

**Analysis of Media and Learning Resources Used by Teachers  
in the Topic of Direct Current Circuits in Physics****Nurhamdin Putra\*, Iskandar Zulkarnain, Wandika, Desnita, and Usmeldi**Master of Physics Education Study Program, Universitas Negeri Padang  
Padang, Indonesia\*[nurhamdinputra@gmail.com](mailto:nurhamdinputra@gmail.com)**Abstract**

This study aims to analyze the media and learning resources used in 6 public and private high schools to explain the 12th-grade Physics material of Direct Current (DC) circuits and to analyze the media and learning resources with the potential for development in teaching Physics, particularly in the topic of DC circuits, in these six schools. The research employed a quantitative descriptive method with a survey approach, and the instrument used was a questionnaire. The data were obtained from the distribution of questionnaires, with 282 respondents from 6 different schools. The collected data were analyzed by calculating the percentage of media and learning resources used by the six schools. The results showed that the learning media with the highest percentage is "other media," including print media (textbooks), whiteboards, and direct explanations by teachers, with 40.46%. Meanwhile, the lowest percentage is for PhET at 10.54%. Regarding learning resources, printed books have the highest percentage at 44.98% and the lowest for modules at 9.17%. In conclusion, the most widely used media by the six schools to explain DC circuits are print media (textbooks), whiteboards, and direct explanations by teachers. The most commonly used learning resource is printed books. Additionally, the media with the potential for development is PhET, and the learning resource with development potential is modules. This is because these media and learning resources are still underutilized in the six public and private high schools when explaining DC circuits. This research provides insights into the needed media and learning resources, their limited availability, and their potential for development in teaching DC circuits in these six public and private high schools.

**Keywords:** analysis; learning physics; learning resources; media

Received : 8 June 2023

Accepted : 13 January 2024

Published : 27 February 2024

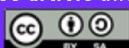
DOI : <https://doi.org/10.20527/jipf.v8i1.9069>

© 2024 Jurnal Ilmiah Pendidikan Fisika

**How to cite:** Putra, N., Zulkarnain, I., Wandika, W., Desnita, D., & Usmeldi, U. (2024). Analysis of media and learning resources used by teachers in the topic of direct current circuits in physics. *Jurnal Ilmiah Pendidikan Fisika*, 8(1), 1-11.**INTRODUCTION**

Knowledge and technology are crucial to master due to the demands of the 21st century. All current life activities are

related to technology. For example, communication requires communication tools, travel requires transportation tools, building a house requires tools and



construction materials, and other life activities that all utilize technological products. The numerous benefits of technology in life make mastering the knowledge and technology very necessary. Therefore, creative, innovative, quality individuals who can act quickly and accurately are highly needed. To produce quality human resources, the role of education is essential (Lestari, 2021; Malina et al., 2021; Pratiwi et al., 2019; Siswanto, 2018).

According to Law No. 20 of 2003 concerning the National Education System, Article 1 states that education is an effort to provide a learning environment so students can freely enhance their potential. Additionally, education is a useful container for students to improve their abilities through learning activities. Education is expected to produce intelligent, high-quality individuals who can effectively utilize current advancements (Fitri, 2021).

The learning process is an activity that requires a good and appropriate design to inspire students to achieve educational goals. In the learning process, teachers have the task of providing material and the obligation to develop the learning topics to maximize learning outcomes. To fulfill these tasks and obligations, teachers need innovation in learning media that can optimize students' learning abilities, be effective in their use, and make the taught material easily understandable for students (Al-Qoyyim et al., 2022; Azmanita & Festiyed, 2019a; Indriana, 2011).

The supporting factors in learning are the media and learning resources. Learning media assists students in their learning process. The availability of rich and diverse learning resources and media is a characteristic of a quality learning process. Learning media is a technology that contains information applicable to learning and is used to convey information physically or communicate in

written, visual, and auditory forms, including hardware technology (Hartini et al., 2017; Karimah et al., 2014; Muthoharoh & Sakti, 2021; Wati et al., 2021). According to the Directorate of High School Development, learning resources are everything around students that contain messages and information, such as the environment, objects, and people, and can be used by students for learning and improving attitudes (Degeng, 1990; Marsa & Desnita, 2020; Prastowo, 2015; Yusuf, 2010).

In essence, the learning process in schools should be conducted interestingly so that it does not feel boring. Learning objectives become difficult to achieve if the learning process is perceived as dull, especially for subjects involving many mathematical elements. Many students find physics challenging due to its numerous mathematical formulas, and understanding physics concepts requires deeper thinking and reasoning (Irawan & Ermawaty, 2020).

Physics is a branch of natural science that examines natural events, predicts natural phenomena within the limited scope of the empirical world, and encompasses everything within human experience. The primary goal of physics is to explain natural phenomena rationally. In physics learning, students gain direct experience and explore concepts independently, enabling them to accept, retain, and apply those concepts (Azmanita & Festiyed, 2019a; Nosela et al., 2021; Yanti et al., 2017). Besides studying natural phenomena, physics also discusses various interactions that occur within it. By using physics, one can explain the mysteries of the universe (Aththibby & Salim, 2015). Many events in daily life are related to physics. The role of physics education is to familiarize students with understanding information, ideas, and principles of physics and to develop scientific thinking and scientific process skills (Sukiminiandari et al., 2015).

Students consider Physics lessons difficult because the teaching process is often monotonous, making the subject boring and unappealing. To make physics learning interesting, teachers need to take action by using media in the teaching process. The success of a learning experience largely depends on the use of learning media. Learning media must be used correctly to encourage students to be active, creative, and enjoy learning, ultimately improving the quality of learning (Irawan & Ermawaty, 2020).

The availability of physics learning media in schools is still relatively limited and does not fully support achieving learning objectives. Diani & Hartati (2018) revealed that the teachers' physics learning media is uninteresting and not supportive. Teachers only use textbooks in teaching physics. Meanwhile, Marsa & Desnita (2020) explained that the variety of learning resources and teaching materials used by teachers is lacking in physics learning. Arif et al. (2019) also stated that simulations, animations, videos, and images are rarely used in physics learning. Moreover, the teaching materials are still in print, containing only material presentations and exercises. Materials like these do not comply with the criteria for good teaching materials.

Based on the results of the questionnaire analysis of physics learning implementation, which was administered to high school students from 6 public and private schools, it was found that one of the physics topics that students find difficult to understand is DC circuits. This aligns with teachers' statements that many students do not pass exams on this topic. Furthermore, the learning media teachers use to explain DC circuits to 12th-grade students mostly involve chalkboards and printed materials. The commonly used learning resource is printed books. Teachers still rely on conventional teaching media and resources. Therefore, students face difficulties in comprehending the DC circuits material.

Based on the above statements, developing physics learning media and resources is necessary to enhance students' understanding of DC circuits. However, before doing so, an analysis of the media and learning resources used in the DC circuits material in 6 public and private high schools is essential. This research aims to analyze the existing media and learning resources used and those with the potential for development in the DC circuits material.

This study is conducted to identify the needed media and learning resources, assess their availability (currently limited), and identify their potential for development in the DC circuits material in 6 public and private high schools. The novelty of this research lies in analyzing two components: physics learning media and learning resources. The data for this study were collected from 6 schools, consisting of both public and private institutions. Additionally, this research focuses only on the 12th-grade material, DC circuits.

## **METHOD**

This type of research is quantitative descriptive with a survey method. Descriptive research describes events or occurrences according to what happens (Sudjana & Ibrahim, 1989). The survey method is quantitative to obtain data from a research sample through questionnaires and interview techniques (Sugiyono, 2018).

The object of the study is related to the media and learning resources used by six public and private high schools to explain DC circuit materials. These six schools consist of 4 schools in West Sumatra, one in Bengkulu, and one in Riau. There are four public schools and two private schools. The data collection instrument used is a questionnaire. Data were obtained by distributing questionnaires via Google Forms to 12th-grade science students from the six public and private high schools. From distributing

questionnaires to these students, data were obtained from 282 respondents. Questionnaires were also given to 12th-grade physics teachers. Six teachers filled out the questionnaire, with only one teacher from each school participating. The data were processed using Microsoft Excel to determine the percentage of each media and teaching material used. The equation used to calculate the percentage includes:

$$P = \frac{F}{n} \times 100\% \quad \dots (1)$$

The meaning of the above equation is Percentage (P), Frequency being calculated for the percentage (F), and the Total frequency/number of individuals (n) (Sudijono, 2011).

## RESULTS AND DISCUSSION

The research data were obtained from questionnaires distributed to 12th-grade science students in 6 public and private high schools. The total data obtained were 282 respondents. This data was used to analyze the media and learning resources used in physics education, specifically for the DC circuit materials.

### Analysis of Physics Learning Media on the Topic of DC Circuits

The percentage of the learning media used by the six schools to explain DC circuit materials is presented in detail in Table 1.

Table 1 Percentage of learning media used

No	Learning Media Used					Total
	Smartphone	PhET	PPT	Computer	Others	
1	0	0	0	0	43	43
2	21	10	22	4	12	69
3	10	8	10	2	37	67
4	10	10	20	5	25	70
5	5	0	1	36	25	67
6	9	9	12	5	0	35
Total	55	37	65	52	142	351
Percentage	15.67%	10.54%	18.52%	14.81%	40.46%	100%

Table 1 shows that the media with the highest percentage is "other media" at 40.46%. This includes print media (textbooks), whiteboards, and direct explanations by the teacher. On the other hand, the lowest percentage is for PhET at 10.54%. This data indicates that most of the six schools use print media (textbooks), whiteboards, or direct explanations to teach DC circuit materials. This aligns with Herayanti et al. (2015), who state that teachers writing on the whiteboard and giving lectures are commonly used teaching methods. The dominance of these conventional media in teaching is due to the limited number of educators who fully utilize information technology, especially the Internet, particularly in the teaching process (Azmanita & Festiyed, 2019;

Suyoso & Nurohman, 2014). Approximately 70 to 90% of teachers are considered not to have mastered technology, resulting in suboptimal educational utilization (Shofia & Ahsani, 2021). Additionally, educators may lack creativity in creating teaching materials, leading to a lack of variety in learning resources (Dasmu et al., 2020).

PhET is the least used media among schools to explain DC circuit materials. One reason for its limited use is that teachers may not be well-versed in operating PhET. Teachers may require training on PhET simulations to enhance their knowledge of its usage and operation in physics education (Bhakti et al., 2019; Budi et al., 2021; Saiyidah et al., 2020). The low usage of PhET suggests that there is a significant

opportunity for the development of this virtual laboratory in these six schools. This is because PhET is rarely used to explain the concepts of DC circuits, and students would likely be more enthusiastic and engaged when using a new medium they are not familiar with. PhET is a useful tool for improving conceptual understanding and student learning motivation, addressing the lack of laboratories in schools (Khaerunnisak, 2018).

Physics learning processes involving PhET simulations can enhance student motivation by making the learning process interesting. Moreover, it can improve students' problem-solving skills, especially in the context of DC circuit materials (Susilawati et al., 2022). In line with Yuliati et al. (2018), combining inquiry-based learning with PhET simulations can transform students' problem-solving methods from unstructured and unclear to scientific, structured, and memory-based in dealing with DC circuit problems. This indicates a positive change in students' problem-solving skills. Ismalia et al. (2022) also explain that PhET simulations can enhance students' conceptual understanding of Static Electricity. PhET simulations can capture students' attention and explain the material in detail, making it easy to understand.

PhET is one of the supporting tools for the success of learning. Learning that utilizes PhET aims to facilitate the development of students' skills and learning outcomes (Yuliana et al., 2021). PhET simulations are interactive, creating an exciting learning environment as students can learn while playing in the PhET simulation. This simulation can also teach students a constructivist thinking pattern (Abdul et al., 2022). One of the advantages of PhET simulations is that they can help teachers deliver a lot of material in one place,

making the use of time more efficient (Rahmadita et al., 2021).

Physics learning strives to understand real-life processes; therefore, learning should be presented using suitable media to achieve its goals (Widiasih et al., 2023). Learning goals can be achieved if students' interest in the presented subject is fulfilled, and students' interest in learning will increase if teachers use different learning media than usual (Hadiati et al., 2023). Learning media is a part of learning that includes messages, people, and devices following technological developments (Aprilia et al., 2023). Good learning media can be a key factor in creating cooperative learning and realistically improving student achievement through learning outcomes. Learning media is indeed a crucial factor for the success of learning outcomes. Teachers accommodate new learning styles by developing media or instruments (Noris et al., 2023).

Learning media should start evolving by placing creativity as the optimization target because, in reality, students' creativity in Indonesia at various levels regarding the use of learning media is still low. The quality of learning is influenced not only by the learning model but also by learning media. Learning implemented by utilizing information and communication technology depends heavily on the role of teachers as facilitators in responding to the low utilization of learning media in several schools in Indonesia (Silfiani et al., 2022).

### **Analysis of physics learning resources on the topic of DC circuits**

In addition to learning media, this study also analyzes the learning resources used by six schools in explaining the concepts of DC circuits. Table 2 presents the percentage of learning resources used by six schools in studying the concept of DC circuits.

Table 2 Percentage of learning resources used

No	Learning Resources					Total
	Printed Books	Internet	Worksheets	Module	Others	
1	43	0	0	0	0	43
2	34	13	4	6	48	105
3	37	14	6	20	2	79
4	35	20	10	5	0	70
5	46	40	35	0	2	123
6	11	10	5	11	1	38
Total	206	97	60	42	53	458
Percentage	44.98%	21.18%	13.10%	9.17%	11.57%	100%

Table 2 depicts that the learning resource with the highest percentage is printed books, with 44.98%, followed by the Internet at 21.18%, and worksheets at 13.10%. Next is other learning resources at 11.57%, and the lowest percentage is for modules at 9.17%. From this data, it is clear that the six schools mostly use printed books available in the schools to explain DC circuit materials. This is because printed books or textbooks remain the primary source of information for teachers and students in the learning process (Damayanti et al., 2018; Maturradiyah & Rusilawati, 2015). One of the most crucial components in learning is the textbook. Supporting factors for realizing student-centered learning (SCL) include textbooks (Hayati et al., 2015). Additionally, Muslich, as cited in Cahyati & Hartono (2015), states that textbooks function as a means to facilitate the achievement of learning goals and make the learning process more effective and efficient.

However, here, modules are relatively less used in explaining DC circuit materials. This suggests that modules have a significant opportunity for development in these six schools. Furthermore, modules are independent learning materials for students. By developing a module, teachers can indirectly teach without face-to-face interaction with students because the module systematically organizes content, methods, limitations, and evaluation methods. However, modules should be

developed considering their characteristics to create an engaging module that can achieve the expected competencies (Hudha et al., 2017). Moreover, modules are one of the teaching materials that teachers possess and are effective and efficient in achieving learning goals. Currently, most teaching materials do not utilize technology, such as electronic modules (Ramadayanty et al., 2021).

Elisa et al. (2022) explain that learning physics can be linked to local culture. Local culture or wisdom is the identity or characteristic of a region. Traditional snacks are important to preserve because they are unique culturally. The concept of physics in traditional snacks can be made into a module. Learning activities in class or practical work both require modules. Modules can be created to guide students to work scientifically and serve as a practical guide. To enable independent learning, modules must be systematically and interestingly structured for easy understanding (Yusra et al., 2021). Modules are part of teaching materials. Learning will be easier for students if teaching materials are simple, practical, and relevant (Saputra et al., 2023). Moreover, modules help students become active learners and facilitate the achievement of learning goals (Setianingrum et al., 2022).

Learning modules can take the form of electronic modules (E-modules). Physics E-modules, when combined with

STEM, have been proven to be valid and practical for improving 21st-century skills in students (Nazifah & Asrizal, 2022). Furthermore, research states that interactive E-modules are considered practical by students, with a practicality percentage of 71%, and practical for teachers, with a percentage of 81%, indicating that they are suitable for physics learning (Mahardika et al., 2021). A physics module based on science literacy developed by Susdarwati et al. (2021) has proven effective in improving students' critical thinking skills in DC circuit materials, with a percentage increase of 17.56%. From these explanations, it is evident that the development of a module is greatly needed to optimize the quality of physics learning.

The limitation of this study is that it focuses only on the DC circuit materials for the 12th-grade level. Additionally, this study is analytical research, so subsequent researchers need to do further research. Recommendations for future research include: First, the development of integrated PhET learning media for DC circuit materials. Second, the development of learning materials, whether in print or electronic form, particularly for DC circuit materials.

## CONCLUSION

Based on the findings of the data analysis, it can be concluded that, first, the most widely used learning media in the six public and private high schools to explain DC circuit materials is "other media," including printed media (textbooks), whiteboards, and direct explanations by teachers, with a percentage of 40.46%. Meanwhile, the most commonly used learning resource is printed books, with a percentage of 44.98%.

Second, the learning media with the most potential for development in the 6 public and private high schools is the PhET simulation because it is used very

little in schools, as indicated by the percentage obtained, which is 10.54%. Meanwhile, the learning material with the potential for development is the module, as indicated by the percentage obtained, which is 9.17%.

## REFERENCES

- Abdjul, T., Katili, N., Kurniasari, S., & Yunus, M. (2022). The effect of the application of PhET-assisted ryleac model on students' science process skills. *Jurnal Penelitian Pendidikan IPA*, 8(5), 2216–2223.
- Al-Qoyyim, T. M., Pratama, R. H., Saputra, H. A., Satipa, D. A., Santika, H. D., Lestari, D., Martiana, R., Juliana, D., & Gunada, I. W. (2022). Kelas desain: pelatihan pembuatan media pembelajaran fisika berbasis canva untuk mahasiswa calon guru. *Jurnal Pengabdian Magister Pendidikan IPA*, 5(4), 463–467.
- Aprilia, C., Anggereini, E., Nazarudin, N., & Ahda, Y. (2023). The Development of web-based learning media (glideapps) to improve digital literacy and science literacy about materials human digestive systems. *Jurnal Penelitian Pendidikan IPA*, 9(3), 1112–1117.
- Arif, M., Festiyed, F., Desnita, D., & Dewi, W. S. (2019). Pembuatan bahan ajar berbasis android untuk pembelajaran fisika pada materi gelombang bunyi, gelombang cahaya dan alat optik di kelas XI SMA/MA. *Pillar of Physics Education*, 12(3).
- Aththibby, A. R., & Salim, M. B. (2015). Pengembangan media pembelajaran fisika berbasis animasi flash topik bahasan usaha dan energi. *Jurnal Pendidikan Fisika*, 3(2).
- Azmanita, Y., & Festiyed, F. (2019a). Analisis kebutuhan media untuk pengembangan e-book tema abrasi pada pembelajaran fisika era 4.0. *Jurnal Penelitian Pembelajaran Fisika*, 5(1).

- Azmanita, Y., & Festiyed, F. (2019b). Analisis kebutuhan media untuk pengembangan e-book tema abrasi pada pembelajaran fisika era 4.0. *Jurnal Penelitian Pembelajaran Fisika*, 5(1).
- Bhakti, Y. B., Astuti, I. A. D., & Dasmu, D. (2019). Peningkatan kompetensi guru melalui pelatihan PhET simulation bagi guru mgmp fisika kabupaten serang. *J-ABDIPAMAS (Jurnal Pengabdian Kepada Masyarakat)*, 3(2), 55–62.
- Budi, A. S., Sari, S. W., Sanjaya, L. A., Wibowo, F. C., Astra, I. M., Puspa, R. W., ... & Pertiwi, W. A. (2021). PhET-assisted electronic student worksheets of physics (eSWoP) on heat for inquiry learning during covid. In *Journal of Physics: Conference Series*, 2104 (1), 012030. IOP Publishing.
- Cahyati, A., & Hartono, H. (2015). Analisis ilustrasi gambar pada buku teks fisika kelas xi yang banyak digunakan di sma negeri se-kabupaten demak. *UPEJ Unnes Physics Education Journal*, 4(3).
- Damayanti, A. E., Syafei, I., Komikesari, H., & Rahayu, R. (2018). Kelayakan media pembelajaran fisika berupa buku saku berbasis android pada materi fluida statis. *Indonesian Journal of Science and Mathematics Education*, 1(1), 63–70.
- Dasmu, D., Lestari, A. P., & Alamsyah, M. (2020). Peningkatan hasil belajar fisika melalui penerapan media pembelajaran interaktif berbasis ispring suite 9. *SINASIS (Seminar Nasional Sains)*, 1(1).
- Degeng, I. N. S. (1990). *Ilmu pembelajaran: taksonomi variabel*. Jakarta: Departemen Pendidikan Nasional.
- Diani, R., & Hartati, N. S. (2018). Flipbook berbasis literasi Islam: Pengembangan media pembelajaran fisika dengan 3D pageflip professional. *Jurnal Inovasi Pendidikan IPA*, 4(2), 234–244.
- Elisa, E., Prabandari, A. M., Istighfarini, E. T., Alivia, H., & Nuraini, L. (2022). Digital module innovation based on exploration of physics concepts containing local wisdom" making traditional snacks" to support the formation of pancasila students. *Jurnal Penelitian Pendidikan IPA*, 8(6), 2923–2932.
- Fitri, S. F. N. (2021). Problematika kualitas pendidikan di indonesia. *Jurnal Pendidikan Tambusai*, 5(1), 1617–1620.
- Hadiati, S., Pramuda, A., & Matsun, M. (2023). A musschenbroek learning media with arduino based with relay and max6675 sensor to increase hots and creativity. *Jurnal Penelitian Pendidikan IPA*, 9(3), 1006–1011.
- Hartini, S., Misbah, M., Dewantara, D., Oktovian, R. A., & Aisyah, N. (2017). Developing learning media using online prezi into materials about optical equipments. *Jurnal Pendidikan IPA Indonesia*, 6(2), 313–317.
- Hayati, S., Budi, A. S., & Handoko, E. (2015). Pengembangan media pembelajaran flipbook fisika untuk meningkatkan hasil belajar peserta didik. *Prosiding Seminar Nasional Fisika (E-Journal)*, 4, SNF2015-II.
- Herayanti, L., Fuaddunnazmi, M., & Habibi, H. (2015). Pengembangan media pembelajaran berbasis moodle pada mata kuliah fisika dasar. *Jurnal Pendidikan Fisika Dan Teknologi*, 1(3), 205–209.
- Hudha, M. N., Aji, S., & Rismawati, A. (2017). Pengembangan modul pembelajaran fisika berbasis problem based learning untuk meningkatkan kemampuan pemecahan masalah fisika. *SEJ (Science Education Journal)*, 1(1), 36–51.
- Indriana, D. (2011). *Ragam alat bantu media pengajaran*. Yogyakarta: Diva Perss.



- Irawan, V., & Ermawaty, I. R. (2020). Analisis kebutuhan media pembelajaran video animasi 3d pada mata pelajaran fisika sma. *Prosiding Seminar Pendidikan Fisika FITK UNSIQ*, 2(1), 101–106.
- Ismalia, I., Kusumawati, M., & Wahyuni, P. (2022). Investigating the use of phet simulation as a substitute for practical tools in understanding the concept of static electricity. *International Journal of Education and Teaching Zone*, 1(1), 20–25.
- Karimah, R. F., Supurwoko, S., & Wahyuningsih, D. (2014). Pengembangan media pembelajaran ular tangga fisika untuk siswa SMP/MTs kelas VIII. *Jurnal Pendidikan Fisika*, 2(1).
- Khaerunnisak, K. (2018). Peningkatan pemahaman konsep dan motivasi belajar siswa melalui simulasi physics education technology (PhET). *Jurnal Penelitian Pendidikan IPA*, 4(2).
- Lestari, S. (2021). Pengembangan orientasi keterampilan abad 21 pada pembelajaran fisika melalui pembelajaran PjBL-STEAM berbantuan Spectra-Plus. *Ideguru: Jurnal Karya Ilmiah Guru*, 6(3), 272–279.
- Mahardika, A. I., Wiranda, N., Arifuddin, M., Kamal, M., Erlina, M., & Hayati, M. (2021). The student response to interactive e-modules to support science literacy in distance learning physics. *International Journal of Innovative Science and Research Technology*, 6(11). [www.ijisrt.com](http://www.ijisrt.com)258
- Mahtari, S., Wati, M., Hartini, S., Misbah, M., & Dewantara, D. (2020). The effectiveness of the student worksheet with PhET simulation used scaffolding question prompt. *Journal of Physics: Conference Series*, 1422(1), 012010. IOP Publishing.
- Malina, I., Yuliani, H., & Syar, N. I. (2021). Analisis kebutuhan e-modul fisika sebagai bahan ajar berbasis PBL di MA muslimat NU. *Silampari Jurnal Pendidikan Ilmu Fisika*, 3(1), 70–80.
- Marsa, P. B., & Desnita, D. (2020). Analisis media, sumber belajar, dan bahan ajar yang digunakan guru fisika sma materi gelombang di sumatera barat ditinjau dari kebutuhan belajar abad 21. *Jurnal Eksakta Pendidikan (Jep)*, 4(1), 81–88.
- Maturradiyah, N., & Rusilawati, A. (2015). Analisis buku ajar fisika SMA Kelas XII di Kabupaten Pati berdasarkan muatan literasi sains. *UPEJ Unnes Physics Education Journal*, 4(1).
- Muthoharoh, V., & Sakti, N. C. (2021). Media pembelajaran interaktif menggunakan adobe flash CS6 untuk pembelajaran IPS siswa sekolah menengah atas. *Edukatif: Jurnal Ilmu Pendidikan*, 3(2), 364–375.
- Nazifah, N., & Asrizal, A. (2022). Development of STEM integrated physics e-modules to improve 21st century skills of students. *Jurnal Penelitian Pendidikan IPA*, 8(4), 2078–2084. <https://doi.org/10.29303/jppipa.v8i4.1820>
- Noris, M., Saputro, S., Muzzazinah, M., & Rahayu, A. (2023). Development of biology learning media assisted by construct2 to improve critical thinking skills. *Jurnal Penelitian Pendidikan IPA*, 9(2), 498–504.
- Nosela, S., Siahaan, P., & Suryana, I. (2021). Pengaruh model pembelajaran level of inquiry dengan virtual lab terhadap keterampilan proses sains peserta didik sma pada materi fluida statis. *Journal of Teaching and Learning Physics*, 6(2), 100–109.
- Prastowo, A. (2015). *Menyusun rencana pelaksanaan pembelajaran (RPP) tematik terpadu (implementasi kurikulum 2013 untuk SD/MI)*. Jakarta: Prenadamedia Group.

- Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA abad 21 dengan literasi sains siswa. *Jurnal Materi Dan Pembelajaran Fisika*, 9(1), 34–42.
- Rahmadita, N., Mubarak, H., & Prahani, B. K. (2021). Profile of problem-based learning (pbl) model assisted by PhET to improve critical thinking skills of high school students in dynamic electrical materials. *Jurnal Penelitian Pendidikan IPA*, 7(4), 617–624.
- Ramadayanty, M., Sutarno, S., & Risdianto, E. (2021). Pengembangan e-modul fisika berbasis multiple representation untuk melatih keterampilan pemecahan masalah siswa. *Jurnal Kumparan Fisika*, 4(1), 17–24.
- Saputra, M. A., Hadi, S., Sholahuddin, A., Sulastri, A., Hasbie, M., Aufa, M. N., & Fitri, M. A. (2023). The validity of science module with the collaborative based science learning model to improve critical thinking skills and decision making skills. *Jurnal Penelitian Pendidikan IPA*, 9(2), 639–644.
- Setianingrum, D. A., Pratiwi, S., & Jumadi, J. (2022). Development of science module based on flipbook about physics in the respiratory system to improve students' learning independence. *Jurnal Penelitian Pendidikan IPA*, 8(6), 2621–2628.
- Shofia, N. A., & Ahsani, E. L. F. (2021). Pengaruh penguasaan it guru terhadap kualitas pembelajaran dimasa pandemi. *Forum Paedagogik*, 12(2), 201–215.
- Silfiani, S., Jasruddin, J., & Amin, B. D. (2022). The development of videoscribe assisted learning media to improve understanding of physics concepts. *Jurnal Penelitian Pendidikan IPA*, 8(6), 2995–3000.
- Siswanto, J. (2018). Keefektifan pembelajaran fisika dengan pendekatan stem untuk meningkatkan kreativitas mahasiswa. *Jurnal Penelitian Pembelajaran Fisika*, 9(2).
- Sudijono, A. (2011). *Pengantar statistik pendidikan*. Rajawali Press.
- Sudjana, N., & Ibrahim. (1989). *Penelitian kualitatif dan kuantitatif*. Bandung: Sinar Baru.
- Sugiyono. (2018). *Metode penelitian kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta.
- Sukiminiandari, Y. P., Budi, A. S., & Supriyati, Y. (2015). Pengembangan modul pembelajaran fisika dengan pendekatan saintifik. *Prosiding Seminar Nasional Fisika (e-Journal)*, 4, SNF2015-II.
- Susdarwati, S., Dimas, A., & Hannum, F. (2021). The development of scientific literacy-based physics learning module on direct current circuit material. *Journal of Physics: Conference Series*, 1869(1), 012164.
- Susilawati, A., Yusrizal, Y., Halim, A., Syukri, M., Khaldun, I., & Susanna, S. (2022). The effect of using physics education technology (PhET) simulation media to enhance students' motivation and problem-solving skills in learning physics. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1166–1170.
- Suyoso, S., & Nurohman, S. (2014). Pengembangan modul elektronik berbasis web sebagai media pembelajaran fisika. *Jurnal Kependidikan Penelitian Inovasi Pembelajaran*, 44(1).
- Wati, L., Rahimah, R., Nengsih, E. W., & Mardaya, M. (2021). Media pembelajaran majalah fisika terintegrasi nilai keislaman. *Jurnal Ilmiah Pendidikan Fisika*, 5(2), 195–203.
- Widiasih, W., Zakirman, Z., & Ekawati, R. (2023). Development of augmented reality media to improve student understanding of optical eyes system materials. *Jurnal Penelitian Pendidikan IPA*, 9(2), 915–919.
- Yanti, D. E. B., Subiki, S., & Yushardi, Y. (2017). Analisis sarana prasarana

- laboratorium fisika dan intensitas kegiatan praktikum fisika dalam mendukung pelaksanaan pembelajaran fisika sma negeri di kabupaten jember. *Jurnal Pembelajaran Fisika*, 5(1), 41–46.
- Yuliana, Y., Wahyudi, W., Doyan, A., & Pineda, C. (2021). Development of phet simulation-assisted inquiry model learning in elasticity materials. *Jurnal Penelitian Pendidikan IPA*, 7(2), 178–183.
- Yuliati, L., Riantoni, C., & Mufti, N. (2018). Problem solving skills on direct current electricity through inquiry-based learning with phet simulations. *International Journal of Instruction*, 11(4), 123–138.
- Yusra, Y., Nurmaliah, C., & Sarong, M. A. (2021). Penerapan modul pembelajaran berbasis inkuiri untuk meningkatkan keterampilan proses sains dan hasil belajar mahasiswa. *Jurnal Penelitian Pendidikan IPA*, 7(SpecialIssue), 1–5.
- Yusuf, P. M. (2010). *Komunikasi instruksional*. Jakarta: Bumi Aksara.