International Journal of Innovation and Education Research (IJIER)
Publisher: Univ Press
Volume 3 Number 2, 2024
Page 110-120

Analysis of Physics Education Students Responses to the Development of Electronics Laboratory Guide Modules

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Abstract

The development of laboratory guide modules represents a strategic step in enhancing the quality of learning in physics education, particularly in electronics courses. This study aims to analyze students' responses to the development of modules based on a collaborative learning approach. Using a survey method involving 29 Physics Education students at Universitas Bengkulu, the results reveal that the developed module demonstrates advantages in terms of structure, language clarity, theoretical relevance, and the effectiveness of visual media. Additionally, the module is deemed capable of improving critical thinking skills, and problem-solving abilities, supporting the achievement of learning outcomes aligned with the syllabus. The average student response score falls into the "Very Strong" category, indicating positive reception of the module. Therefore, the development of innovative laboratory guide modules based on collaborative learning can be recommended to enhance the effectiveness of practical learning in electronics.

Keywords: *Collaborative Learning, Laboratory Guide Module, Response*

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Introduction

Education is a vital long-term investment for every person. It significantly contributes to shaping high-quality human resources. Enhancing education quality involves not only fostering students' potential but also improving educators' abilities to effectively support the learning process (Lestari, Sutarno, Rohadi, Sakti, & Nirwana, 2021). Physics, particularly through laboratory activities, is one of the subjects capable of fostering students' critical thinking skills.

Laboratory activities are a crucial part of the learning experience in physics education, particularly in electronics courses. These activities help students develop both a strong conceptual foundation and practical technical skills applicable to their future careers. Nonetheless, the effectiveness of laboratory sessions largely depends on the availability of well-designed and efficient laboratory guide modules. (Oktaviana & Prihatin, 2020). Ideally, these modules should clarify theoretical concepts, outline practical procedures, and help students enhance their analytical and problem-solving abilities. Laboratory guide modules play an essential role in laboratory sessions; beyond functioning as instructional tools, they can be structured to equip students with the skills to work systematically and apply scientific methods (Furqan, Yusrizal, & Saminan, 2016).

A module serves as an educational tool that is an essential component of the learning process in universities. Instructional media play a vital role in education by facilitating knowledge transfer from educators to learners. In physics, one example of instructional media is the use of modules (Sukiminiandari, Budi, & Supriyati, 2015). The demand for effective laboratory modules has grown more pressing, highlighting the importance of achieving learning objectives. Many existing modules tend to be descriptive and lack interactive elements, limiting their effectiveness in fostering essential 21st-century skills like critical thinking, collaboration, and communication (Adhelacahya, Sukarmin, & Sarwanto, 2023). The development of modules should be highly adaptable to advancements in science and technology, ensuring that each learning activity aligns with the core competencies and the syllabus (Hudha, Aji, & Rismawati, 2017).

Laboratory activities provide students with opportunities to cultivate critical thinking, problem-solving abilities, and a thorough grasp of concepts. Achieving these goals requires innovative approaches to developing laboratory modules, such as incorporating collaborative learning. (Muslim, Ariska, Sriwijaya, Dasar, & Konsep, 2020). Collaborative learning focuses

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on fostering student interaction, enabling them to work together in solving problems, discussing concepts, and exchanging ideas. This method has been shown to significantly improve both students' conceptual understanding and their social skills. (Nazeef, Khan, & Ali, 2024). Students generally have a highly positive attitude toward collaborative learning, recognizing its benefits in enhancing their understanding of the material while also improving their communication and teamwork skills (Wicaksono, Hakim, Yudiernawati, & Rusmawati, 2024). In the context of electronics courses, collaboration-based module development provides students with opportunities to design experiments, analyze data collectively, and apply knowledge in practical situations. Additionally, this approach can help students understand the relationship between theory and practice, which is crucial in technical fields like electronics.

To improve the effectiveness of learning, it is crucial to develop laboratory guide modules that employ innovative approaches. These modules should go beyond technical instructions by integrating active learning strategies, such as tasks for analyzing experimental results and reflective activities on laboratory experiences. Additionally, evaluating students' feedback on the developed modules is vital, as it provides valuable insights into their acceptance and overall effectiveness. (Suastra, Ristiati, Adnyana, & Kanca, 2019).

This research aims to analyze the responses of students in the physics education program toward the development of an electronics laboratory guide module. The main focus of the research is to evaluate the module’s effectiveness in terms of material clarity, relevance to laboratory needs, and its impact on students' conceptual understanding.

Research Method

The research employed a quantitative approach. The method utilized was a survey conducted through questionnaires distributed after a limited trial using the developed laboratory guide module. The limited trial applied a collaborative learning system. Collaborative learning is a teaching strategy that focuses on students working together to reach common learning goals. It encourages active interaction within a group, where individuals share ideas, solve problems, and develop a collective understanding (Cagatan & Quirap, 2024). Collaborative learning improves the effectiveness of education by fostering active communication among students, leading to a more enriching and rewarding learning experience (Hasja, Rahman, & L, 2023).

Surveys are a method of data collection from multiple units or individuals. This study

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involved a population of 29 physics education students from the 2022 academic year at the Faculty of Teacher Training and Education, Universitas Bengkulu. The research procedures consisted of the following steps: (1) collecting references from books and journals; (2) identifying the research population and sample; (3) preparing research instruments, such as questionnaires; (4) gathering data in the field; and (5) analyzing the average student response scores according to the score interpretation criteria using Equation 1 (Budiastra & Wicaksono, 2023).

$$\frac{\text{Average score of question items}}{\text{highest score question item}} \text{ x } 100\% \quad (1)$$

Criteria :

0% - 20% value = very weak

21% - 40% value = weak

41% - 60% value = enough

61% - 80% value = strong

81% - 100% value = very strong

Data collection involved the use of questionnaires and a module validated by three experts (validation in terms of content, language, and visual aspects). The questionnaires employed were of a closed-ended format, consisting of 13 items assessed on a 4-point Likert scale: STS (Strongly Disagree) with a score of 1, TS (Disagree) with a score of 2, S (Agree) with a score of 3, and SS (Strongly Agree) with a score of 4. The data obtained were subsequently analyzed and interpreted to draw conclusions.

Result and Discussion

Result

Response analysis was performed by evaluating the validity of the instruments to ensure that the data collected aligned with the research objectives. This process focused on two key aspects: validity and reliability. Without these two elements, the results could become inaccurate, respondent information may become irrelevant, and this could lead to erroneous interpretations and poor decision-making (Budiastra, Erlina, & Wicaksono, 2019).

Response analysis used two main approaches to ensure data quality and the reliability of the research findings. The first approach, rational analysis, relied on logical reasoning and

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systematic thinking to assess the results. The second approach, empirical statement-based analysis, was based on data and evidence that could be objectively verified (Budiastra et al., 2019). Both approaches aimed to ensure that the results aligned with the research objectives and could be scientifically justified (Pozzi, Manganello, & Persico, 2023).

The comparison between the modules before and after development is presented in Table 1.

Table 1. Differences Between Modules Before and After Development

No	Topic	Module Before Development.	Module After Development.
Fill Content in Modules.			
1.	Practical Learning Achievements.	Not Yet.	There is, based on 'RPS'.
2.	Objective.	There is.	There is. Development: Refers to RPS. Addition of more specific Learning Objectives to the Module.
3.	Basic Theory.	Not Yet.	There is.
4.	Pre-Test	Not Yet.	There is. Development: added video link or digital learning media from Quizziz.
5.	Tools and materials.	There is.	There is.
6.	Experiment Preparation.	There is.	There is. Added a video link for preparing the experiment.
7.	Experimental Steps.	There is.	There is.
8.	Observation result	There is.	There is.
9.	Discussion	There is.	There is.

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10.	Post Test	Not Yet.	There is.
11.	Conclusion	Not Yet.	There is.
12.	Reference	Not Yet.	There is.
13.	Attachment to Practical Report Format	Not Yet.	There is.
14	Changes to Image Composition and Text Placement on the Module.	There is.	There is Development: Improved image composition and text placement.

The questionnaire results were processed using average scores, score percentages, and evaluation categories for each indicator based on Equation 1. Responses reflect individual tendencies to adopt specific attitudes, whether positive or negative. The results of the questionnaire analysis are presented in Table 2.

Table 2. Results of student responses to the development of electronics practicum modules in the Physics Education Study Program

No	Question	Average score.	Score Percentage %	Criteria
1	This practical guidance module has a neat and systematic structure. The layout and design of this module's practical guide is attractive and make it easy to read.	3,72	93,10 %	Very strong
2	The use of language in the practical guidance module is appropriate and not confusing.	3,65	91,37%	Very strong
3	This electronics practicum guide module can help me prepare myself before doing the practicum.	3,65	91,37%	Very strong
4	The theoretical explanation in this module	3,62	90,52%	Very

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	supports my understanding of the practical material.			strong
5	The pictures, tables, and diagrams used in this practical guide module can help my understanding of the material.	3,55	88,79%	Very strong
6	This practicum guide module helped me identify and solve problems that arose during the practicum.	3,55	88,79%	Very strong
7	I felt helped by the practical step-by-step guide presented in the practicum guide module.	3,55	88,79%	Very strong
8	This practicum guide module helped me in making practicum reports.	3,44	86,20%	Very strong
9	This practicum module encourages me to be more independent in learning	3,51	87,93%	Very strong
10	I feel enthusiastic about studying electronics practicum material using this practicum guide module.	3,48	87,06%	Very strong
11	This practicum guide module was able to improve my ability to carry out measurements and assemble electronic circuits.	3,44	86,20%	Very strong
12	This practicum guide module covers topics that are by the electronics practicum syllabus.	3,5	87,5%	Very strong
13	Overall, I am satisfied with this electronics practicum guide module and feel it is suitable to be applied to practicum activities.	3,55	88,79%	Very strong

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Discussion

The development of the practical guide module based on the data in Table 1, which includes the administration of a pre-test before the practical session, the use of videos or animations for explaining basic theories, and the inclusion of reading assignments or preparations before the practical, can support students in enhancing their understanding of the practical guide module and its connection to the theories learned in class. Moreover, students become more critical during the practicum, utilizing a collaborative learning system and incorporating video links for the practical steps in the module, thereby making students more active and helping them better understand the tasks they perform during the practicum. Regarding report writing, students gain a better understanding of the content and format of practical reports due to the addition of a practical report template in the newly developed electronics practical guide module. This is further supported by student feedback through a questionnaire.

The results of the questionnaire cover various aspect indicators. The aspect of the structure and design of the practical module received an average score of 3.72, with a percentage score of 93.10%. This indicates that the structure of the module is well-organized, and its design is appealing to students, thus supporting optimal student learning. The aspect of language usability scored an average of 3.65, with a percentage of 91.37%, indicating that the language used in the module meets the clarity and ease of understanding criteria, significantly aiding students in comprehending the module content. The aspect of module support for preparing students for the practicum scored 3.65 (91.37%), demonstrating that the practical module is highly effective in helping students prepare before conducting the practical sessions. The aspect of theoretical content presentation received an average score of 3.62 (90.52%), indicating that the theoretical content is effectively designed to help students understand the practical material.

The aspect of visual media effectiveness (images, tables, and diagrams) received an average score of 3.55, with a percentage of 88.79%, indicating that the visual media provided in the module is relevant and supports material comprehension. The aspect of procedural clarity scored 3.55 (88.79%), showing that the instructions for conducting the practical are clearly and systematically presented, facilitating student participation in the practical activities. The aspect of contextual relevance to practical problems also scored an average of 3.55 (88.79%), indicating that the module presents problems that are relevant to the field of electronics, offering

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practical context for students studying the material. The aspect of student skill development received a score of 3.51 (87.93%), indicating that the module significantly encourages the development of students' practical skills.

Questions 9-12 in Table 2 explain the alignment of the module with the syllabus and practical needs. The alignment of the module with the syllabus, learning needs, and practical activities scored an average between 3.44 and 3.48 (86%-88%). This result shows that the module has been developed in harmony with the curriculum needs and practical activities. The aspect of the module's feasibility for application received an average score of 3.55 (88.79%), indicating that students agree that the practical module is suitable for use in the learning process.

Overall, the electronics practical module received high ratings across all evaluation indicators, with percentage scores ranging from 86% to 93%, categorizing it as Very Strong. These findings suggest that the module has been well-designed and is suitable for supporting the learning process and the development of students' practical skills.

Conclusions

The research results indicate that the electronics practical guide module based on collaborative learning is effective in supporting students' understanding of concepts and mastery of skills. The module is systematically designed, with additional elements such as a pre-test, visual media, step-by-step practical guides, and report templates. Students provided positive feedback regarding the structure, design, and content of the module, which helped improve their readiness for the practical sessions as well as their understanding of theory and its application. Overall, the module has proven to be relevant and suitable for implementation in teaching, with an average evaluation score falling within the "Very Strong" category. Further development can be undertaken to expand its implementation and integrate interactive technologies that support the learning process.

Suggestion

Future research could explore the long-term impact of the collaborative learning-based electronics laboratory guide module on students' academic performance and practical skills. Comparing this approach with traditional teaching methods would offer insights into its effectiveness. Expanding the study to include a larger, more diverse sample across different

institutions could enhance the generalizability of the findings. Additionally, investigating the integration of digital tools, assessing the development of soft skills, and evaluating instructor feedback could provide valuable information for further improving the module. Exploring the adaptation of this module for other physics disciplines and incorporating formative assessments could also contribute to its broader application and effectiveness.

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