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Implementation of Project-Based Mathematics Learning in the Industrial Work Practice Program (PraKerIn) for Pancaran Berkat Vocational School Students

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ABSTRACT

Objective: *This study aims to analyze the implementation of project-based mathematics learning in Industrial Work Practice (Prakerin) programs at SMK Pancaran Berkat.* ***Method:*** *This qualitative descriptive study employed observations, interviews, and documentation of students and teachers during the internship.* ***Results:*** *The integration of mathematics in Prakerin through project-based learning improved students' problem-solving abilities, collaboration, and motivation. They also better understood the relevance of mathematical concepts in industrial contexts such as measurement, statistics, and cost calculation.* ***Novelty:*** *This study highlights how contextual project-based mathematics learning can serve as an interdisciplinary bridge between school-based theory and real-world industrial practice.*

INTRODUCTION

Vocational education at the Vocational High School (SMK) level has a strategic role in producing competent human resources who are ready to compete in the world of work. One of the key components in the vocational school curriculum is the Industrial Work Practice Program (PraKerIn), which is designed to narrow the gap between theoretical learning in schools and its application in an industrial environment. Through PraKerIn, students are expected to be able to develop technical, social, and managerial competencies that are in line with their fields of expertise [1].

Implementation of Project-Based Mathematics Learning in the Industrial Work Practice Program (PraKerIn) of SMK Pancaran Berkat Students However, in mathematics learning at SMK, there are still obstacles in connecting abstract concepts with their application in a real context. This obstacle often decreases learning motivation and hinders a deep understanding of the material. In fact, mathematics is a fundamental component in various fields of expertise, such as technology, business, management, and information. Good mathematical skills not only support the mastery of vocational competence, but also strengthen the ability to think logically, analytically, and solve problems that are needed in the professional world [2], [3]. Project-Based Learning (PBL) is seen as a relevant pedagogical approach to addressing these challenges. Through PBL, students are actively involved in authentic investigation and problem-solving structured in the form of projects. This approach not only allows for a contextual understanding of mathematical concepts, but also encourages the development of 21st-century skills, such as collaboration, communication, creativity, and critical thinking [4].

SMK Pancaran Berkat as one of the vocational education institutions has integrated the PraKerIn program into its curriculum. However, the implementation of mathematics learning in the context of PraKerIn still requires further study to optimize the linkage between mathematics materials taught in schools and practical needs in the industrial world. Therefore, this study aims to explore the application of the Project-Based Mathematics Learning model in the context of Industrial Work Practices at SMK Pancaran Berkat. The findings of this study are expected to make a theoretical and practical contribution in improving the quality of mathematics learning in vocational schools, especially those integrated with the world of work experience.

Figure 1. Jason (XI AKL) made a bookkeeping for the receipt of goods entering the Amaris hotel.

Figure 2. Jonathan (XI AKL) creates and audits the financial data of PT Sukses Meg Abadi.

RESEARCH METHOD

In this study, a qualitative approach with descriptive elements is used. A qualitative approach was chosen to deeply understand how the implementation of Project-Based Mathematics Learning (PBL) takes place in the context of the Industrial Work Practice (PraKerIn) program at SMK Pancaran Berkat, as well as to explore students' experiences and perceptions regarding the implementation [5]. Descriptive elements are used to

describe systematically and factually the planning, implementation, challenges, and perceptions of students towards the implementation of PBL in PraKerIn.

The research design used is a case study. The case study was chosen because it allows researchers to conduct an in-depth exploration of the phenomenon of PBL implementation in the program. PreKerIn in a specific context, namely at SMK Pancaran Berkat. This research will focus on the experiences and perspectives of students who have participated in the PraKerIn program that integrates PBL in mathematics learning [6].

This qualitative descriptive approach aims to study and clarify the existence of a phenomenon that occurs in society. A phenomenon or reality in society that reveals that with the existence of a qualitative descriptive method it can be used as a procedure to solve the problem being researched. The problems being investigated are based on existing and visible facts in society [7]. Meanwhile, according to [8], the research will collect the data obtained and then interpreted in collecting data that is appropriate and can support the success of this research, so the author uses the following methods:

1. **Transcription:** The recorded interview data will be transcribed into text form.
2. **Data Reduction:** The data that has been collected will be reduced by selecting, focusing, simplifying, and abstracting information that is relevant to the research question.
3. **Triangulation:** To increase the validity and reliability of the data, triangulation will be carried out by comparing and confirming findings from various data sources (interviews, observations, and documentation) as well as from various research subjects.
4. **Data Presentation:** The results of the data analysis will be presented in the form of a narrative descriptive, which is complemented by direct excerpts from interviews or field notes to support the research findings.

RESULTS AND DISCUSSION

Results

According to the research that has been carried out by associating it with the theoretical foundation and relevant previous research. The discussion will answer the formulation of the research problem and provide a more in-depth interpretation of the findings obtained.

1. Integration of PBL in PreKerIn: The findings of this study show that the application of the Project-Based Learning (PBL) approach in Industrial Work Practice (PraKerIn) activities at SMK Pancaran Berkat has been aligned with the basic characteristics of effective PBL. Students are actively involved in completing projects that are authentic and relevant to the world of work, while encouraging collaboration, critical thinking, and independent problem-solving. This is in line with the opinion [9], which emphasizes that PBL is designed to encourage student engagement in meaningful and contextual learning experiences.

2. Supporting and Inhibiting Factors: The success of PBL implementation in the context of PreKerIn is influenced by various supporting and inhibiting factors. The supporting factors identified include the active involvement of the supervisor, the availability of projects that are contextual and relevant to student competencies, and the existence of flexibility in the curriculum that allows the integration of the PBL approach. On the other hand, the main challenges faced include limited implementation time, the unpreparedness of some industry supervisors in understanding the PBL approach, and differences in the level of readiness and motivation of students.

3. The Effectiveness of PBL in Improving Mathematics Comprehension and Application: From the perspective of students, the integration of PBL in PreKerIn activities has a positive impact on improving the understanding and application of mathematics in a real context. Projects involving calculation, measurement, data analysis, and cost estimation provide students with the opportunity to apply mathematical concepts in real-life work situations. This supports the findings [10], [11], [12], [13], which state that a project-based learning approach can increase the linkage between academic materials and the needs of the world of work.

4. Example of Discussion (Illustrative): As an illustration, one of the student groups from the Accounting and Finance Institution expertise competency carried out a cash flow analysis project of micro business industrial partners where they implemented PraKerIn. In this project, students are tasked with compiling monthly cash flow reports, analyzing expenditure efficiency, and providing simple recommendations for more optimal cash management. This process demands the direct application of financial mathematical concepts, such as calculating liquidity ratios, estimating cash balances, and interpreting cash inflows and outflows trends.

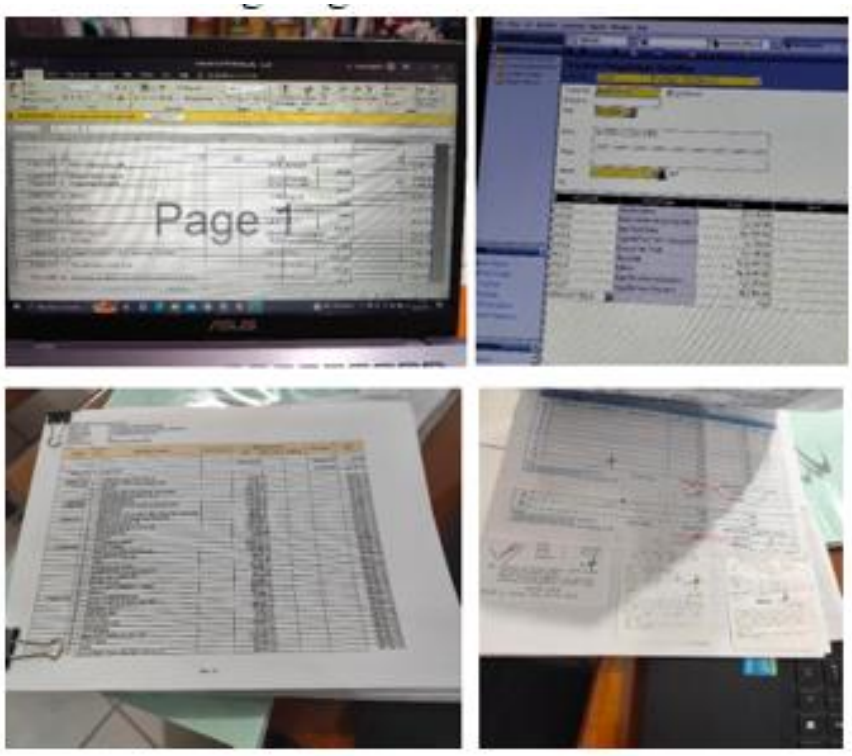

Figure 3. Report Workflow data during PreKerIn.

Discussion

In the context of vocational education, this integration contributes significantly to the achievement of PraKerIn's goal, which is to connect theoretical learning in schools with professional practice in the field. Through PBL, students not only participate in industrial activities, but are also required to complete project-based tasks that demand the direct application of technical and academic competencies.

These findings reinforce the results of the study [14], [15], which emphasizes the importance of cross-sector collaboration as well as training for industry stakeholders in understanding their role in project-based learning. The gap between the world of education and the industrial world, if not addressed with a systemic approach, can hinder the effectiveness of PBL implementation in the context of vocational schools.

Furthermore, the learning experiences that students experience during the project not only improve conceptual understanding, but also essential 21st-century skills such as communication, teamwork, and reflective and adaptive thinking skills. Thus, PBL not only functions as a pedagogical method, but also as a strategy for developing the overall competency of vocational school students.

This project shows how applied mathematics learning can be contextually integrated in the real world of work, as well as encouraging students to think analytically and systematically. In addition, this activity also increases students' awareness of the importance of accurate recording and analysis of financial data in maintaining the financial health of a business unit.

CONCLUSION

Fundamental Finding : This study aims to examine the implementation of Project-Based Mathematics Learning in the Industrial Work Practice (PraKerIn) program at SMK Pancaran Berkat. The application of the Project-Based Learning (PBL) model in the context of PraKerIn has begun through collaboration between mathematics teachers and vocational teachers in designing projects that suit students' competencies and the characteristics of the industrial world. Variations in project implementation are influenced by the type of partner industry as well as the level of involvement of industry advisors. In general, students show a positive response to the implementation of PBL. They report an increased understanding of mathematical concepts, a higher awareness of the relationship between mathematics and world of work practice, and the strengthening of essential skills such as problem-solving and teamwork. **Implication :** The integration of PBL into the PraKerIn program has the potential to bridge the gap between academic knowledge and vocational application, encouraging collaborative curriculum development among subject and vocational teachers. Student feedback confirms that the method enhances both cognitive and soft skills, underscoring the value of interdisciplinary learning experiences that connect mathematics with real-world industry practices. **Limitation :** The implementation of PBL still faces a number of obstacles, including difficulties in designing a truly integrated project, limited

implementation time in the field, and the absence of a special assessment system that explicitly accommodates the mathematical aspects of the PraKerIn project. These limitations affect the consistency and depth of PBL application across different industrial contexts. **Future Research :** Future research could explore more effective strategies for designing integrated projects that balance vocational and academic content, develop standardized assessment tools tailored to PBL in vocational contexts, and investigate long-term impacts of PBL implementation in PraKerIn on student performance and employability. It would also be beneficial to examine the role of industry advisors in shaping the quality and relevance of student projects.

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