

IMPLEMENTATION PROJECT-BASED LEARNING MODEL ON ELECTRICAL MOTOR INSTALLATION

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Abstrak

Proses pembelajaran di sekolah menengah kejuruan merupakan faktor penentu untuk dapat melahirkan lulusan pendidikan menengah kejuruan yang sesuai dengan kompetensinya. Proses pembelajaran akan menentukan apakah tujuan pembelajaran akan tercapai. Penelitian ini bertujuan untuk mengembangkan perangkat pembelajaran berbasis proyek tentang pemasangan motor listrik. Metode yang digunakan adalah *User Centered Design* dengan data yang diolah bersumber dari guru dan siswa. Hasil implementasi bahan ajar berbasis proyek untuk guru adalah Baik dan siswa adalah Cukup Baik. Perangkat pembelajaran berbasis proyek cukup praktis untuk memudahkan siswa memahami pembelajaran pemasangan motor listrik dengan bimbingan dari guru. Temuan ini menegaskan kegunaan besar model ini dalam memfasilitasi pemahaman yang komprehensif tentang Pemasangan Motor Listrik. Melalui perannya yang signifikan dalam subjek ini, model ini telah berkembang menjadi model referensi yang serba guna. Model ini tidak hanya mudah diterapkan di berbagai domain akademik, tetapi juga secara efektif memperkaya pengalaman belajar siswa di berbagai mata pelajaran. Sebagai hasilnya, model ini menjadi alat yang sangat berharga dalam mendukung proses pembelajaran dan pengajaran yang lebih mendalam dan holistik.

Kata Kunci: Project Based Learning; Instalasi Motor Listrik; User Centerd Design; Sekolah Menengah Kejuruan

Abstract

The learning process in vocational high schools is a determining factor in producing graduates of vocational high schools who are in accordance with their competencies. The learning process will determine whether the learning objectives will be achieved. This study aims to develop a project-based learning device on the installation of electric motors. The method used is User Centered Design with data processed from teachers and students. The results of the implementation of project-based teaching materials for teachers are Good and students are Fairly Good. The project-based learning device is practical enough to make it easier for students to understand the learning of installing electric motors with guidance from teachers. These findings confirm the great usefulness of this model in facilitating a comprehensive understanding of the Installation of Electric Motors. Through its significant role in this subject, this model has developed into a versatile reference model. This model is not only easy to apply in various academic domains, but also effectively enriches students' learning experiences in various subjects. As a result, this model becomes a very valuable tool in supporting a deeper and more holistic learning and teaching process.

Keyword: Project-Based Learning; Electrical Motor Installation; User Centered Design; Vocational High School

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INTRODUCTION

Here Implementing active learning requires the teacher's ability to design and develop learning tools in the form of learning models that can help students and teachers in the learning process (Setiyawami et al., 2019). Teachers can create an active learning environment that involves students collaborating with each other, especially in developing and designing quality products (Puncreobutr, 2016). Collaboration is a key practice for success in 21st century learning (Amin & Mustaqim, 2021).

Recent research by (Wulansari et al., 2022) suggests that individual student differences must be considered in educational settings. To this end, it is recommended that the educational environment be enriched through educational models or methods that enhance students' ability to relate what they have learned to their real life, problem-solving skills and critical thinking (Verawati et al., 2022). Project-based learning is a method that directs students to research and produce and ensures they build their own learning process (Ashfahani et al., 2020). Through project-based learning, there will be a contribution to generating individuals who are aware of their own learning and skills, knowledge structures, and actively participate in the learning process (Aprianto et al., 2023; Khuluq et al., 2023). Cooperative learning also plays an important component of active learning (Aji & Rahayu, 2023; Martín-Blas & Serrano-Fernández, 2009). Many studies show that project-based learning is an effective teaching strategy for increasing student learning motivation and helping students engage in learning activities (Permana & Aulia, 2023); (Risdianto, 2019). Several research results show that project-based learning has the potential to improve student learning outcomes (Almulla, 2020); (Chen & Yang, 2019). In summary, evidence of the potential of the PjBL approach, especially facilitating student learning achievement and motivation is well documented in previous research (Saputri & Ediyono, 2022). Previous research by (Pranjono, 2015) states that one learning strategy for developing skills and increasing competence is project-based learning. This strategy forces students to do reflective thinking which is useful for increasing student competence. In addition, this strategy places more emphasis on writing practical reports under teacher supervision. So, each student can make an academic report at the end of the learning program (Pratitis & Jama, 2020); (Hamdani & Suherman, 2021).

This project-based learning model is very suitable to be implemented in Vocational High Schools (Hartati, 2022). This is because vocational schools have an educational approach that is more practical and oriented towards skills and expertise compared to the theoretical approach that is more dominant in public schools. Practices in vocational schools are usually carried out to give students direct experience in applying the knowledge and skills they learn in class (Habibah et al., 2022). Vocational schools in Indonesia have many skills programs, one of which is the Electrical Power Installation Engineering skills program (Soepriyanto et al., 2023). The Electrical Power Installation Engineering Skills Program is a program designed to equip students with the skills, knowledge and attitudes to be competent in the field of electrical installation. The aim of this program is to prepare students especially to work in the field of electrical installations (Arsyad et al., 2016). In this skills program, there are several subjects that must be mastered, one of which is electric motor installation. This course is designed to give students a comprehensive understanding of electric motor installation and operation and prepare them for work in industry. Therefore, it is highly hoped that the use of an appropriate learning model is in accordance with the learning objectives, so that students can have adequate competence in this part of electric motor installation. Therefore, the project-based learning model is very suitable for use in this subject (Hammi et al., 2020).

However, the application of the project-based learning model must be structured or developed according to students' abilities and competencies (Yanti & Novaliyosi, 2023). So that implementation can become easier and learning objectives can be achieved. One model development method that suits student competencies is the User-Centered Design (UCD) method (Firmansyah et al., 2020). a design approach that places the user as the primary focus throughout the entire product or service development process. The UCD method aims to ensure that the product or service produced meets the needs, preferences and expectations of users (Pambudi et al., 2021). The Project-Based Learning (PjBL) model and the User-Centered Design (UCD) method can complement each other in the context of developing Electric Motor Installation subjects. In PjBL, students engage in practical projects that include the application of theoretical concepts in real-world situations (Hartati, 2022). For example, students may be given a project to design, install, and maintain an electric motor system. This project may include aspects of electric motor design, installation, and maintenance. PjBL encourages active learning and allows students to develop practical skills contextually (Purnama et al., 2022).

On the other hand, UCD emphasizes a deep understanding of users. In the context of Electric Motor Installations, the UCD method can be used to design interfaces and controls that suit the needs of operators or technicians working with electric motors (Pratama et al., 2021). This approach ensures that the installation design not only considers technical aspects, but also meets user needs and preferences. By integrating PjBL and UCD in the Electric Motor Installation subject, students will not only gain a strong theoretical understanding, but also practical skills and sensitivity to user needs. Projects implemented in PjBL can be designed with a focus on user needs, and the UCD process can be used in the design and evaluation phases of these projects. This creates a holistic learning experience that includes technical, creative aspects and the use of user-centered design methods.

METHOD

This research is included in descriptive qualitative research where the results of the research are described with data that represents the results of the implementation of project-based learning which has been developed using the user-centered design method on the subject of electric motor installation (A. M. Sibuea et al., 2021; Sugiyono, 2015). The type of data used in implementing project-based learning is primary data, meaning that the data is obtained directly from research subjects that have been validated by experts and are practical (A. Sibuea et al., 2020). This research will be conducted at Vocational High Schools in Indonesia.

Data collection techniques are a vital aspect of the user-centered design model, as they play a crucial role in understanding user needs and validating design decisions (Balasubramanian et al., 2014). In this research, the focus is not only on obtaining information or correcting facts but also on aligning the learning flow design with the needs and preferences of the users. The process of data collection involves various methods, each of which contributes to a comprehensive understanding of user requirements. These techniques, such as Focus Group Discussion (FGD) and the Delphi technique, are chosen strategically to ensure that user perspectives are incorporated into the design process (Swank & Houseknecht, 2019).

In the context of user-centered design, data collection goes beyond mere information gathering; it serves as a means to validate the effectiveness of the learning flow design. Validated instruments are utilized to collect data related to the design's efficacy, ensuring that it meets the intended learning objectives and addresses user needs adequately. By incorporating user feedback and utilizing validated instruments, the design process becomes iterative, allowing for continuous improvement based on user insights. This iterative approach is fundamental to the user-centered

design model, ensuring that the final product resonates with the target audience and delivers a meaningful learning experience

RESULT

Based on the suggestions given by the validator, revisions were made to obtain a project-based learning tool that was practical and suitable for testing as a learning tool in the Electric Motor Installation subject. Practical test data for project-based learning tools in the Electric Motor Installation subject were taken from a questionnaire that was distributed to teachers and students.

Implementation Related to the ease of use of the learning model developed. Implementation data obtained through questionnaires filled with 3 (three) teachers from questionnaire contents can be seen in the implementation of the media. The results of an assessment of the implementation of learning tools are summarized in Table 1.

Table 1. Teacher Response

No	Aspects	Percentage (%)				Category
		T1	T2	T3	Avg	
1	Easy to apply	80	82	81	81	Good
2	Organizations	82	71	77	77	Quite Good
3	Usefulness	83	82	83	83	Good
4	Access	88	83	89	87	Good
5	Equivalence	92	90	89	90	Very Good
Average		86	81	84	84	Good

From Table 1 based on data through a questionnaire filled out of 3 teachers towards the implementation of the project-based learning model, the electrical motor installation subjects of Vocational High School can be analyzed that in general the three respondents are almost the same value. First, the ease to apply of project-based learning tools made by each teacher the average value is 81% (Good). Second, from the organizing aspect the project-based learning device gets a different value of teacher 1, the average value is 82%, the teacher 2 scores are 71%, while teacher 3 scores are 77% so the total score of 2 teachers is 77% (Quite Good). Third, in terms of usefulness project-based learning devices get scores from teachers by giving the same value of 83% (Good). Fourth, in terms of access project-based learning devices get scores from teachers by giving value of 87% (Good). Fifth, in terms of equivalence of project-based learning devices get high scores with score of 90% (Very Good). From the total average value of the five aspects of the assessment of the practicality of project-based learning devices on the electrical motor installation subjects of Vocational School according to the response of 3 teachers is 84 (Good). This project-based learning tool is recommended for use in other subjects.

For implementation, the learning model also requires input in the form of responses from 33 students. This data is obtained after learning, through questionnaires given to students. The results obtained as shown in Table 2.

From Table 2 based on data through a questionnaire which was filled out of 33 students towards the implementation of the project-based learning model of electrical motor installation subjects at Vocational High School, we can analyze that: First, the ease of use of project-based learning devices has an average score of 68% (Quite Good). The second point is, in terms of the ease of understanding the material for project-based learning devices the average score is 74% (Quite Good). Third, in terms of the attractiveness of project-based learning devices, the average value is 71% (Quite Good). Fourth, in terms of project-based learning tools can be used as self-learning to get an average final score of 75%. From the total average value of the four aspects of implementation assessment of project-based learning on the electrical motor installation subjects of Vocational High School according to the response 33 students were 71% (Quite Good). From

these results it is recommended to use project-based learning tools for students. It is hoped that later the other researchers can examine the aspects of students learning independently, because in this study the results are still in the fairly practical category-Quite Good.

Tabel 2. Students' Response

No	Aspects	Questionnaires Aspects	Percentage (%)	Category
1	Ease of users of learning devices	I can learn project-based lessons easily	73	Quite Good
		With my project-based lessons can learn on their own even without a teacher	58	Less Good
		With project-based learning becoming more practical	75	Quite Good
		I can understand learning material easily through project-based learning.	71	Quite Good
		I can repeat the answer to project-based learning questions at home	67	Quite Good
		Project-based learning really helped me in understand the concepts of learning material	65	Quite Good
2	Ease of understanding material	With project-based learning, I can understand the concepts of learning material in a short time	73	Quite Good
		I understand subject matter more quickly if using project-based lessons	72	Quite Good
		Time used project-based learning is very precise	77	Quite Good
3	The appeal of the learning device	I please learning with project-based learning	69	Quite Good
		Learning with project-based learning intrigued me to study harder	74	Quite Good
		I do not feel tired of answering the project-based learning even though for a long time	69	Quite Good
4	Can be used as independent learning	I like learning with project-based learning	75	Quite Good
		Project-based learning makes me more creative	76	Quite Good
		Learning with project-based learning arouses my interest in self-study	74	Quite Good
Average			71	Quite Good

DISCUSSION

The project-based design aimed at increasing abilities of students' creativity, where students are given direction to be able to express abilities of creativity in learning tools so that students can carry out independent learning (Wulansari et al., 2022). The project-based learning tool was developed in accordance with the material on the subject of electrical motor installation that was taught to students of Vocational High School.

In evaluating the practicality of project-based learning tools for the Electrical Motor Installation subject at Vocational School, three teachers provided comprehensive feedback across five key aspects. Firstly, the ease of application of the project-based learning tools, rated at an average of Good, indicates that each teacher found them accessible and manageable for implementation in their teaching. Secondly, in terms of organization, the project-based learning device received a score of Quite Good. This aspect reflects how well-structured and coherent the learning procedures and activities were in achieving the basic competencies outlined in the curriculum and lesson plans. Thirdly, the usefulness of the project-based learning devices was rated at Good. This rating underscores the variability in their application, allowing teachers to adapt and innovate within the framework of project-based learning to enhance student engagement and learning outcomes. Fourthly, regarding access, teachers rated the project-based learning devices at Good. This high score highlights the effective combination of online and face-to-face elements, which increases accessibility and supports diverse learning styles and needs among students. Fifthly, the equivalence of the project-based learning devices received a high score of

Very Good. This aspect confirms that the learning devices were appropriately tailored to match students' abilities, ensuring that all learners could engage effectively with the projects. Overall, the total average score across these five aspects, as assessed by the three teachers, is Good. This indicates a strong endorsement for the use of these project-based learning tools not only in the Electrical Motor Installation subject but also suggests their potential applicability across other subjects within the Vocational School curriculum. The positive feedback underscores the effectiveness and practicality of integrating project-based learning methodologies into teaching practices for enhanced student learning and engagement.

Based on student response data from implementation tests, several key aspects of project-based learning devices were evaluated. Firstly, the ease of use of project-based learning devices received an average score of Quite Good. Students found these tools pivotal in practical learning experiences, allowing them to grasp materials independently, review at home, and understand subject concepts without constant teacher supervision. Secondly, the ease of understanding the material through project-based learning devices also earned a Quite Good average score. Students reported rapid comprehension of lesson concepts, highlighting the efficiency and effectiveness of time spent on project-based learning activities. Thirdly, the attractiveness of project-based learning devices was rated Quite Good on average. Students expressed high satisfaction with this approach, noting increased engagement and active participation in learning activities, thereby mitigating monotony in their studies. Lastly, the project-based learning tools' capacity for fostering self-learning achieved a final average score of Quite Good. This aspect underscored students' enhanced creativity and heightened interest in pursuing independent learning opportunities facilitated by the project-based approach. Overall, these findings emphasize the positive impact of project-based learning devices on student learning experiences, fostering autonomy, comprehension, engagement, and creativity throughout their educational journey.

This is in line with research conducted by (Laili, 2019) A study was conducted to research the effectiveness of developing an e-module project-based learning approach for the subject of electric motor installation. The results of this study demonstrated that utilizing an e-module that incorporated project-based learning activities significantly improved student learning outcomes in the electric motor installation course. Compared to traditional instructional methods, the e-module approach facilitated deeper engagement, hands-on application of concepts, and enhanced understanding among students. The project-based nature of the e-module enabled students to actively construct knowledge through practical, real-world scenarios related to electric motor installation tasks. Consequently, students exhibited higher achievement levels, better knowledge retention, and improved problem-solving abilities in the subject area. The findings highlight the potential of leveraging technology-enabled project-based learning strategies to create more effective and meaningful learning experiences, ultimately leading to improved academic performance in technical domains such as electric motor installation. Then the research conducted by (Astarina et al., 2020) the researcher conducted a study on project-based learning in vocational high schools to assess its effectiveness in enhancing transferable skills among students. The findings highlighted that integrating project-based learning into vocational education significantly improves skills essential across various professions. Through hands-on projects reflecting real-world challenges, students developed critical skills like problem-solving, teamwork, and communication. This approach not only deepened subject understanding but also boosted students' confidence and readiness for future careers in dynamic industries.

Project-based learning tools specifically designed for the electrical motor installation curriculum offer a pragmatic and hands-on approach that significantly enhances students' comprehension of the subject matter. These tools provide a structured framework for students to

engage in practical, real-world scenarios and activities that closely simulate the tasks and challenges encountered in the field of electrical motor installation. Through the use of these project-based learning tools, students are guided by instructors to apply theoretical concepts learned in the classroom to tangible projects that require them to plan, design, and execute the installation of electrical motors. This experiential learning process fosters a deeper understanding of the subject as students actively grapple with the intricacies of motor installation, troubleshooting potential issues, and adhering to industry standards and safety protocols. The project-based learning tools serve as a bridge between theoretical knowledge and practical application, allowing students to develop essential skills such as problem-solving, critical thinking, and decision-making in a controlled and supportive learning environment. By breaking down complex processes into manageable steps and providing clear instructions and guidelines, these tools enable students to progress at their own pace while receiving timely feedback and guidance from their instructors. Furthermore, the collaborative nature of project-based learning encourages teamwork, communication, and the exchange of ideas, mimicking the collaborative dynamics found in professional settings. As students work together to overcome challenges and achieve project milestones, they develop valuable interpersonal and leadership skills that are highly transferable to their future careers in the electrical industry.

CONCLUSION

This study has provided a reference using a project-based learning model that can be used in learning to electrical motor installation. This research can provide input to education providers because the model developed can improve student learning outcomes. The teacher can use this learning media so that its use is not only the electrical motor installation material but can be used for other learning. In the development research using the UCD model it produces a project-based learning product, implementation project-based learning on the subject of electrical motor installation in the second semester of electrical power installation techniques Vocational High School. Project-based learning on subject's electrical motor installation developed is based on competency standards. This project-based learning consists of one interrelated basic competency learning that directs students in the initial design of electrical installation.

Validation of project-based learning devices after conducting the results of observations or direct observation, curriculum analysis (In-installation learning achievements of electrical motor installation), reference book analysis Electrical Motor Installation and analysis of students. Observation or direct observation aims to pay attention to the characteristics of the learning process, especially unique and comprehensive learning, the development of learning is quite potential to meet the demands of learning. Project-based learning can direct students to systematic work procedures and standards for making or completing a product. The curriculum analysis aims to determine the curriculum requirements for the material. While the analysis of students aims to determine the characteristics of students who are used as research subjects.

The implementation of project-based learning as an instructional approach in the educational process for the Electrical Motor Installation subject has proven to be a resounding success. This is evidenced by the overwhelmingly positive responses and feedback provided by both students and teachers regarding the project-based learning tools that were specifically developed for this purpose. Through a comprehensive evaluation process, feedback from educators and learners was systematically collected and compiled into structured practice tables. These tables presented a clear overview of the average assessment ratings assigned by both groups, revealing an encouraging "Good" rating on average. The positive evaluation confirms that project-based learning tools effectively bridge theory and practice in the Electrical Motor Installation subject,

acknowledged by both instructors and engaged students. With successful outcomes in the initial phase, it is clear that the design and implementation of project-based learning have passed rigorous testing. These encouraging results validate the method's suitability and promise for integrating into this specific curriculum. Future research could explore extending project-based learning across more subjects in the Electrical Motor Installation curriculum, aiming to validate its effectiveness and applicability more broadly. This expansion would offer insights into its benefits and challenges across various areas of the field, enhancing understanding of optimal implementation strategies to maximize student engagement, retention, and skill development.

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