



Comparative Analysis of the Effect Of Blended Learning Model Through Experimental Approach and Project on the Scientific Demeanor and Learning Outcomes

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ABSTRACT

This paper analyzes differences in students' learning outcomes in a blended learning model that uses experimental and project methods. In addition, this paper also investigates the effect of scientific demeanor on learning outcomes. The research method uses a simple random sampling technique in four classes at the Light Vehicle Engineering department. The research uses four variables, namely scientific demeanor, learning outcomes, physics learning that uses a blended learning model with experimental, and project methods. Scientific attitude is observed through observing participants' responses to specific situations while learning outcomes are measured through tests that are taken after a particular learning process. The research results indicate three main findings. First, there are significant differences in learning outcomes between students who are taught by using the blended learning model with the experimental method and the students who are taught with the project method. Second, there are substantial differences in learning outcomes based on students' scientific demeanor. Third, there is no significant effect between the blended learning model using experimental and project methods and students' demeanor toward learning outcomes. The research results contribute to the understanding of how different learning can influence students' learning outcomes. In addition, the findings regarding the relationship between scientific demeanor and learning outcomes can also support efforts to develop more effective and adaptive learning strategies for various types of students.

Keywords: blended learning, scientific demeanor, learning outcomes, experimental approach and project

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INTRODUCTION

Learning media continues to develop in accordance with current needs and technological developments (Hussa, 2018; Wrahatnolo & Munoto, 2018). Educational institutions are competing in preparing their students to be familiar with the use of technology. Learning aids such as the presence of a computer laboratory will determine the optimization of information and communication technology (Ravisekaran & Ramakrishnan, 2018). This is because the implementation of technology in the learning process will have a significant effect on both students and teachers (Husain, 2014). One form of technology implementation in the learning process is the use of internet-based technology.

Learning using internet-based technology needs to be implemented because today's students cannot be separated from the use of the internet in everyday life (Chen et al., 2022; Sutikno et al., 2019). This is supported by the results of a survey from the Association of Indonesian Internet Service Providers (APJII), (2017) in 2017 shows that based on user age, 75.50% of internet users in Indonesia are those aged 13-18 years. Based on the level of education 70.54% are high school / vocational students. The devices used by the majority of internet users in Indonesia 59.67% are privately owned and 65.98% access them every day. This survey shows that teenagers, especially high school or vocational age groups, cannot be separated from the use of the internet, especially with the development of current gadgets.

Educational institutions use internet-based technology in an effort to improve services to students or teachers in order to increase the effectiveness and efficiency of the learning process (Affandy, 2020; Wardani et al., 2019). Increased internet-based learning or what is called e-learning can be realized if internet access

is fast and easy (Munir, 2017). E-learning is learning that is presented through a computer designed to support individual learning (Clark, 2002).

E-learning has undergone significant development in recent years (Chen et al., 2022), not only as a means to deliver information, but also as a tool specifically designed to build specific job-related skills (Elgohary et al., 2022). The E-learning approach emerged as a response to the need for more relevant and adaptive education in the modern learning era (Harandi, 2015).

E-learning approaches in modern learning contexts focus on building job skills, encouraging the adoption of learning strategies that are more adaptive, interactive, and responsive to industry developments (Elgohary et al., 2022). E-learning is thus not only a source of information, but also a powerful tool to prepare individuals with the skills needed to face diverse career challenges (Affandy et al., 2019a; Ustundag & Cevikcan, 2018).

This e-learning allows students to follow the teaching and learning process without having to physically go to class but through computers in their respective places (Elgohary et al., 2022; Zufria, 2016). E-learning is able to overcome problems in the form of delays or not even delivering learning materials (Sukanto & Binar, 2012). In addition, e-learning can cause a person to access subject matter and share information at any time (Belina & Batubara, 2013). This causes the use of e-learning facilities to be a must in every learning process, including physics learning in SMK. This is because physics is a group of basic C1 subjects in the field of expertise in SMK which functions so that students achieve competence in their field of expertise or productive subjects. In addition, the Physics subject in SMK also serves to prepare students to develop skill programs at a higher level.

The facts on the ground show that the use of e-learning in physics learning at SMK Negeri 1 Mondokan is still rarely implemented. This is supported by the results of interviews with several Physics teachers that teachers rarely carry out learning with practicum or through e-learning media, even though they have been equipped with quite complete supporting infrastructure, both technological facilities such as computer laboratory rooms, and internet networks with fiber optic connections. 10 GB as well as adequate network computer equipment to meet student needs.

The use of e-learning facilities for learning also cannot be separated from various shortcomings. One of them is the lack of interactions between teachers and students even between students (Wardani et al., 2019). This lack of interaction can slow down the formation of living values in the learning process which will cause the low quality of students' scientific attitudes such as honesty, cooperative attitude, being objective, and introspective (Kusmana, 2011). This is also supported by the results of a field study at SMKN 1 Mondokan Sragen that the attitude of being honest, cooperative, objective, evidence-based, and introspective of students in using e-learning is in the low category. The low scientific attitude of these students demands to integrate e-learning in learning. This is in accordance with the demands of the 2013 curriculum to emphasize the need to integrate scientific attitude education that can optimize the development of students' scientific attitudes (Suwartini, 2017).

The goal of a comprehensive education goes beyond the mere formation of academic skills (Dalmeri, 2014). In addition to developing knowledge and skills, education also has a strong focus on the formation of scientific attitudes in students. Scientific attitudes include engagement in critical thinking, high curiosity, openness to different points of view, and dedication to the search for truth through exploration and research (Dirgantoro, 2016).

Scientific attitudes such as honest attitude, open attitude to new ideas, objective attitude, cooperation, and introspection are part of character education which is very important to be integrated into subjects and teaching and learning processes (Dewi, 2015). Therefore, a good teacher is not only able to form cognitive but also scientific attitude (Affandy et al., 2019b; Aslan, 2017; Derlina et al., 2015).

One way that can be done to integrate scientific attitudes in learning is through the blended learning model. The blended learning model is a learning approach that combines two important elements in education, namely face-to-face learning and computer-based learning (Alessi & Trollip, 2002; Elgohary et

al., 2022; Nugraheni & Dina, 2017). In this model, students experience holistic and diverse learning experiences, using technology as a means to enrich the learning process.

This integration is possible because the blended learning model provides easy access to learning materials, the variety of student learning resources, and frequent interactions between teachers and students that cause the process of transferring of knowledge and also transferring of value (Graham, 2003). This is also supported by Munir, 2017 that the blended learning model provides opportunities for all student characteristics to be able to learn independently, sustainably and develop which causes the formation of students' scientific attitudes. The formation of a good scientific attitude of students will improve student academic achievement (Raka, 2011). This is also supported by (Najib & Achadiyah, 2015) that scientific attitude, self-confidence, and independence can improve learning achievement. This is what causes learning achievement, namely the mastery of the concept of students who learn with blended learning models is higher than students who learn through face-to-face (Hermawanto et al., 2013).

Simple Harmonic Motion (SHM) is one of the materials in Physics subjects which has many concrete applications in everyday life. Education at the vocational level is more oriented to real-world education and training so that concrete applications serve to prepare students to develop skill programs at a higher level. The selection of SHM material was also based on teacher interviews that students' scores for the SHM material were unsatisfactory. This is because in even semesters, students' time is reduced a lot because class X students in even semesters also have to deepen productive material to prepare for Internships (PKL). Therefore, C1 subject teachers including physics must accelerate the completion of the material so that students can deepen their productive material.

The experimental method and the project method are suitable to be applied in physics learning using a blended learning model because physics learning is not only emphasizing only on concepts and principles, but also on facts in the form of concrete applications that can be developed for technological progress. The experimental method is a learning method that emphasizes students to conduct experiments as checking or proving that the existing theory is indeed true (Sodikin et al., 2014). The experimental method can develop a scientific attitude, thus making students more confident in the truth or conclusions based on their own experiments (Sunariyati et al., 2019). Meanwhile, the project method is a learning process that starts from a problem, then analyzed from various interrelated aspects so that a meaningful and comprehensive solution is found (Saputri et al., 2013). The project method can train students' ability to work together in groups, foster students with habits, apply knowledge, attitudes and skills in everyday life in an integrated manner (Rohmani et al., 2015).

From the description above, it can be seen that the success of the learning process is influenced by many factors, namely student characteristics, learning approaches, methods and learning media. For this reason, it is necessary to conduct research on the use of the blended learning model in Physics subjects in Vocational Schools in terms of scientific attitudes.

The objectives of the research are: (1) to determine the differences in learning outcomes of students who are given learning using the blended learning model using the experimental method and the project method, (2) to determine the differences in learning outcomes between students who have high character, medium character, and low character, and (3) determine the interaction effect between the blended learning model using the experimental method and the project method and student character on student learning outcomes.

METHOD

This research was conducted in SMK Negeri 1 Mondokan Sragen. This research was conducted in September 2018 – June 2019. This research is an experimental-research with the research design used is a quasi-experimental research, involving two classes as an experiment without involving the control class. The first and second experimental classes were treated with a blended learning model with a percentage of online meetings of 30% at the first meeting and 70% offline meetings at the second and third meetings. The first

experimental class was given a blended learning model with an experimental method, while the second experimental class was given a blended learning model with a project method.

Population is the subject of research (Arikunto, 2013). The study population was all students of class X SMK Negeri 1 Mondokan, Department of Light Vehicle Engineering in the second semester of the 2018/2019 Academic Year. The selection of research samples using Simple Random Sampling method from 4 classes majoring in Light Vehicle Engineering. The research sample consisted of two classes that were randomly selected from classes in the light vehicle engineering department.

Multivariate analysis with a significance level of 0.05. The research design used in this study is a 3x3 factorial design with the same frequency of cell contents as presented in Table 1. There are two different treatments, namely blended learning model learning with experimental method (A_1) and blended learning model learning using project method (A_2). Scientific attitudes are divided into three categories, namely students who have high scientific attitudes (B_1), students who have moderate scientific attitudes (B_2) and students who have low scientific attitudes (B_3).

Table 1. Experimental Research Design

Scientific Attitude (B)	Blended Learning (A)	
	Experimental Method (A_1)	Project (A_2)
High (B_1)	$A_1 B_1$	$A_2 B_1$
Medium (B_2)	$A_1 B_2$	$A_2 B_2$
Low (B_3)	$A_1 B_3$	$A_2 B_3$

The independent variables are the blended learning model with project and experimental methods, the moderator variable is scientific attitude, and the dependent variable is learning outcomes. The moderator variable of scientific attitude is categorized into three categories, namely 1 if it is low, 2 if it is moderate and 3 if it is high. Classification of high, medium, low categories is based on the quartile value (Budiyono, 2009). High category if $X > \text{Quartile } 3 (Q_3)$, medium category if $\text{Quartile } 1(Q_1) < X < \text{Quartile } 3(Q_3)$, and low category if $X < \text{Quartile } 1(Q_1)$.

Based on the experimental research design in Table 1, the proposed hypothesis consists of 3 pairs of hypotheses as follows: H_{0A} : There is no difference in the effect of the blended learning model with experimental methods and project methods on the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion. H_{1A} : There is a difference in the effect of the blended learning model with experimental methods and project methods on the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion. H_{0B} : There is no difference in the effect of high, medium and low scientific attitudes on the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion. H_{1B} : There is a difference in the effect of high, medium and low scientific attitudes on the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion. H_{0AB} : There is no interaction between the blended learning model with project methods and experimental methods with students' scientific attitudes towards the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion. H_{1AB} : There is an interaction between the blended learning model with project methods and experimental methods with students' scientific attitudes towards the learning outcomes of class X students of SMK Negeri 1 Mondokan in the 2018/2019 academic year on the subject of simple harmonic motion.

Hypothesis testing is carried out using the SPSS 23 program with the following conditions: (1) H_0 is accepted if $P\text{value} \geq \alpha$, (2) H_0 is rejected if $P\text{value} < \alpha$. After testing the hypothesis, then proceed with the further ANOVA test which is carried out if the results of the analysis of variance show that the hypothesis H_0 is rejected (Budiyono, 2009, 2017). It is used to track the mean difference for each pair of columns, rows, and each pair of cells. ANOVA further test was carried out using SPSS 23.

The research procedures used are: (1) Identifying the problem, namely how the use of the blended learning model with experimental methods and project methods influences scientific attitudes and student learning outcomes in physics learning, (2) research design using factorial design, (3) data collection, (4) implementation of blended learning models and learning methods, (5) measurement, both of Scientific Attitudes and learning outcomes, (6) data collected will be analyzed using multivariate analysis to test the significant influence of factors such as type of learning method, use blended learning model, and the interaction between the two factors on scientific attitudes and student learning outcomes, (7) interpretation of results, and (8) conclusions and implications.

RESULTS AND DISCUSSION

The prerequisite test used was the SPSS 22 application. The normality test used the Shapiro Wilk method, while the homogeneity test used the Levene statistic method. Each test uses a significance level (0.05). The results of the normality test of the data obtained that the P-value in each test for the normality of learning outcomes and scientific attitudes was greater than the significance (0.05) so it could be concluded that the data on learning outcomes and scientific attitudes came from samples with normal distribution.

The results of the homogeneity testing of learning outcomes and scientific attitudes showed that the p value obtained was greater than the significance value set at 0.05. This indicates that there is no significant difference in the variation of learning outcomes and scientific attitudes between the tested groups. In other words, the tested groups have a sufficient level of homogeneity, and any differences that may be seen in learning outcomes and scientific attitudes can be attributed more to other factors beyond the variability between the tested groups.

The p value that is greater than the significance value of 0.05 in testing the homogeneity of learning outcomes and scientific attitudes provides empirical support for the assumption of data homogeneity. This provides a stronger foundation in interpreting the research results and drawing more appropriate conclusions related to the effect of the treatment or variables tested on students' learning outcomes and scientific attitudes. The results of the analysis of variance are presented in Table 2.

Table 2. Analysis Test Results

Variable	P-value	Decision
Learning methods (A)	0,002	Ho rejected
Scientific Attitude (B)	0,002	Ho rejected
Interaction (AB)	0,580	Ho Accepted

Differences in the effect of learning methods on student learning outcomes

The results of the ANOVA test carried out using SPSS 22 obtained p-value < significance level (0.05) so that H_{0A} was rejected or H_{1A} was accepted. Based on the results of data analysis obtained in the first hypothesis in accordance with what has been proposed, there is a difference in the effect of the blended learning model with experimental methods and project methods on student learning outcomes.

ANOVA further test was carried out on the first hypothesis, namely between learning methods and student learning outcomes. This is done to speed up the decision on H_{1A}. H_{1A} shows that there is a difference in the effect of the blended learning model with the experimental method and the project method on student learning outcomes.

ANOVA further test using the estimated marginal means obtained the average value of the experimental method 66.81 (std. error 1.61) with Lower Bound 63.58 and Upper Bound 70.022. The mean value of the project method is 71.19 (std. error 1.61) with Lower Bound 67.97 and Upper Bound 74.41. The research findings provide an in-depth understanding of the effectiveness of using blended learning model with project method in improving students' understanding of physics concepts. The findings reflect the relevance and potential of the learning model that encourages students to be actively involved in learning and build a deeper understanding of the subject matter.

The use of blended learning model with project method gives students the opportunity to learn actively and exploratively. The project-based learning process allows students to explore physics concepts in a more meaningful and in-depth way. They do not only passively receive information, but also engage in concept discovery through hands-on experience. In this process, students have the opportunity to face challenges, overcome obstacles, and gain a deeper understanding of physics concepts (Ropero-Padilla et al., 2021).

The results of previous studies that also revealed the superiority of the project method over the experimental method in learning contexts have provided a strong basis for the interpretation of the findings in this study. Previous findings conducted by (Purwandari et al., 2017) provide broader empirical support for the effectiveness of the project method, which gives weight to the results obtained in this study.

Based on previous studies (Saputri et al., 2013) there are several reasons that may explain why the project method is considered better than the experimental method. First, the project method encourages students to think critically and creatively in designing and executing complex projects, which allows for the application of concepts in a real context. Second, the project method creates deeper student engagement and intrinsic motivation, as they feel they have responsibility for the project they designed themselves.

A similar finding in the study (Du et al., 2022; Kusherawati et al., 2020) also validated the decision to use the project method in this study. Through comparisons with previous research results, the conclusions drawn from this study become more convincing and relevant. In this context, findings that are consistent with previous research provide stronger evidence of the superiority of the project method in improving learning outcomes.

Differences in the effect of Students' Scientific Attitudes on Learning Outcomes

The results of the ANOVA test conducted using SPSS 23 showed that the P-value < significance level (0.05) so that H_{0B} was rejected or H_{1B} was accepted. Based on these results, it shows that the results of the data analysis obtained in the second hypothesis are in accordance with what has been proposed, namely there is a difference in the effect of the scientific attitudes of students in the high, medium and low categories on student learning outcomes.

ANOVA further test was carried out on the second hypothesis, namely between scientific attitudes and student learning outcomes. This is done to speed up the decision on H_{1B}. Hypothesis H_{1B} shows that there is a difference in the effect of students' attitudes in the high, medium and low categories on student learning outcomes.

Further test ANOVA used the estimated marginal means and the results obtained mean values on: (1) low scientific attitude 57.11 (std. error 1.49) with Lower Bound 54.12 and Upper Bound 60.09; (2) moderate scientific attitude 70.57 (std. error 1.03) with Lower Bound 68.52 and Upper Bound 72.63; (3) high scientific attitude 78.62 (std. error 1.58) with Lower Bound 75.45 and Upper Bound 81.79. This shows that scientific attitude affects students' cognitive learning achievement. The scientific attitude used in this research is honest, curious, communicative, disciplined, and creative. This scientific attitude is needed by students to take actions according to the scientific method.

The scientific method applied in physics serves as a tool to analyzing and solving problems related to natural phenomena. Previous research has shown that this scientific approach involves data collection, hypothesis testing, theory development, and experiment validation. The nature of physics as a scientific discipline guides this process by providing a structured and tested framework in investigating phenomena involving elements such as space, time, energy, and matter. Therefore, a scientific attitude is needed so that students are able to solve the problems (Najib & Achadiyah, 2015; Suwartini, 2017).

Based on previous studies Rohmani et al., (2015), indicates that high scientific attitudes are often associated with stronger motivation to learn, perseverance in exploring complex concepts, as well as curiosity that drives students to seek deeper understanding. This scientific attitude reflects a critical, analytical and open approach to a deeper understanding of the subject matter.

In this study, these findings also support the results of previous studies (Wahyudi, 2016) which is in line with the pattern of the relationship between scientific attitudes and learning achievement. Students who

have a positive scientific attitude towards learning physics tend to have higher intrinsic motivation, develop deeper conceptual understanding, and have better critical thinking skills. Along with that, they are able to apply this knowledge and skills to achieve better learning achievement in testing and assessment.

The difference in cognitive learning outcomes between students who have high, medium and low scientific attitudes can be seen through the way students solve a problem contained in the question (Affandy et al., 2019b; Pratiwi et al., 2019). Students who have a high scientific attitude tend to try to find out everything they learn more deeply and more broadly, students who have a scientific attitude are not studying everything in depth, while students who have a low scientific attitude tend to get bored of learning something new.

Interaction between Blended Learning Model and Scientific Attitude towards Learning Outcomes

The results of the ANOVA test conducted using SPSS 23 showed that the P-value significance level (0.05) so that H_0AB was accepted or H_1AB was rejected. The results of the data analysis obtained in the third hypothesis are not in accordance with what has been proposed so that the conclusion obtained is that there is no relationship between the blended learning model with the project method and the experimental method with students' scientific attitudes towards student learning outcomes. The absence of interaction between learning methods and scientific attitudes can be seen through the estimated marginal means graph in Figure 1.

In Figure 1 it can be seen that from the three lines of scientific attitude categories there is no intersection between the lines. This is because the average of students' knowledge learning outcomes in the medium scientific attitude category is always greater than students in the low scientific attitude category and smaller than students in the high scientific attitude category both in the experimental and project methods. This shows that the interaction between the blended learning model with the project method and the experimental method with a scientific attitude does not have a significant effect on student learning outcomes.

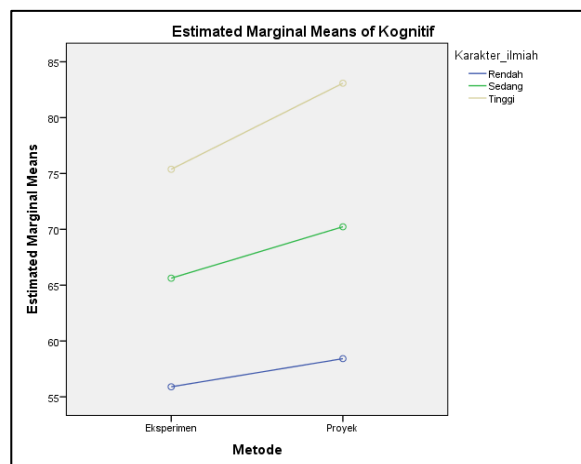


Figure 1. Graph of the estimated marginal means between learning methods and scientific attitudes

The absence of interaction between learning methods and scientific attitudes means that the level of scientific attitudes with experimental methods and project methods has almost the same effect on student learning outcomes. This is because the two learning methods, namely the experimental method and the project method, both require a scientific attitude to create an effective learning process. It is supported by (Isuari & Utomo, 2017) that the scientific attitude of students will have a good impact on the learning process, especially on learning by investigation or discovery. This is also supported by research from Sodikin et al., (2014) that there is no interaction between learning methods and scientific attitudes because scientific attitudes are internal factors that exist in students that affect the learning process with various learning methods to achieve a goal.

CONCLUSIONS AND RECOMMENDATION

Based on the findings and analysis conducted in this study, we can draw some important conclusions related to the use of blended learning model with experimental method and project method in physics learning context. The overall results of this study provide evidence that the blended learning model with project method has a greater potential in improving students' learning outcomes in physics subject. In addition, this study also shows the importance of scientific attitude in helping students achieve better learning outcomes. Although no interaction between learning model and scientific attitude was found in the effect on learning outcomes, these results provide further insight into the factors that influence learning achievement in the context of modern learning. In order to improve the effectiveness of learning, approaches that combine the project method and the cultivation of positive scientific attitudes need to be considered in greater depth.

The recommendations can make a valuable contribution in broadening the understanding of the effect of blended learning model with experimental method and project method on students' scientific attitude and learning outcomes. By involving more specific aspects and different contextual variations, future research can provide a richer and more insightful.

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