects that are relevant and challenging: Choose projects that have direct relevance to the student's field of study and challenge them to apply the knowledge and skills they have learned. These projects should encourage problem solving, collaboration and critical thinking (Condliffe et al., 2017).
- 3) Form effective study teams: Organize students into effective study teams to work together on projects. Ensure that the team has members with diverse skills and promote harmonious teamwork (Helle et al., 2006).
- 4) Provide support and guidance: Provide adequate support and guidance to students during the PjBL process. Lecturers and facilitators must be available to assist students in overcoming challenges and directing them towards achieving project goals.
- 5) Integration with the curriculum: Integrate PjBL into the overall curriculum. Ensure that these projects support and complement the material taught in class, so that students can relate their learning to a wider context (Eriza & Hadi, 2023).
- 6) Comprehensive performance-based evaluation: Use performance-based evaluation methods to assess student progress and achievement in PjBL. Focus on understanding and applying knowledge, skills, and teamwork, not just on written tests. To assess individual performance, it can be combined with the self-assessment method. Apart from that, an alternative that can be used as an assessment of individual performance is a portfolio (Jaeger & Adair, 2015). Portfolios have been proposed as an alternative assessment tool in project-based learning, because they can provide a more comprehensive and authentic representation of student learning outcomes (Jaeger & Adair, 2015).
- 7) Collaboration with industry or community: Collaborating with industry or local communities to develop quality PjBL projects.

Even though the implementation strategy has been formulated based on internal and external factors, insynchronization between input, process and results will definitely occur. As a result, PjBL has been proven to be able to improve students' learning abilities, however, to maximize the implementation of PjBL, related factors must also support each other. The resulting lack of synchronization can hamper the effectiveness of PjBL and make it difficult for students and teachers to achieve the desired learning outcomes. Therefore, it is important to overcome this asynchrony in ways such as:

- 1) Provide adequate training and support to teachers to develop the skills required in PjBL.
- 2) Communicate policy changes clearly to all educational staff to ensure consistent understanding.
- 3) Adapt evaluation and assessment processes to reflect the PjBL approach, perhaps with the development of appropriate assessment instruments.

By overcoming this asymmetry, the implementation of PjBL can run effectively and produce more meaningful learning for students. The formulation of this strategy can be an alternative for educational institutions or teachers in implementing a learning innovation by considering factors such as strengths, weaknesses, opportunities and threats.

## 5. Conclusion

Project Based Learning (PjBL) is a learning approach that involves students in real projects that require problem solving, collaboration, and application of knowledge in relevant contexts. Based on the results of IFAS and EFAS calculations,  $IFAS = 5.037$  and  $EFAS = 4.407$ . Based on this value, the IFAS and EFAS intersection points are in quadrant II, so the strategy that fits these conditions is the S-T strategy. This condition illustrates that despite facing various threats, the implementation of this PjBL still has internal strength. The strategy that must be implemented is to use strength to take advantage of long-term opportunities by way of a diversification strategy. In the implementation of Project Based Learning (PjBL), IFAS (Internal Factor Analysis Summary) and EFAS (External Factor Analysis Summary) are strategic analysis tools that help educational institutions or teachers to evaluate internal and external factors that influence the success of the PjBL approach. The combination of IFAS, EFAS and SWOT analysis results provides a comprehensive understanding of the factors that influence the success of PjBL implementation. With this information, educational institutions or teachers can identify the strategic steps needed to maximize the benefits of PjBL and overcome obstacles that may arise in the process.

Based on the conclusions above, several suggestions for implementing project based learning (PjBL) to achieve maximum results include active and consistent involvement of the entire teaching team, provision of adequate resources by the institution, adequate support for students, and the use of evaluation tools such as individual portfolios or self-assessment. By paying attention to these suggestions, it is hoped that the implementation of PjBL in higher education can be effective in helping students develop skills and knowledge that are in-depth and can be implemented sustainably.

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