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The effectiveness of project tasks on students' regional potential-based to increase students' knowledge

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Abstract: The industrial world needs professionals who are able to align the needs of the market. Its intense market competition not only demands the ability to work, but also the ability to create innovative products. Therefore, higher education must prepare excellent graduates with those ability. One of the efforts is to improve the learning model by implementing Project Tasks on Students' Regional Potential. This study belongs to pre-experimental research with a one-group pretest-posttest design, subjected to 30 students of D3 Mechanical Engineering study program. Based on the research results, it can be concluded that the students who were taught by Project Tasks on Students' Regional Potential got significant improvement from their pre-test to post-test scores. Consequently, it can be interpreted as there was an effect of the Project Tasks treatment given to research subjects. Therefore, this model can be referred as an effective model to adapt, implemented on learning for vocational higher education.

Keywords: project-based learning; vocational education; engineering student; regional potential

1. Introduction

The dynamic nature of the 21st century requires vocational education to foster lifelong learning and competence development capabilities for sustainable professional self-determination (Zinchenko et al., 2020). Vocational education is a key component of the education sector that contributes to a country's competitive advantage through the high quality and competence of its workforce, which is the result of quality education, especially in TVET (Moses, 2016). The industrialized world needs professional people who are able to keep up with the needs of the market. Education in the 21st century, especially TVET, is designed to produce productive graduates (Jalinus et al., 2019) to ensure that students are well-rounded and adaptable (Avitia-Carlos et al., 2022; Tommasi et al., 2022). The fierce market competition in the industrial world requires not only the ability to work, but also the ability to create products with innovative value (Syahril et al., 2019). Therefore, vocational education graduates must have a balance of thinking skills and technical skills to produce the human resources needed in the 21st century. Vocational education must also be equipped with specific skills (4C) (Hartanto et al., 2020), including critical thinking and problem solving, creativity and innovation, communication and collaboration.

One of the efforts that can be made in vocational education is to improve the learning model. The learning process with the right model can increase the potential of competent students to produce quality human resources (Rizvi et al., 2020). A learning model that is considered suitable for teaching students to develop critical and creative thinking skills to create real products is a project-based learning model (Jalinus et al., 2017). Project-based learning provides opportunities for students to create projects that they make themselves or in groups (Amamou & Cheniti-Belcadhi, 2018). A study conducted by (Syahril et al., 2024, 2021) revealed that project tasks based on local potential according to students' perceptions are

effective on motivation, interest, and real world. In line with this research, (Jalinus et al., 2017) concluded in their research that the application of project-based learning model builds identification and problem solving skills to produce a project according to real world needs.

The project tasks from students' regional potential-based project model based on regional potential is a new model in vocational education (Syahril et al., 2021) . Through project assignments based on regional potential, it provides students with new enthusiasm in carrying out learning and provides opportunities to apply theoretical knowledge in solving problems with critical and creative thinking skills. Improving the vocational education learning model with a project assignment model based on regional potential is also in line with the Minister of Industry's Regulation No. 14 of 2021 on the development of small and medium industries through One Village One Product (OVOP) for village development. With this model, the potential of local natural and human resources can be explored to produce marketable products and produce vocational graduates that meet the needs of the 21st century. To support government programs, vocational training steps using the project task learning model of regional potential can explore the potential of natural and human resources, which will produce marketable products, and realize vocational training.

This study aims to determine the effectiveness of the implementation of the Project Tasks from Students' Regional Potential-based of each student. Through this learning model, it is expected that students will be able to make a positive impact, which is to significantly contribute to the development of their regional potential as well as the increasing student knowledge in learning Applied Technology Machinery course.

2. Material and methods

2.1 Type of research

The type of research conducted was a one-group pretest-posttest design. Researchers tested one group using a pre-experiment and a post-intervention/treatment test. The results of the pretest and posttest were then compared to determine the comparative effectiveness of the interventions. The research flow is shown in Figure 1.

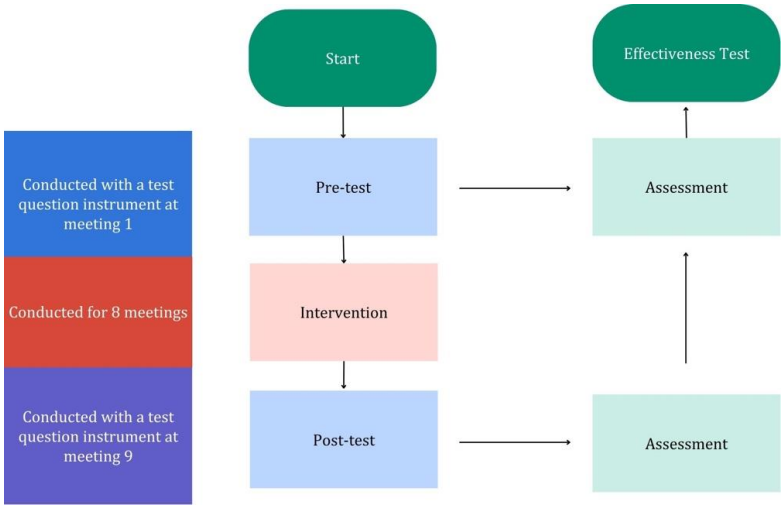

Figure 1. One-group pretest-posttest design

2.2 Research participant

The subjects in this study were vocational education students to identify the effectiveness of the regional potential-based project task learning model. The research subjects consisted of 30 students of D3 Mechanical Engineering study program at Universitas Negeri Padang which was conducted in the Applied Technology Machine course.

2.3 Research instrument

The instrument used in this study were pretest and posttest, employing essay questions, adjusted from the curriculum of the Mechanical Engineering department of Universitas Negeri Padang. The grid of essay questions can be seen in table 2.

Table 2. Instrument indicators

No.	Instrument Indicators
1	Appropriate technology design problem definition concept
2	Features of the engineering design
3	A systematic approach to the right technology
4	Designing the right technology
5	Project task orientation based on regional possibilities

2.4 Research procedue

The application of the model in the Applied Technology Machine course based on project assignments from regional potential is adjusted by following the syntax so that students can achieve learning outcomes in lectures. The syntax of the application of the project assignment-based model of applied regional potential can be seen in Figure 2.

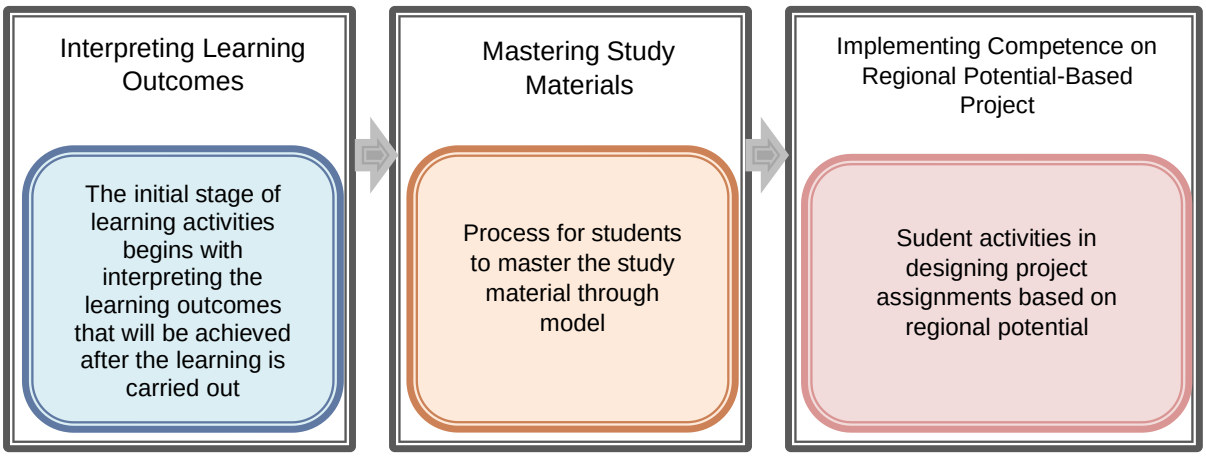

Figure 2. Project task learning model syntax from regional potential

Through Syntax 1, students are required to interpret learning outcomes in order to achieve the expected learning outcomes at the end of the learning. Applied Technology Machine course studies knowledge about the application of the use of appropriate technology machines. Students must be able to understand the systematic approach of applied technology machines, be able to formulate problems, generate alternative design concepts, evaluate and select concepts, detail designs so that they can be manufactured, and know the strategies and methods of manufacturing and testing the design products to produce a final design report. All indicators of course completion is based on the potential of each student's area of origin.

Syntax 2 is a process by which students master the material through a model and confirm their understanding with the instructor. The material covered in Syntax 2 includes an introduction to engineering design. The learning process in Syntax 2 takes 1 session. Students are asked to understand the introduction to engineering design in order to begin to identify regional potential so that they can plan appropriate engineering projects based on the potential of the area of origin.

Syntax 3 is the stage of implementation of the competence on project assignments from regional potential. Students are assigned to identify regional potentials, then formulate solutions, carry out detailed designs including budget plans to the stages of project task

implementation. The specified design plan is then applied to the application of the designer. In addition, the designs created are presented and evaluated so that students can promote the designs created and produce a final report. During the competency implementation process, students can use the model and provide guidance with instructors to produce good design projects that become the final outcomes of the course.

2.5 Techniques for data analysis

The data analysis technique used was descriptive statistical analysis to assess students' learning outcomes, intervened with the regional potential based project task learning model. The data was analyzed, utilizing SPSS for the standard deviation, normality tests, and paired T-test to assess the significant different between pre-test and post-test scores.

3. Results and discussion

The pre-test and post-test results were compared to assess the comparison before and after treatment. Visualization of pretest and posttest results of project-based learning model can be seen in Figure 3.

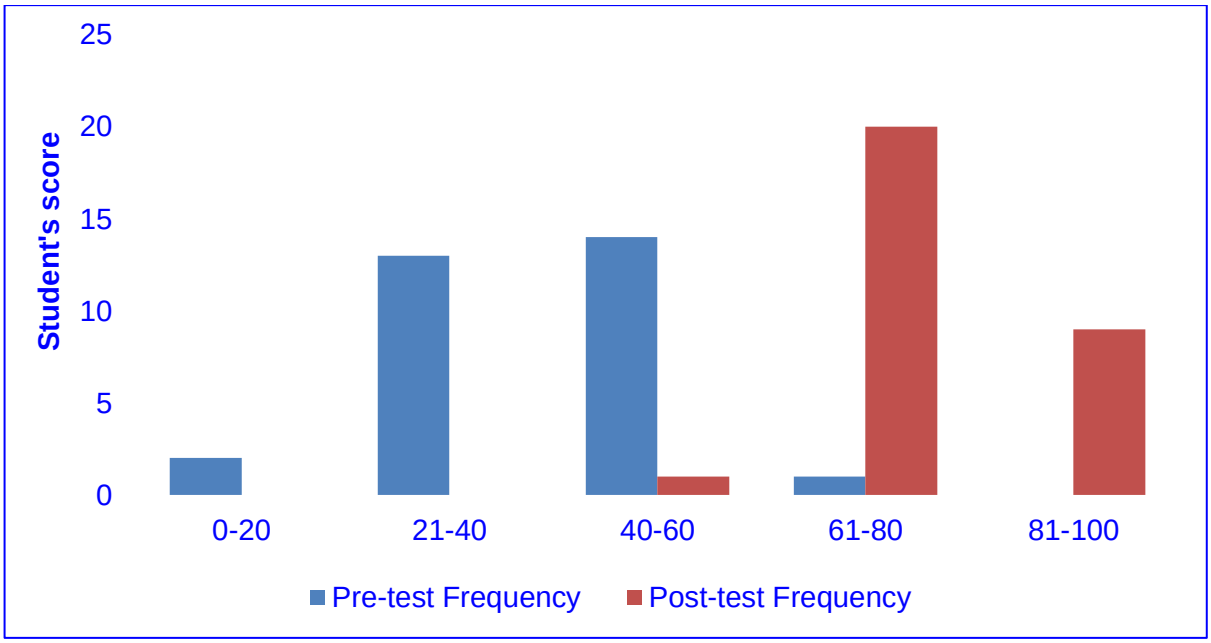

Figure 3. Visualization of pretest and posttest result of project-based learning model

From the results of the histogram analysis in Figure 3, it can be seen that there is a significant increase in student scores between the pre-test and the post-test. Before the intervention, most students scored relatively low on the pre-test, especially in the 0-40 range. In the 0-20 interval there were only 2 students, while in the 21-40 interval there were 13 students, indicating that most students were in the low score category. This indicates that many students started with a limited understanding of the tested material.

However, after the intervention, the post-test showed a clear change. Most students were able to improve their scores, with many scoring in the 61-80 range, indicating a significant improvement in their learning outcomes. In the post-test, there were 20 students who scored in the 61-80 range, a very significant number compared to only 1 student in the pre-test.

In addition, a comparison between the pre-test and the post-test also shows a marked difference in the distribution of scores. In the pre-test, most students were in the very low score range of 0-40, with 15 students falling into this category. However, after the intervention, many students were able to jump to a higher score range. For example, on the post-test, there were

9 students who scored in the 81-100 range, indicating that they gained a better understanding after the training. Some students even showed excellent performance, with post-test scores reaching 90, indicating excellent results. It is clear from the table that the distribution of students' scores changed significantly. Before the intervention, most students had low pre-test scores, mostly in the 0-40 range. However, after the training, most students scored higher on the post-test, with many students scoring in the 61-80 range and some even scoring 81-100.

Overall, these data suggest that the intervention was highly effective in improving students' understanding and skills. The significant increase in post-test scores compared to pre-test scores indicates that the training program was successful in improving the quality of student learning. It also shows that the intervention can help students who initially had low scores to improve their learning outcomes to a higher level.

In addition, the evaluation of the effectiveness of Project Tasks from Students' Regional Potential-based project was verified using the paired t-test, which first performed a prerequisite test, namely the normality test, to determine whether or not the data were normally distributed. The paired T-test was used to determine the level of significance between 2 different treatments on the same subject. Decision criteria of these formulas are if tvalue ≤ 0.05, it means that there is significantly different on students learning outcomes. if tvalue > 0.05, it means that there is no significant difference on students learning outcomes. Overall, the results of this study support the previous literature which shows that project-based learning models are effective in developing students' productive skills. From this study, it was found that the development of project-based learning model based on regional potential gave better value. The results of normality test and paired t-test are presented in Tables 3 and 4.

Table 3. Normality test result

		Unstandardized Residual
N		30
Normal Parameters[a,b]	**Mean**	.0000000
	Std. Deviation	8.27197509
Most Extreme Differences	**Absolute**	.112
	Positive	.110
	Negative	-.112
Test Statistic		.112
Asymp. Sig. (2-tailed)		.200[c,d]

a. Test distribution is Normal
b. Calculated from data
c. Lilliefors Significance Correction
d. This is a lower bound of the true significance

From the normality test performed with the Kolmogorov-Smirnov test formula, the results obtained were 0.200 or greater than 0.05, or the data were declared normally distributed.

Table 4. Paired T-test result

Paired Differences						**t**	**df**	**Sig. (2-tailed)**
	Mean	**Std. Deviation**	**Std. Error Mean**	**95% Confidence Interval of the Difference**				
				Lower	**Upper**			
Pair 1 Pretest-Posttest	-36.367	14.177	2.588	-41.661	-31.073	-14.050	29	.000

Table 4 presents the results of the t-test analysis, obtained a significance level of 0.000 <0.05, which indicates a significant difference between the pre-test and post-test. Therefore, it was found that there was an effect on the difference in treatment given to research subjects, namely

the use of project assignment-based model from regional potential. Vocational education effectively develops students' critical thinking, problem solving, collaboration, and self-management skills through a The project tasks from students' regional potential-based project in accordance with the needs of 21st century skills. The 4C skills are formed through a long process during the learning process by developing an appropriate technology machine based on the potential of the region of origin. Project assignments that are based on the potential of the student's region of origin help build critical thinking patterns and the quality of a vocational education graduate that will not only benefit the student but also have a good impact on the region of origin. Students have great control over the problem solving they determine for the potential of their region, starting from the resources needed to the development of the product produced (Larmer et al., 2018).

Project Tasks from Students' Regional Potential-based project can involve the creation of technological solutions that meet the local conditions and needs of an area. For example, students may design environmentally friendly technologies such as renewable energy systems or waste treatment systems that use local resources. They can also design products or tools that support economic activities in the area, such as agricultural tools or handicrafts based on local materials. In addition, students can design information technology-based applications that help the community, such as educational applications for remote areas or information systems for natural resource management.

The effectiveness of this model is assessed in several ways. First, how well the technology developed matches the potential and needs of the region. For example, whether the technology makes effective use of local resources and provides real solutions for the community. Second, the extent to which the solutions produced are accepted and applied by the people in the area and have a positive impact, such as improving the quality of life or creating jobs. In addition, the effectiveness of this model is also measured by the students' ability to develop innovative and sustainable solutions, as well as the skills they acquire during the project. Thus, this project model measures not only the technological results produced, but also the students' ability to design solutions that can contribute to the development of the region in a sustainable way.

4. Conclusion

Project Tasks from Students' Regional Potential-based Project is an innovative Project Based Learning (PjBL) learning model suitable for vocational education. This study aims to demonstrate the effectiveness of a project-based learning model based on regional potential. In order to complete the project task, the researcher piloted the model as a guide and guide so that students could plan design projects more easily. The effectiveness of the model will be evaluated based on student learning outcomes. The model has an impact on instructors and students in the learning process. Project assignments completed by students based on regional potential using model are one of the steps for vocational education, especially in D3 Mechanical Engineering study program, Universitas Negeri Padang in preparing graduates who have expertise in various fields, including critical and creative thinking skills. In this study, the results obtained that model were considered effective in the learning process. The limitation of this research is that the model is only for the D3 Mechanical Engineering study program, Universitas Negeri Padang. In addition, the limitation of this research is that there are no further studies related to other aspects of the causes of increasing student learning outcomes in the completion of project assignments based on regional potential.

Author's Declaration

Author contribution

Dinda Khaira Latifa: Conceptualization, Investigation, and Writing - Original Draft. **Rezkilaturahmi**: Formal analysis, Data Curation, and Writing - Review & Editing.

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Competing interest

The authors declare no conflict of interest from the conduct of research and publication of this article.

Ethical Clearance

This study involved students as research subjects. The researcher obtained research permission from the Faculty of Engineering, Universitas Negeri Padang, under letter number 2910/UN35.2.1/LT/2021. Both students and lecturers involved have provided consent for the collected data to be used for academic publication purposes.

AI Statement

This article is an original work of the authors without including any AI generated sentences, tables, and images.

Publisher's and Journal's Note

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