Validity and Reliably Test: An Analysis of Students' Comprehension and Skill in Applied Physics

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Abstract *– The low level of students' understanding of basic physics concepts impacts their learning outcomes. To address this issue, several teaching methods were implemented, including project-based learning (PBL), problem-solving, simulation, interactive discussions, and group presentations. This study aims to enhance students understanding of the Applied Physics course in the Electrical System Engineering for Oil and Gas Program at Ambon State Polytechnic. This research employs a quantitative descriptive approach, with data collected through questionnaires from 25 first-semester students. The findings indicate that the applied methods positively contributed to improving students understanding, with 48% of students achieving a good level of comprehension and 24% reaching an excellent level. Factors supporting this improvement include students active engagement in the learning process, the use of technology in simulations, and more interactive and contextual teaching methods. Thus, the implementation of these innovative teaching methods has proven effective in enhancing students comprehension of Applied Physics concepts. Continuous evaluation and development of teaching strategies are necessary to ensure the ongoing improvement of learning quality in the future.*

Keywords*: Project-Based Learning; Applied Physics; Student Understanding; Vocational Education; Simulation.*

INTRODUCTION

Higher education institutions oriented toward vocational education have a diverse human resource background. Both lecturers and students come from various disciplines, depending on their most recent level of education (Ulimaz, 2022). This diversity is also evident among students entering vocational higher education institutions, where they have different educational backgrounds before enrolling in college. Most new students in vocational education institutions come from either general high schools (SMA) or vocational high schools (SMK), often with majors that do not align with the fields of study they choose in higher education (Ulimaz, Agustina, et al., 2020).

The diversity of students' educational backgrounds has implications for the learning process in the classroom. Students with a vocational high school (SMK) background require a more in-depth delivery of material compared to those from a general high school (SMA) background with a science major. This is supported by Subchan and Rossa (2021), who state that educational background is understood as an individual's experience acquired through a learning program. This experience may include (a) knowledge or cognitive-related aspects, (b) attitudes, and (c) certain behaviors. Differences in cognition lead to different ways of learning and thinking. Varied educational backgrounds result in different knowledge development, where such development occurs in accordance with the learning experiences one has acquired. Research conducted by Setiyawan (2018) indicates that learning differences arising from diverse educational backgrounds can lead to learning gaps, adjustment processes in skill development, and a slowdown in the overall learning process. The implementation of classroom learning is influenced by several factors, including students, instructors, and facilities (Bistari, 2018). Teaching, in the context of the learning process, is not merely about delivering subject matter but also about organizing the environment in a way that facilitates student learning (Kirom, 2017). Within this context, it is important to understand that effective learning does not solely focus on outcomes but also emphasizes the learning process itself. This ensures that learning is meaningful and conducted through proper procedures (Alfrid Sentosa & Norsandi, 2022).

One of the courses that require an in-depth understanding of concepts in the learning process is Applied Physics. This course is taught in the first semester as it serves as a prerequisite for more advanced courses. Applied physics is a branch of physics that focuses on the application of fundamental physics principles in technological development and problem-solving across various industrial fields. In the context of the Electrical System Engineering for Oil and Gas study program, applied physics plays a crucial role in understanding electrical phenomena, electromagnetism, electrodynamics, and energy, which are directly related to electrical systems in the oil and gas industry. These physics principles are utilized in energy efficiency analysis, the design of safe and reliable electrical systems, and the optimization of electrical resource usage in oil and gas exploration and production operations.

However, in practice, understanding applied physics concepts remains a challenge for some students. Observations and interviews with several lecturers and students enrolled in the Applied Physics course have revealed various difficulties in conceptual comprehension. Students often struggle to grasp basic physics concepts, as reflected in their low exam scores and formative test results. This indicates that many students have yet to reach an adequate level of understanding.

Therefore, it is necessary to develop appropriate learning media for the Applied Physics course to shift students perspectives. The selection of learning media should align with the course characteristics and learning objectives. Choosing the right media plays a vital role in students academic success and their ability to follow the coursework effectively (Sriyanti, I. 2009).

To address students' conceptual difficulties, we propose the application of creative teaching methods in applied physics to enhance understanding and skills. Effective applied physics education requires lecturers to utilize technology and modern teaching approaches. By implementing Project-Based Learning (PBL) or simulations, lecturers can help students develop problem-solving and critical thinking skills, which are essential competencies for the professional world.

RESEARCH METHODS

This study was conducted in the Electrical System Engineering for Oil and Gas program at Ambon State Polytechnic, focusing on the Applied Physics course. The research data was collected through surveys or questionnaires distributed to first-semester students of the 2024/2025 academic year. The research process flowchart is presented in Figure 1.

The research data was obtained from student responses to a questionnaire distributed after the implementation of several learning methods. The data was then processed using SPSS and analyzed based on the students' level of understanding of the Applied Physics course in the Electrical System Engineering for Oil and Gas Technology Study Program, using validity and reliability tests. Data collection was carried out using a questionnaire completed by 25 respondents, specifically students enrolled in the Applied Physics course in the first semester of the 2024/2025 academic year.

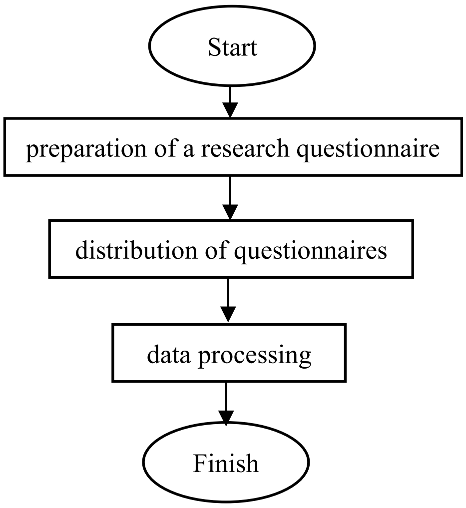

Figure 1. Research Flowchart

The questionnaire was distributed directly in written form to students, who provided answers based on their learning experiences during the first semester of 2024. The purpose of this data collection was to measure students understanding of the course material while attending in-person classes. Additionally, the questionnaire served as a medium for students to provide feedback, suggestions, and input to improve the teaching and learning process. Students responses will contribute to future course improvements.

The interpretation table of the correlation coefficient (r) is shown in Table 1.

Table 1. Interpretation of the Correlation Coefficient

Coefficient Interval	Strength of Relationship
0,80 – 1,000	Very Strong
0,60 – 0,799	Strong
0,40 – 0,599	Moderate
0,20 – 0,399	Low
0,00 – 0,199	Very Low

(Kadir, 2015).

RESULTS AND DISCUSSION

Results

The effectiveness of the implemented instructional methods Problem Based Learning (PBL), problem solving, and simulation was demonstrated through observational data collected during the learning process and student responses to questionnaires. Following the application of these methods, students exhibited improved understanding of how physics concepts are applied in everyday life and were able to complete assignments involving both problem solving and simulations. According to the questionnaire results, 24% of students demonstrated a very good level of understanding, 48% good, 24% fair, and 4% poor. While the majority of students fell into the good and very good categories, continuous efforts are needed to support those who still face challenges in comprehending the material. It is important to note that these findings are observational, as no control group or pre-test/post-test comparison was employed to establish a causal relationship between the teaching methods and student understanding. Nevertheless, the trends observed from both the questionnaires and classroom observations suggest a positive potential of these methods in enhancing student learning outcomes.

Through the problem-solving approach and simulations, students were better able to understand fundamental concepts in Applied Physics and implement real-world case studies. The implementation of interactive discussions and group presentations helped students refine their communication skills and develop critical thinking in solving problems. The results of the research questionnaire on students understanding of Applied Physics are shown in Figure 2, while the validity and reliability test results are presented in Table 2.

According to Putri (as cited in Dewi & Sudaryanto, 2020), an instrument can be considered reliable or consistent in measurement if it has a Cronbach's Alpha value greater than 0.70. The questionnaire data collected was analyzed using SPSS software to obtain the Cronbach's Alpha value, which serves as an indicator of the reliability or internal consistency of the research instrument. Based on the analysis results, the Cronbach's Alpha value obtained was 0.878. Since this value exceeds the minimum required threshold of >0.70, the questionnaire can be considered reliable and suitable for use in the study.

Table 2. Validity and Reliability Test Using SPSS

Correlations

		X01	X02	X03	X04	X05	X06	X07	X08	X09	X10	X11	X12	X13	TOTAL
X01	Pearson Correlation	1	.566**	.621**	-.014	.267	.214	.315	.109	.542**	.056	.147	.405*	-.197	.469*
	Sig. (2-tailed)		.003	.001	.947	.196	.305	.126	.602	.005	.790	.483	.045	.345	.018
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X02	Pearson Correlation	.566**	1	.554**	.478*	.595**	.452*	.572**	.533**	.461*	.309	.451*	.626**	.334	.827**
	Sig. (2-tailed)	.003		.004	.016	.002	.023	.003	.006	.020	.133	.024	.001	.103	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X03	Pearson Correlation	.621**	.554**	1	.385	.497*	.242	.499*	.585**	.461*	-.196	.365	.251	.073	.639**
	Sig. (2-tailed)	.001	.004		.057	.011	.243	.011	.002	.020	.348	.072	.226	.729	.001
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X04	Pearson Correlation	-.014	.478*	.385	1	.703**	.440*	.583**	.480*	.169	-.007	.203	-.010	.341	.595**
	Sig. (2-tailed)	.947	.016	.057		.000	.028	.002	.015	.420	.974	.329	.961	.095	.002
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X05	Pearson Correlation	.267	.595**	.497*	.703**	1	.323	.820**	.635**	.363	.260	.475*	.426*	.406*	.846**
	Sig. (2-tailed)	.196	.002	.011	.000		.115	.000	.001	.074	.209	.016	.034	.044	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X06	Pearson Correlation	.214	.452*	.242	.440*	.323	1	.339	.201	-.016	.134	.157	.391	.358	.513**
	Sig. (2-tailed)	.305	.023	.243	.028	.115		.098	.335	.941	.524	.454	.053	.079	.009
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X07	Pearson Correlation	.315	.572**	.499*	.583**	.820**	.339	1	.557**	.223	.130	.155	.458*	.439*	.771**
	Sig. (2-tailed)	.126	.003	.011	.002	.000	.098		.004	.284	.536	.459	.021	.028	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X08	Pearson Correlation	.109	.533**	.585**	.480*	.635**	.201	.557**	1	.214	.110	.448*	.381	.504*	.706**
	Sig. (2-tailed)	.602	.006	.002	.015	.001	.335	.004		.305	.599	.025	.060	.010	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X09	Pearson Correlation	.542**	.461*	.461*	.169	.363	-.016	.223	.214	1	.262	.466*	.379	.106	.529**
	Sig. (2-tailed)	.005	.020	.020	.420	.074	.941	.284	.305		.206	.019	.062	.613	.007
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X10	Pearson Correlation	.056	.309	-.196	-.007	.260	.134	.130	.110	.262	1	.452*	.576**	.548**	.428*
	Sig. (2-tailed)	.790	.133	.348	.974	.209	.524	.536	.599	.206		.023	.003	.005	.033
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X11	Pearson Correlation	.147	.451*	.365	.203	.475*	.157	.155	.448*	.466*	.452*	1	.538**	.446*	.621**
	Sig. (2-tailed)	.483	.024	.072	.329	.016	.454	.459	.025	.019	.023		.006	.025	.001
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X12	Pearson Correlation	.405*	.626**	.251	-.010	.426*	.391	.458*	.381	.379	.576**	.538**	1	.545**	.712**
	Sig. (2-tailed)	.045	.001	.226	.961	.034	.053	.021	.060	.062	.003	.006		.005	.000
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
X13	Pearson Correlation	-.197	.334	.073	.341	.406*	.358	.439*	.504*	.106	.548**	.446*	.545**	1	.596**
	Sig. (2-tailed)	.345	.103	.729	.095	.044	.079	.028	.010	.613	.005	.025	.005		.002
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25
TOTAL	Pearson Correlation	.469*	.827**	.639**	.595**	.846**	.513**	.771**	.706**	.529**	.428*	.621**	.712**	.596**	1
	Sig. (2-tailed)	.018	.000	.001	.002	.000	.009	.000	.000	.007	.033	.001	.000	.002	
	N	25	25	25	25	25	25	25	25	25	25	25	25	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Reliability Statistics

Cronbach's Alpha	N of Items
.878	13

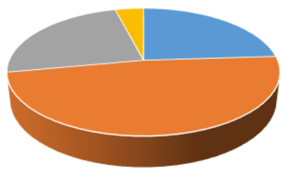

Figure 2. Research Questionnaire Diagram

Meanwhile, the calculated Pearson correlation (r-value) of the questionnaire items ranged from 0.428 to 0.846. According to the interpretation standards of correlation coefficients in Table 1 (Kadir, 2015), these values fall into the category of moderate to very strong relationships, indicating that all items in the questionnaire are valid.

Additionally, to illustrate students comprehension of Applied Physics, the questionnaire data is visualized in a pie chart. Based on Figure 2, it can be observed that 48% of students demonstrated a good level of understanding, while 24% showed a very good understanding of the taught material. Meanwhile, 24% of students had a moderate level of understanding, and the remaining 4% displayed a low level of comprehension. These results provide insight into the variation in students' understanding levels and the effectiveness of the teaching methods implemented.

Discussion

Based on the research findings, 4% of students had a low level of understanding of the material presented. The factors contributing to this low comprehension include delays in grasping concepts during the learning process, difficulties in understanding fundamental prerequisite materials before studying more complex concepts, and a lack of interest or enthusiasm in the course. This condition indicates that some students still face challenges in optimizing their learning experience. Therefore, further efforts are needed to identify the specific causes for each student so that appropriate solutions can be provided based on their needs.

One strategy that can be implemented to enhance students understanding is connecting the learned material to its real-life applications. By adopting a practical application-based approach, students are expected to understand the concepts better and see the relevance of the material in real-world contexts. Additionally, more interactive and innovative teaching methods can be applied to increase students interest and engagement in the learning process.

The findings of this study are supported by several previous studies that also demonstrate the effectiveness of more innovative learning approaches in enhancing students' understanding. Research conducted by Gulo (2022), Purwanto (2021), and Hikmawati (2023) revealed that the implementation of Project-Based Learning (PBL) models has been proven to improve students' comprehension in learning. This model provides students with opportunities to learn through hands-on experiences by working on projects related to the subject matter, particularly for students in the Electrical Systems Engineering for Oil and Gas program. Students are given PBL activities related to topics such as kinematics, electrostatics, electrodynamics, and electromagnetism in everyday life, enabling them to more easily understand and apply these concepts in real-world contexts.

The study conducted by Faradillah et al. (2021) showed that the reasoning instrument used had moderate levels of validity and reliability, making it reasonably dependable for measuring reasoning. In addition, research by Razali et al. (2025) also assessed the levels of validity and reliability, and the results indicated a high reliability index, ranging from 0.82 to 0.92. Similar studies were also conducted by Rukmini et al. (2024), Ismail et al. (2022), and Nada et al. (2022), each of which examined the validity and reliability of instruments relevant to their respective fields of study. The results of these tests indicated that the instruments used in these studies were valid and reliable.

Furthermore, research conducted by Ismail (2021), Lembang et al. (2021), and Komisia et al. (2023) indicates that the Problem-Solving method in learning also has a positive impact on improving conceptual understanding, particularly in mathematics and science. This approach encourages students to think critically in solving problems, enabling them not only to understand theoretical concepts but also to apply them in various situations. Overall, this research aligns with previous studies that emphasize the importance of experiential and application-based learning methods in improving students learning outcomes.

CONCLUSION

Conventional learning methods have been found to be less effective in promoting active student participation in the learning process. Therefore, this study on improving students understanding adopts a two-way learning method, ensuring that students are not only passive recipients of the material but also actively engaged in the learning process. This teaching method has proven to be effective in both facilitating learning and enhancing students comprehension.

The methods and stages used in improving students understanding of Applied Physics need to be conducted continuously to increase the percentage of students achieving a high level of understanding. The goal is to exceed the results obtained in this study, where 24% of students demonstrated a good understanding, and 48% exhibited a very good level of comprehension, as shown in the questionnaire diagram.

Additionally, the research findings require regular evaluation to assess students understanding and progress in Project – Based Learning (PBL) and Problem - Solving approaches. It is also essential to explore alternative methods that can further enhance students analytical skills and overall learning outcomes.

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