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RESEARCH ARTICLE

ET-PHYSICS in Higher Education: Developing Inquiry-Based Lab Guides Integrated with Local Wisdom for Basic Physics I

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Abstract

This study aims to develop an inquiry-based Basic Physics I practicum guide integrated with local wisdom to improve the quality of student learning. The method used is research and development (R&D) with the ADDIE model, which includes the stages of Analyse, Design, Development, Implementation, and Evaluate. The research instruments are validation sheets for material, language, and media aspects. The validation results showed a high level of feasibility, with an average score of 4.61 from subject matter experts, 4.25 from language experts, and 4.2 from media experts. This guide has been validated by experts and is ready for further testing. The integration of local wisdom makes learning more contextual and meaningful, while the inquiry approach encourages students to actively engage in scientific investigation and understand the relationship between physical phenomena and cultural contexts. The novelty of this research lies in the combination of the inquiry approach with local wisdom in the development of practical guides, which is still rarely applied at the university level. This guide is expected to become a reference in physics learning that fosters scientific attitudes, responsibility, and scientific process skills. The scientific contribution of this research is the provision of a culturally responsive laboratory guide model, with the implication that the integration of local contexts can increase student engagement and conceptual understanding. This research is limited to the development and expert validation stages, so further research is needed to evaluate the effectiveness of this guide in a real learning environment.

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INTRODUCTION

Education is very important for the advancement of a nation in science, technology, and human resources. The learning process at school can only be carried out effectively and can improve human resources (Akmaluddin et al., 2025). As stated in Article 3 of Law No. 20 of 2003 concerning the Indonesian National Education System.

Education in Indonesia is currently required to be able to adapt to various existing aspects so that it can keep up with developments. In addition, the world of education must be able to produce reliable human resources who are able to compete in the era of globalization (Madhakomala et al., 2022). The most appropriate effort to be made is through improving the quality of education.

Improving the quality of education is inseparable from the role of the government in achieving optimal educational goals. One of the Indonesian government's efforts to improve the quality of education is through continuous curriculum improvement (Hidayat et al., 2025). Curriculum development in Indonesia has undergone changes until the current curriculum based on the Merdeka Curriculum is regulated by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek). The regulations are stipulated in the Minister of Education, Culture, Research, and Technology Regulation Number 12 of 2024. Curriculum changes are adapted to changes in cultural life, the times, and the development of science. These changes are a form of continuous improvement in education in anticipation of future needs. In the Merdeka Curriculum, learning is centered on students or "student-centered learning," which is one of the learning approaches applied in this curriculum (Marthawati & Setyo, 2024). This approach places students as active subjects in learning.

Physics, as a fundamental science that studies natural phenomena, plays a crucial role in developing students' critical, analytical, and creative thinking. Physics is one way to teach students to have a scientific attitude and scientific methods to obtain scientific products (Sulistiyono & Arini, 2024). Physics education at the university level has a significant responsibility to produce graduates who not only master physics concepts but also possess critical, analytical, and creative thinking skills and the sense of responsibility required to face the challenges of the 21st century (Kurniawan et al., 2024). Efforts to realize these challenges in the physics education learning process are supported by the Basic Physics I course.

Basic Physics I, as an introductory course, is an important foundation in the physics education curriculum. This course introduces basic concepts that will form the basis for understanding more complex physics concepts in the future. Mastering these concepts at an early stage is very important, but learning Basic Physics I often faces various complex challenges. Abstract physics concepts, the lack of relevance of learning materials to everyday life, and the lack of supporting products are some of the factors that can hinder the effectiveness of learning (Wahyudi et al., 2022).

Based on observations with Physics Education lecturers at PGRI Silampari University who teach Basic Physics I, it was found that they still face various challenges. The practical guidelines currently used are procedural and do not provide opportunities for students to explore, formulate hypotheses, or draw conclusions independently.

Basic Physics I is often considered an abstract and difficult subject to understand due to the lack of context that is relevant to the experiences of students at . In fact, Basic Physics I is present in various aspects of life, including in the local wisdom possessed by the community around PGRI Silampari University. Local wisdom, which is traditional knowledge and practices passed down from generation to generation, contains many physics concepts that can be explored and integrated into learning (Sulistiyono & Arini, 2025).

The inquiry approach, which emphasizes discovery-based learning, can be a solution to overcome this problem. Inquiry provides opportunities for students to be active (Purtadi et al., 2023). The integration of local wisdom in inquiry can increase the relevance of learning, as students can connect physics concepts with their own experiences.

Recent international studies have also highlighted that guided inquiry has become one of the most recommended approaches in science education because it promotes conceptual understanding, scientific reasoning, and science process skills while maintaining sufficient instructional support for leaners. Moreover, contemporize science education emphasizes the importance of connecting scientific concepts with students socio cultural backgrounds and everyday experiences to create meaningful learning environments. Integrating local wisdom into guided inquiry is therefore consistent with global trends toward culturally responsive science education, where indigenous and local knowledge are recognized as valuable contexts for scientific investigation rather than as separate or competing knowledge systems (UNESCO,2021). Thus, the integration of local wisdom in inquiry based physics learning not only addresses local educational needs but also reflects internationally recognized principles of effective science education.

PGRI Silampari University, as a higher education institution committed to developing quality human resources, needs to innovate in physics learning. Therefore, this study aims to develop a Basic Physics I practical guide based on inquiry integrated with local wisdom. The inquiry approach provides opportunities for students to actively seek and discover physics concepts through direct experience (Gunawan et al., 2019). The integration of local wisdom in the practicum guide can increase the relevance of learning materials to students' daily lives, thereby improving their interest and motivation.

However, to date, the Basic Physics I laboratory manual used at PGRI Silampari University remains procedural in nature and does not guide students towards independent scientific inquiry activities. Students tend to follow the experimental steps without understanding the conceptual meaning behind the activities, and the available guides have not integrated the context of local wisdom that is close to their lives (Sundari et al., 2024). This condition creates a gap in the learning process, where students have not gained meaningful and contextual learning experiences.

Based on this, this study has novelty in the development of a Basic Physics I practicum guide based on inquiry integrated with local wisdom. The integration of these two approaches has not been widely done in the development of physics practicum teaching materials at the university level. This guide not only emphasizes the scientific discovery process through an inquiry approach but also highlights local cultural values as a scientific context, thereby fostering a sense of responsibility, scientific process skills, and the relevance of physics learning to students' real lives.

Furthermore, this study does not aim to report the final results of the development of practical guidelines, but rather focuses on the initial stages of research and development, namely the Analysis, Design, and Development stages, with validation by experts. Thus, this study is in the early stages of R&D and is part of an ongoing study that will continue to the implementation and evaluation stages in subsequent studies. This clarification is important so that the contribution of the research can be understood within the framework of a systematic R&D process.

METHOD

This study utilizes a research and development (R&D) methodology. Research and development in the world of education is a process that aims to develop and determine the validity of a product (Hasanah Dewi Lestari, 2023). In this study, the product to be developed is a Basic Physics I practicum guide based on integrated local wisdom inquiry as a learning resource, which will then be validated. The research design model used in this study is the ADDIE research and development model. The ADDIE model consists of five stages, namely Analyze, Design, Development, Implementation, and Evaluate (Mardianto et al., 2022). The product validation process involves three expert validators, consisting of one subject matter expert, one media expert, and one language expert. These validators provide comprehensive assessments of the content, media presentation, and language usage in the developed practical guidelines. The involvement of students and expert validators aims to ensure that the final product meets user needs and academic standards. The research instruments used included several evaluation tools to measure product feasibility and quality. The main instrument was a validation sheet covering material, language and media aspects using a 5-point Likert scale.

This study focuses on the development of an inquiry based Basic Physics I laboratory guide integrated with local wisdom using the ADDIE model. The present paper reports the initial phases of the development process, namely the Analysis, Design, and Development stages, including expert validation of the developed product. The implementation and evaluation stages will be addressed in subsequent studies.

Data Analysis

The data analysis technique for the validation results of the Basic Physics I practical guide based on integrated local wisdom inquiry is product validation conducted on the aspects of material, media, and language. Validators conducted validation using a validation sheet instrument with a 5-point scale scoring system, with the following criteria: 5 = very good; 4 = good; 3 = adequate; 2 = poor; 1 = very poor, which was then converted into qualitative data in the form of product feasibility levels (Yolanda et al., 2021). Additionally, the average validation results are also used as supporting evidence for product suitability. The guidelines for converting scores are outlined in Table 1 below.

Table 1. Conversion guidelines for scores

No.	Score Interval	Category
1	$X > \bar{x}i + 1.80$ Sbi	Very good
2	$\bar{x}i + 0.6$ Sbi$< X \leq \bar{x}i + 1.80$ Sbi	Good
3	$\bar{x}i - 0.6$ Sbi$< X \leq \bar{x}i + 0.6$ Sbi	Sufficient
4	$\bar{x}i - 1.80$ Sbi$< X \leq \bar{x}i - 0.6$ Sbi	Insufficient
5	$X > \bar{x}i - 1.80$ Sbi	Very insufficient

RESULT AND DISCUSSION

The development of an inquiry-based Basic Physics I practicum guide integrated with local wisdom conducted in this study included five stages of development, namely the Analyze stage, Design stage, Development stage, Implementation stage, and Evaluation stage (Christine Ulina Tarigan et al., 2024). In detail, the development stages are as follows: Analyze: at this stage, the learning needs for Basic Physics I practical work are identified, student characteristics are analyzed, the context of local wisdom relevant to physics material is analyzed, and gaps in existing practical work learning are analyzed. Design: designing a practical guide framework that includes inquiry-based activities (questioning, designing simple experiments, observing, analyzing data, drawing conclusions) and integrating elements of local wisdom (using local phenomena or local culture as the context for experiments). Development: developing a preliminary draft of the guide based on the design. then validated by three groups of experts: subject matter experts (physics lecturers), language experts (Indonesian language lecturers), and media experts (media specialists). Each expert provided an assessment using a 1–5 Likert scale and qualitative input for revision. Implementation: the revised guide was applied in the Basic Physics I practical class for a number of students. The responses of students and teachers/practicum were recorded as evaluation material, and Evaluation was carried out formatively based on the results of validation and readability tests to determine the level of product feasibility. Data analysis was carried out by calculating the average score for each aspect of validation and categorizing it based on feasibility criteria.

The validation of the Basic Physics I practicum guide based on integrated local wisdom inquiry aims to obtain feasibility before testing and to explore comments, criticisms, and suggestions both in writing and orally (Sulistiyono, 2022). The validation results show that the developed Basic Physics I practicum guide has a high level of feasibility. The material validation obtained an average score of 4.61 on a scale of 5, with 83 out of 90 scores indicating that the material in the practicum guide is highly feasible based on the assessment criteria, falling into the very good category. This indicates that the content presented is in line with the curriculum and relevant to student needs. The language validation also showed satisfactory results with an average score of 4.25 out of 5, with a total score of 34 out of 40, indicating that the language in the practicum guide is feasible based on the assessment criteria, falling into the good category. This indicates that the language used in the practicum guide is easily understood by students. Meanwhile, media validation received a score of 4.2 on a scale of 5, with 63 out of 75 validators stating that the media was acceptable based on the assessment criteria, falling into the good category. This indicates that the media used in the practical guide is sufficiently interesting and can support the learning process.

Table 2. Number of Scores from Validators

No.	Validation	Number of Scores	Number of Items	Average	Category
1	Materials	83	18	4.61	Highly Suitable
2	Language	34	8	4.25	Suitable
3	Media	63	15	4.2	Suitable

The high validation results in terms of material, language, and media indicate that the integrated inquiry-based Basic Physics I practical guide developed with local wisdom has excellent comprehensive quality. These results are inseparable from the application of the systematic ADDIE development model, which is oriented towards user needs, so that each stage of development—from needs analysis and design to evaluation—can produce a product that is valid and suitable for use (Hasanah Dewi Lestari, 2023).

The material aspect received the highest score because the content of the guide was compiled in accordance with the curriculum learning outcomes and included inquiry activities relevant to local cultural phenomena, making the concepts of physics more contextual and meaningful for students (Afkarina Izzata Dini & Febri Setiya Rini, 2024). This integration of local wisdom helps students understand the relationship between physics and daily life and increases their engagement in the learning process (Wahyuni et al., 2025).

Meanwhile, the linguistic aspect received high marks because the guide uses scientific language that is communicative, simple, and easy to understand, in line with the findings of) that the use of clear language in practical guides has a positive effect on students' understanding of concepts. The media aspect also showed good results because the appearance and structure of the guide were designed to be attractive, systematic, and easy to use in practical activities, as explained by (Washliyah, 2025) that the presentation of attractive learning media can increase student motivation to learn.

Overall, the high validation results reflect the success of the product development process, which not only meets academic standards but also considers cultural relevance and student learning needs, as emphasized by (Suratmi et al., 2024) that the integration of local culture in science learning can strengthen students' conceptual understanding and scientific attitudes.

In this context, it is important to note that the development of inquiry-based laboratory guides can help students to be more active in the learning process. By involving students in the investigation and experimentation process, they not only learn about physics concepts but also develop critical and analytical thinking skills. According to , inquiry-based learning can increase students' motivation and engagement in the learning process because it provides them with the opportunity to discover the concepts being studied through direct experience. This makes inquiry a relevant approach in physics learning, which requires strong conceptual understanding and problem-solving skills. By directly involving students in the process of experimentation and discovery, physics learning becomes more contextual, meaningful, and enjoyable.

The integration of the inquiry approach with local wisdom adds value to the learning process. Local wisdom contains traditional knowledge and practices that have long developed in society, reflecting the harmonious relationship between humans and their environment (Taufik et al., 2021). When local wisdom is used as a context in learning, students can understand physics concepts through phenomena that are close to their daily lives. This not only increases the relevance of learning but also fosters a sense of pride and responsibility towards local culture (Ruswinarsih et al., 2025). Therefore, combining the inquiry approach with local wisdom is an appropriate strategy to improve the quality of the learning process for students, especially in Basic Physics I practical.

Figure 1. Expert Validation

Figure 2. Language Expert Validation

Figure 3. Media Expert Validation

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Although the validation results indicate that the practical guide has a high level of feasibility, this study has not yet tested the effectiveness of the product in directly improving student learning outcomes or science process skills. Validation has only been carried out by experts, so empirical data based on field trials is not yet available. Therefore, the findings of this study should be understood as part of the initial stage of product development, which will be continued in subsequent studies through small and large-scale implementation.

CONCLUSION

The development of an inquiry-based Basic Physics I practical guide integrated with local wisdom is validated by experts and ready for further testing. This study offers a rare and original contribution at the university level. Theoretically, integrating cultural heritage supports constructivist theory by providing contextual scaffolding, which enhances students conceptual understanding an engagement in everyday scientific investigations. Practically, it offers a replicable template for other universities to integrate their own local cultures into rigid science curricula.

However, this study has not yet tested product effectiveness on learning outcomes or science process skills, as empirical data from field trials is not yet available. Therefore, these findings represent the initial stage of product development, which must be continued in subsequent studies through small- and large-scale implementation.

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