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Development of Guided Inquiry-Based Student Worksheet Assisted by Assemblr Edu to Enhance Conceptual Understanding in Electronics Course

Indah Selviandri*, Nehru, Cicyn Riantoni
Physics Education Department, Universitas Jambi, Jambi, Indonesia

**Corresponding Author: indahselviandri55@gmail.com*

Abstract

This study aims to develop a Guided Inquiry-Based Student Worksheet (LKPD) assisted by Assemblr Edu to improve students' conceptual understanding in an Electronics course. The LKPD is designed to engage students in structured investigative learning through the guided inquiry approach, while Assemblr Edu serves as a visualization tool for displaying 3D representations of equipment, materials, and electronic circuits used in learning activities. The study follows the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation), but is limited to the development phase. Data were collected through expert validation sheets and student perception questionnaires. The content and media experts each provided a validation score of 95%, categorizing the LKPD as "highly valid" for field testing. Furthermore, the student perception analysis yielded a favorable score of 92.3%, indicating strong acceptance of the product in terms of design, content clarity, and learning motivation. These results confirm that the developed LKPD is both pedagogically and technologically suitable for use in higher education, particularly in supporting students' conceptual understanding of complex topics such as RC and RLC series circuits in alternating current (AC). The integration of guided inquiry with augmented reality enhances student engagement and allows for better conceptual visualization, making it a promising tool for improving the quality of Electronics instruction.

Keywords: Student worksheet; Guided inquiry; Assemblr edu; Conceptual understanding.

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INTRODUCTION

The rapid advancement of information and communication technology has significantly influenced the landscape of education, prompting shifts in instructional strategies and the development of learning materials. In the midst of this digital transformation, the teaching of physics continues to demand substantial efforts to cultivate students' deep conceptual understanding. Physics is not merely a discipline concerned with natural phenomena; rather, it serves as a vital platform for developing scientific reasoning and complex problem-solving skills. Among the various courses within the physics education curriculum, Electronics stands out as a subject with a high degree of conceptual and technical complexity. This course requires students to master interrelated concepts involving electrical theory, the characteristics of electronic components, and their practical applications in real-world technological and industrial contexts (Supraptono & Setiawan, 2017).

Despite its importance, many students encounter significant challenges in grasping the concepts of electronics. The abstract nature of the material, coupled with the prevalent use of lecture-based methods, often results in passive learning environments that emphasize rote memorization over meaningful understanding (Islami & Sunni, 2019). Such conditions hinder students from effectively connecting various concepts and applying them in real-life scenarios. To address these issues, there is a pressing need for instructional tools that promote active, in-depth, and contextual learning.

One promising solution is the implementation of Student Worksheets (Lembar Kerja Peserta Didik, LKPD). LKPDs are instructional materials systematically designed to guide learners in exploring concepts and solving problems. Their strengths include minimizing the instructor's dominant role, fostering student-centered learning, presenting concise and clear content, and offering relevant exercises to reinforce understanding (Sari & Wulandari, 2020). In particular, guided inquiry-based LKPDs encourage students to become active participants in their own learning processes, engaging them in investigative tasks that lead to conceptual discovery.

A growing body of research supports the use of guided inquiry in LKPDs across various educational levels. Haryanto et al. (2017) developed guided inquiry-based LKPDs that effectively enhanced both practical skills and conceptual understanding in junior high school science education. Similarly, Fitri et al. (2017) demonstrated that guided inquiry learning significantly improved students' comprehension of the respiratory system. In higher education, Riani et al. (2021) integrated the Edmodo digital platform into physics LKPD development, resulting in increased student interactivity and improved understanding. The guided inquiry model positions students as central agents in the learning process, with instructors serving as facilitators. This model encourages learners to investigate problems, design and conduct experiments, analyze data, and derive conclusions through a structured inquiry framework (Triandini et al., 2021). These findings affirm the effectiveness of guided inquiry-based LKPDs in fostering deeper understanding and active engagement across educational contexts.

However, the integration of technology in the development of LKPDs remains limited. Most existing implementations are either in printed format or utilize basic digital platforms such as Edmodo or Google Forms. These tools, while accessible, lack immersive features that support the visualization of abstract scientific concepts. Emerging technologies, particularly those based on Augmented Reality (AR), offer new possibilities for enhancing science learning. Assemblr Edu, an AR-based platform, enables users to access interactive 3D animations, audio, and visual content using smartphones, thereby offering an enriched and accessible learning experience (Ramadhan et al., 2024). Its features, including QR code scanning and interactive visualization, allow students to independently explore abstract concepts in a concrete and engaging manner.

Despite the clear potential of Assemblr Edu, there remains a gap in the literature regarding the development of guided inquiry-based LKPDs that are integrated with AR platforms, especially for higher education Electronics courses. Current approaches still rely heavily on conventional methods that may not sufficiently support students in visualizing complex and abstract content. Therefore, there is a critical need to develop innovative instructional materials that combine pedagogical rigor with technological interactivity to address these limitations.

To respond to this challenge, the present study introduces a novel learning tool: a guided inquiry-based LKPD integrated with Assemblr Edu, specifically designed for the topic of RC and RLC series circuits in alternating current (AC) within the Electronics course. The LKPD is structured according to the guided inquiry syntax, comprising six stages: (1) orientation to the problem, (2) presentation of the problem, (3) hypothesis formulation, (4) design and conduct of experiments, (5) data analysis, and (6) conclusion drawing. This structure aims to promote critical thinking and student involvement throughout the inquiry process. Additionally, the integration of AR via QR codes enables the visualization of circuit components and operations, which enhances students' ability to comprehend abstract concepts more effectively.

This study addresses the following research questions:

1. What is the feasibility of the guided inquiry-based LKPD assisted by Assemblr Edu according to content and media experts?
2. What are students' perceptions of the use of the developed LKPD in learning Electronics?

Accordingly, the objective of this study is to describe both the feasibility and student perceptions of using a guided inquiry-based LKPD integrated with Assemblr Edu. The aim is to establish the effectiveness of this innovative instructional material in enhancing students' conceptual understanding of complex topics in Electronics. By doing so, this research contributes to the advancement of pedagogical strategies and digital resources in science education.

METHODS

Type of Research

This study employed a Research and Development (R&D) design aimed at producing an innovative instructional product in the form of a guided inquiry-based Student Worksheet (LKPD) integrated with Assemblr Edu, specifically for the Electronics course in higher education. The development model adopted was the widely recognized ADDIE model, which includes five sequential stages: Analysis, Design, Development, Implementation, and Evaluation. However, in this study, the scope was limited to the Development stage, as the primary objective was to produce the LKPD and evaluate its feasibility and user perception.

Development Procedure

The development of the guided inquiry-based LKPD assisted by Assemblr Edu followed the ADDIE model, a widely recognized instructional design framework consisting of five key phases: Analysis, Design, Development, Implementation, and Evaluation (see Figure 1). In this study, the procedure was limited to the first three stages, with a focus on producing a valid and applicable instructional product.

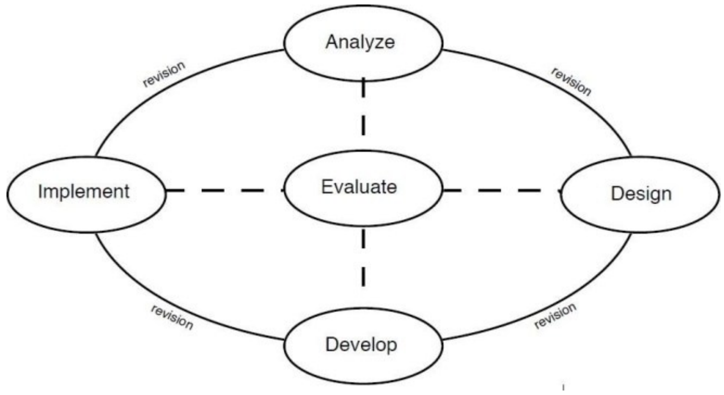

Figure 1. The ADDIE model

The Analysis phase aimed to identify the core problems within the existing learning process, particularly in the Electronics course. This stage was conducted through field observations and literature reviews to understand the learning characteristics of students and determine the instructional needs. The results revealed that traditional lecture-based teaching methods were still dominant, with limited student engagement and a lack of interactive media to support the understanding of abstract concepts, such as RC and RLC series circuits. Based on this analysis, the necessity of developing an instructional tool that promotes active learning and visual engagement became evident.

In the Design phase, the instructional content and structural framework of the LKPD were carefully planned. This involved mapping out the content according to the guided inquiry syntax, which consists of six stages: (1) orientation to the problem, (2) presentation of the problem, (3) hypothesis formulation, (4) experiment design and execution, (5) data analysis, and (6) conclusion drawing. To support the visualization and interactivity elements, QR codes were embedded within the LKPD pages. These QR codes direct students to 3D animations and interactive learning materials hosted on the Assemblr Edu platform, thereby enhancing comprehension of complex electronic components and principles.

During the Development phase, the LKPD was produced in a printable format and integrated with digital media through Assemblr Edu. The product was enriched with barcodes linking to 3D simulations of tools, circuits, and components. To ensure the quality of the instructional material, the LKPD underwent a validation process involving both content experts and media experts. Each expert evaluated the product based on specific criteria such as accuracy, relevance, visual presentation, interactivity, and technological integration. After undergoing revisions based on expert feedback, the improved version of the LKPD was tested with a group of university students. Their perceptions were gathered through structured questionnaires, which provided insights into the LKPD's practicality, effectiveness, and student engagement.

Through this systematic procedure, the LKPD was iteratively refined to meet both academic and technological standards, aiming to offer a more meaningful and interactive learning experience in the Electronics course.

Research Instruments

To collect comprehensive data on the feasibility and reception of the developed Student Worksheet (LKPD), two primary instruments were employed during the study. The first instrument was the Expert Validation Sheet, which was utilized by both subject matter experts and media experts. These sheets were designed to evaluate various aspects of the LKPD, including the relevance and accuracy of the content, the clarity of instructional language, the structural presentation of information, and the integration of interactive elements—particularly the use of Assemblr Edu for augmented reality-based visualization. The validation process provided critical insights into the pedagogical soundness and technological quality of the instructional product. The second instrument was the Student Perception Questionnaire, which was distributed to students who participated in the trial implementation of the LKPD. This questionnaire aimed to capture students' perspectives on the usability, visual appeal, and instructional effectiveness of the worksheet. It included items that assessed students' motivation, ease of understanding the materials, and the extent to which the guided inquiry approach and AR integration supported their conceptual understanding. The responses collected from this instrument were essential in determining the practical value and acceptance of the product in real learning settings.

Data Analysis Techniques

The data analysis in this study encompassed both quantitative and qualitative approaches to comprehensively evaluate the overall quality and acceptance of the developed instructional product. Quantitative analysis was conducted to assess the feasibility of the LKPD using validation scores obtained from expert assessments, which were calculated using a Likert scale and interpreted through percentage-based criteria. Meanwhile, qualitative analysis involved examining feedback, suggestions, and critiques from both experts and students to gain deeper insights into the strengths and areas for improvement of the LKPD, thereby supporting iterative refinement and enhancement of the instructional material.

Quantitative Analysis

Quantitative analysis was performed to evaluate the feasibility of the LKPD based on expert validation. The Likert scale was used as the scoring method, where responses were rated from 1 to 4, corresponding to "Strongly Disagree" to "Strongly Agree" respectively. The scoring criteria are presented in Table 1.

Table 1. Likert scale scoring criteria (adapted from Fatona, 2021)

Response Option	Score
Strongly Agree	4
Agree	3
Disagree	2
Strongly disagree	1

To determine the percentage score of each item, the following formula was used:

$$\text{Percentage} = [(\text{total score})/(\text{maximum score})] \times 100\%$$

After obtaining the percentage score, the result was interpreted according to Table 2, which categorizes the level of feasibility as follows:

Table 2. Feasibility rating interpretation (adapted from Supriatna et al., 2022)

Percentage range	Feasibility Level
76 % - 100 %	Very Feasible
51 % - 75 %	Feasible
26 % - 50 %	Moderately Feasible
0 % - 25 %	Less Feasible

These thresholds provided a clear guideline for determining whether the LKPD met acceptable standards for content validity, visual design, and technological integration before being field-tested with students.

Qualitative Analysis

In addition to quantitative scoring, qualitative data were gathered in the form of written comments and suggestions from both expert validators and student respondents. These data were used to improve various elements of the LKPD throughout its development iterations. Feedback from validators focused on content structure, instructional clarity, design aesthetics, and the effectiveness of AR visualizations. Student responses addressed layout appeal, engagement, ease of use, and conceptual clarity. These inputs were essential in enhancing the quality of the LKPD to meet pedagogical goals and user expectations.

RESULTS AND DISCUSSION

Analysis Phase

The initial phase of this study focused on analyzing the learning needs within the Electronics course. Observations and preliminary assessments revealed that the current instructional approach heavily relied on traditional lecture methods, which lacked student-centered strategies and the use of interactive learning media. Students frequently expressed difficulties in understanding abstract content, especially topics such as RC and RLC series circuits in alternating current (AC) contexts. These topics require high levels of visualization and conceptual linkage, which were not sufficiently addressed in the available instructional materials.

Furthermore, it was found that instructors had not adopted guided inquiry-based worksheets nor utilized technological tools such as Assemblr Edu to support the learning process. Assemblr Edu, with its capacity to present electronic components and circuit operations in 3D, had not yet been incorporated into instructional practices. This gap underscored the necessity to develop a learning resource that actively engages students, provides structured scientific guidance, and leverages technology to accommodate the abstract nature of the course content.

Design Phase

During the design phase, the student worksheet (LKPD) was structured according to the syntax of guided inquiry. This model includes six stages: (1) problem orientation, (2) problem presentation, (3) hypothesis formulation, (4) experiment planning and implementation, (5) data analysis, and (6) conclusion drawing. The entire LKPD was intentionally crafted to stimulate critical thinking and active investigation among students.

To enhance visual comprehension and accessibility, the LKPD was embedded with QR codes directing students to Assemblr Edu, where they could explore interactive 3D visualizations of electronic circuits and components. This integration aimed to bridge the gap between abstract theory and tangible understanding, enabling students to interact with concepts in a more engaging and realistic manner.

Development Phase

Feasibility of the Guided Inquiry-Based LKPD with Assemblr Edu

Before implementing the LKPD in real classroom settings, it was subjected to a series of validation tests by content experts and media experts. This validation process aimed to assess the product's feasibility for trial use. Content validation occurred in three stages. The initial validation yielded a score of 73%, which was categorized as "valid," indicating the product had acceptable quality but required refinement. Identified issues included misalignment between content and learning objectives, a lack of systematic presentation, and suboptimal image quality.

In response to these findings, revisions were made, including the addition of QR-linked instructional videos and sample problems for each subtopic. The second validation increased the score to 83%, categorized as "very valid." A final revision phase resulted in a score of 95%, firmly placing the LKPD in the "highly valid" category, suggesting that the product was thoroughly suitable for field testing.

These results align with previous findings emphasizing the positive impact of interactive media on conceptual understanding in electronics education (Sari et al., 2021). Moreover, guided inquiry-based worksheets have been shown to be more effective than conventional learning methods in fostering conceptual comprehension (Wulandari & Santosa, 2020). The improvements throughout the validation stages are illustrated in Figure 2, which shows the progression of content expert validation scores across three phases.

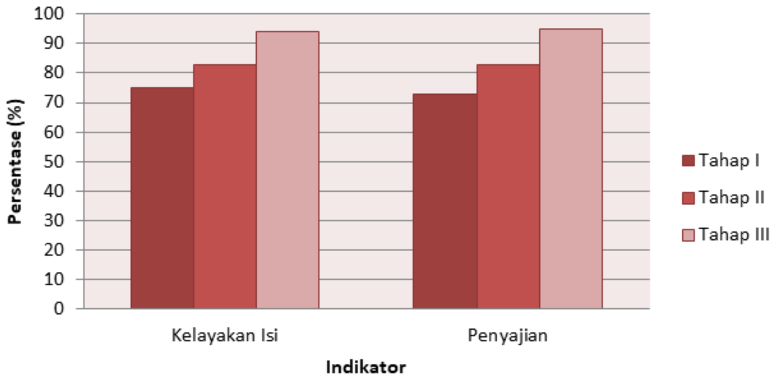

Figure 2. Material expert validation results

Parallel validation by media experts focused on four indicators: integration, color schemes, layout design, and the Assemblr Edu interface. In the first evaluation phase, the LKPD achieved a 75% rating, labeled as "valid." Nevertheless, several issues were noted, such as lack of differentiation between instructor and student versions, overly saturated color backgrounds, irrelevant imagery, low-resolution graphics, and missing labels for QR codes.

After targeted improvements, the LKPD score rose to 95%, meeting the "highly valid" criterion. These results support the view that 3D-based interactive media such as Assemblr Edu significantly enhance student motivation, engagement, and comprehension of abstract content (Ramli et al., 2025). The details of media expert validation improvement are presented in Figure 3.

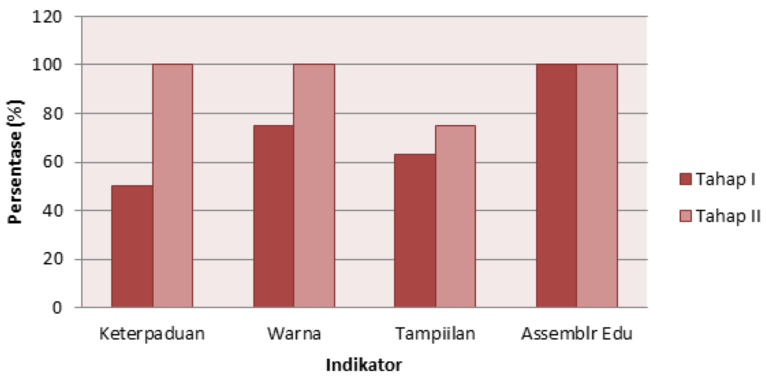

Figure 3. Media expert validation results

Overall, the validation stages demonstrated consistent improvement, indicating that the LKPD had reached a sufficient level of quality for instructional use. With high validity ratings from both content and media experts, the worksheet emerged as a robust supplementary material suitable for guided inquiry learning in electronics, particularly for abstract circuit topics.

Student Perceptions of the LKPD

The final stage of the development process involved field testing the LKPD with 34 second-year Physics Education students from Universitas Jambi. The objective was to evaluate student perceptions regarding the design, clarity, relevance, and overall effectiveness of the product. Data were gathered using a structured questionnaire administered offline.

The results revealed strong positive feedback. In terms of layout design, the LKPD scored 94%, indicating that students highly appreciated its neat arrangement, consistent font usage, and supportive illustrations. For the engagement factor, the LKPD scored 90%, suggesting it was effective in capturing students' attention and enhancing learning motivation. Content feasibility received a score of 93%, reflecting students' recognition of the material's relevance, clarity, and alignment with guided inquiry principles.

These findings are consistent with prior research highlighting the importance of structured, visually appealing, and contextually relevant instructional materials in increasing student interest and learning outcomes (Pratiwi & Sari, 2021). The graphical summary of student perception results is shown in Figure 4.

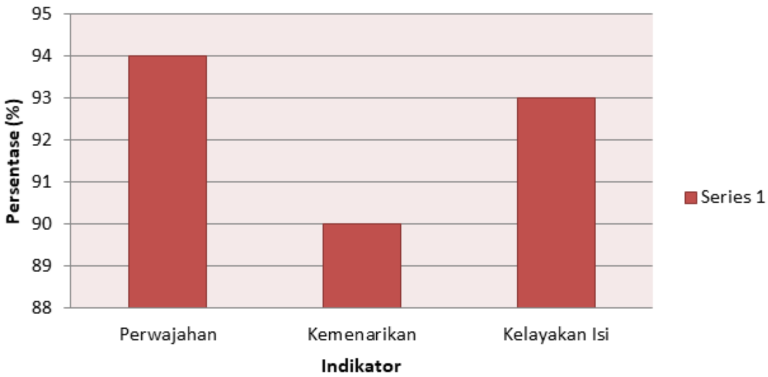

Figure 4. Student perception results

Based on these results, it can be concluded that the guided inquiry-based LKPD assisted by Assemblr Edu was not only feasible and academically sound but also well-received by students. The integration of AR elements and inquiry-based learning processes enabled a clear and meaningful instructional experience. Consequently, the LKPD can be effectively applied in the classroom to support electronics education and enhance the quality of concept acquisition among undergraduate physics students.

CONCLUSION

Based on the development process and evaluation of the guided inquiry-based Student Worksheet (LKPD) assisted by Assemblr Edu in the Electronics course, two key conclusions can be drawn in relation to the objectives of this study.

First, in terms of product feasibility as assessed by content and media experts, the developed LKPD fulfilled essential criteria related to content accuracy, presentation quality, and visual design. These criteria are aligned with the principles of guided inquiry pedagogy and effective integration of digital media. The iterative validation process demonstrated substantial improvements, indicating that the LKPD is both technically and substantively appropriate for instructional use. It effectively addresses the need for innovative instructional materials that enhance students' conceptual understanding, particularly in abstract topics such as RC and RLC series circuits within the Electronics curriculum.

Second, student perception of the LKPD revealed a highly favorable response, characterized by strong levels of engagement, ease of use, and instructional effectiveness. These findings suggest that the product is not only academically viable but also relevant and meaningful from the perspective of students' learning experiences. The incorporation of interactive AR-based elements and guided inquiry structure significantly enriched the learning process, enabling students to engage more deeply with complex concepts.

In conclusion, the guided inquiry-based LKPD assisted by Assemblr Edu is a pedagogically sound and technologically relevant resource that can be effectively utilized to support and enhance the quality of Electronics education at the undergraduate level.

RECOMMENDATION

Although the guided inquiry-based LKPD on RC and RLC circuit materials has demonstrated strong feasibility and positive student reception, further development and refinement are still needed. Future researchers are encouraged to continue improving the quality of this instructional tool, particularly in terms of visual design, interactivity, and the depth of conceptual content. Expanding the scope of its implementation and assessing its effectiveness across different learning environments and student populations would also provide valuable insights. Additionally, integrating more complex simulations, adaptive feedback, or multimedia resources may enhance the learning experience and promote deeper engagement with abstract physics concepts.

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REFERENCES

Fitri, T. Y., Hasanuddin, & Abdullah. (2017). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Inkuiri Terbimbing untuk Meningkatkan Pemahaman Konsep Peserta Didik pada Materi Sistem Pernapasan Manusia Kelas VIII di

SMPN 1 Indrapuri. *Jurnal Edubio Tropika*, *5*(2), 98–102.

Haryanto, P. C., Wilujeng, I., & Anjasari, P. (2017). Pengembangan Lembar Kerja Peserta Didik (Lkdp) Berbasis Guided Inquiry Untuk Meningkatkan Practical Skills Dan Pemahaman Konsep Ipa Peserta Didik SMP Development Of Students Worksheet Based On Guided Inquiry To Improve Practical Skills And Comprehension. *Jurnal Pendidikan Matematikan Dan Sains*, 1–7.

Islami, A. V., & Sunni, M. A. (2019). *Penguasaan Konsep Elektronika Dasar Mahasiswa Program Studi Teknik Komputer Dengan Pembelajaran Kontekstual Melalui Pemecahan Masalah*. *1*, 348–357

Pratiwi, D. N., & Sari, R. M. (2021). Pengaruh Desain dan Isi Bahan Ajar Terhadap Motivasi dan Pemahaman Belajar Siswa. *Jurnal Pendidikan dan Pembelajaran*, 8(2), 105-114.

Ramadhan, S., Mutiara, M., Karlina, N., Rahmah, L., Lusiana, L., Nurnabila, N., & Nurdiniawati, N. (2024). Pemanfaatan Alat Peraga Augmented Reality (Ar) Menggunakan Assembler Edu Bagi Anak Spirit Nabawiyah Comuniti (Snc). *Taroa: Jurnal Pengabdian Masyarakat*, *3*(2), 144–157. https://doi.org/10.52266/taroa.v3i2.2834

Ramli, Z. J., Sukitman, T., & Zainuddin. (2025). Implementasi Media Pembelajaran Berbasis Website 3D Assemblr Edu pada Materi Tata Surya Mata Pelajaran IPAS Kelas 6 di SDN Bunder 2. Consilium: Education and Counseling Journal, 5(1), 699–709. https://doi.org/10.36841/consilium.v5i1.6235

Riani, L., Misdalina, M., & Sugiarti, S. (2021). Pengembangan LKS Berbasis Inkuiri Terbimbing Berbantuan Edmodo Untuk Meningkatkan Pemahaman Konsep Fisika Siswa Kelas X IPA. *Jurnal Penelitian Pembelajaran Fisika*, *12*(1), 90–99. https://doi.org/10.26877/jp2f.v12i1.7552

Sari, R. P., Putri, D. M., & Rahman, A. (2021). Pemanfaatan media interaktif untuk meningkatkan pemahaman konsep pada mata kuliah elektronika. Jurnal Pendidikan dan Pembelajaran, 28(1), 45-54.

Supraptono, E., & Setiawan, H. (2017). Dampak Penggunaan Media Pembelajaran Berbasis Web Terhadap Kompetensi Materi Perkuliahan Elektronika Dasar. *Jurnal Penelitian Pendidikan Indonesia*, *2*(3), 1–9.

Wulandari, D. A., & Santosa, S. (2020). Pengaruh LKPD Berbasis Guided Inquiry terhadap Pemahaman Konsep dan Keterampilan Berpikir Kritis Mahasiswa. *Jurnal Pendidikan Fisika Indonesia*, 16(1), 30-38.