DOI: 10.14421/impulse.2024.41-02

IMPULSE: Journal of Research and Innovation in Physics Education
Volume 4, Issue 1, 12 – 21

© ISSN (p): 2798–1762; ISSN (e): 2798-1754
http://ejournal.uin-suka.ac.id/tarbiyah/impulse

The Influence of Discovery Learning Model Assisted by Multimedia Module on Students' Critical Thinking Skill

Zul Hidayatullah[1*], Theofilus Gratiamus Gusemanto[2]

[1] Department of Science Education, Faculty of Mathematics and Natural Sciences, Universitas Hamzanwadi, Indonesia
[2] SMAS St. Ignasius Loyola Labuan Bajo, Indonesia
*Corresponding author: zulhidayatullah5@gmail.com

ABSTRACT

Proficiency in critical thinking is a crucial attribute that students must possess to effectively navigate the advancements in science and technology in the contemporary era of the fourth industrial revolution. Nevertheless, children's critical thinking abilities remain relatively deficient, and receive minimal instruction. Multimedia modules reinforce a discovery learning approach, providing an alternate method for developing critical thinking abilities. This research aims to determine the influence of the multimedia-assisted discovery learning paradigm on the development of students' critical thinking abilities. The research used a quasi-experimental approach, specifically a pretest-posttest control group design. Purposive sampling served as the sampling approach, ensuring that the students in the two classes under comparison shared the same initial competencies. We divided the 68 students in the research sample into two classes: the experimental class and the control class. We assess students' critical thinking abilities by administering an essay examination that evaluates their performance on critical thinking benchmarks. The data analysis for this research employs the independent t-test and the N-gain test. The study reveals that the experimental class outperforms the control class in terms of students' critical thinking abilities. The t-test's statistical significance, with a p-value of 0.000 or less than 0.05, confirms that the multimedia module-assisted discovery learning model has a significant impact on students' critical thinking abilities about momentum and impulse materials. The N-gain analysis of pretest and posttest results for students in the experimental class indicates a moderate rise in the five critical thinking indicators. We can conduct further studies to adapt this learning strategy to different topics. However, it is crucial to recognize that the instructor must invest time and creativity in preparing this multimedia module.

INTISARI

Keterampilan berpikir kritis merupakan keterampilan penting yang harus dimiliki peserta didik dalam menghadapi perkembangan ilmu pengetahuan dan teknologi di era modern 4.0. Namun faktanya kemampuan berpikir kritis siswa masih tergolong rendah dan jarang dilatih. Salah satu alternatif untuk melatih kemampuan berpikir kritis adalah dengan penggunaan model Discovery Learning berbantuan modul multimedia. Penelitian ini bertujuan untuk

ARTICLE HISTORY
Received: May 5, 2024
Accepted: July 01, 2024

KEYWORDS:
Critical Thinking, Discovery Learning, Multimedia Module, Physics

KATA KUNCI:
Berpikir Kritis, Fisika, Model Pembelajaran Discovery, Modul Multimedia

* Corresponding author:
Zul Hidayatullah, Department of Science Education, Faculty of Mathematics and Natural Sciences, Universitas Hamzanwadi, Indonesia
✉ zulhidayatullah5@gmail.com ✆+62 813-3924-2571

mengetahui pengaruh model Discovery Learning berbantuan modul multimedia terhadap kemampuan berpikir kritis siswa. Jenis penelitian ini adalah eksperimen semu dengan desain kelompok kontrol pretest-posttest. Metode pengambilan sampel yang digunakan adalah purposive sampling dengan tujuan agar siswa pada kedua kelas yang dibandingkan mempunyai kemampuan awal yang sama. Sampel penelitian berjumlah 68 siswa yang dibagi menjadi dua kelas yaitu kelas eksperimen dan kelas kontrol. Kemampuan berpikir kritis siswa diukur menggunakan tes uraian yang didasarkan pada indikator berpikir kritis. Analisis data pada penelitian ini menggunakan uji t independen dan uji N-gain. Hasil analisis menunjukkan bahwa kemampuan berpikir kritis siswa pada kelas eksperimen lebih baik dibandingkan pada kelas kontrol. Hal ini terlihat dari hasil signifikansi uji t yang menunjukkan angka 0,000 atau lebih kecil dari 0,05, sehingga dapat disimpulkan bahwa terdapat pengaruh model Discovery Learning berbantuan modul multimedia terhadap kemampuan berpikir kritis siswa. pada materi momentum dan impuls. Secara lebih rinci terlihat kelima indikator berpikir kritis mengalami peningkatan pada kategori sedang berdasarkan analisis N-gain pada skor pretest dan posttest siswa kelas eksperimen. Penelitian selanjutnya dapat menerapkan pembelajaran seperti ini dengan materi yang berbeda, namun perlu diperhatikan bahwa penyusunan modul multimedia ini memerlukan waktu dan kreativitas guru.

A. Introduction

Science learning, especially physics in the 21st century, emphasizes high-level thinking skills. These high-level thinking skills help students have logical, critical, and systematic thinking that can solve every problem. High-level thinking skills in 21st-century learning include critical thinking, creativity, innovation, problem-solving and collaboration, and making decisions [1][2]. Critical thinking skills are a crucial aspect of higher-level thinking that pupils must possess [3]. This is because, in the 21st century, students need to possess strong information-filtering skills to false information. Additionally, they need to develop their critical thinking skills to effectively address any challenges. Critical thinking skills refer to students' ability to engage in logical reasoning and delve into the underlying aspects of a situation, including the identification of causes and effects.

Critical thinking is a cognitive process that involves the application of knowledge and skills to solve problems, make decisions, analyze assumptions, and conduct investigations or research using gathered data and information to generate desired information or conclusions [4]. Critical thinking skills are very necessary in the modern era as the goal of education [5]. Critical thinking skills are different from merely criticizing without a solution. This skill encourages students to consider and look for many alternative solutions based on existing facts. Therefore, learning at schools should develop critical thinking, innovation, creativity, and technological skills [6]. Critical thinking correlates with student academic achievement. Critical thinking encourages students' cognitive processes to highly think achieve excellent learning outcomes and become better [7]. However, students' critical thinking skills are still relatively low because of the transferring knowledge pattern without

considering students' thinking skills. Critical thinking skills are rarely trained [8] as observed in the unidirectional learning process. Tests and questions given to students frequently focus solely on low cognitive thinking, with an emphasis on rote memory.

Learning science or physics, in particular, entails several complex concepts that require strong reasoning and critical thinking skills for comprehension. Thus, it is imperative to cultivate critical thinking abilities in pupils from a young age to gradually enhance their critical thinking capabilities. There are multiple methods for cultivating critical thinking skills, such as administering assessments that assess critical thinking indicators, using engaging educational resources to enhance students' abstract conceptual reasoning skills, implementing diverse instructional models to prevent student monotony, and so on. The use of instructional media is critical, as numerous scientific subjects prove difficult to comprehend solely through verbal explanations, indicating the necessity of illustrative examples [9]. Multimedia is considered a very useful application of ICT in the learning process. Many complex and abstract concepts can be visualized with multimedia [10]. In this context, the use of educational media in scientific or physics education is critically important. Educational media refers to any tool or resource utilized to enhance the learning process, ensuring the effective and efficient delivery of educational content.

Currently, there is a wide range of learning media options, including multimedia modules, e-modules, virtual reality, augmented reality, simulations, virtual laboratories, smartphone-based media, and others. The multimedia module is a viable alternative for integrating into the educational curriculum. Multimedia is an educational approach that employs technology to stimulate student engagement and transform monotonous learning routines into enjoyable experiences [11]. Interactive multimedia is learning media that is structured in such a way as to combine text, audio, graphics, animation, and video in delivering teaching material that allows students to actively interact with each other [12]. Multimedia influences students' high-level thinking skills such as problem-solving, evaluation, hypothesis formulation and conclusion-making, and self-reflection. Learning with multimedia has a positive impact on students because learning is student-centered [13]. Interactive multimedia has increased learning outcomes, interaction, and critical thinking skills. However, there was still a lack of literature on learning multimedia to help students develop their thinking engagement [14]. The use of multimedia in teaching especially in developing countries builds students' intellectual capacity and knowledge that will help them compete favorably with their peers in every part of the world [15].

The multimedia module cannot run by itself. Multimedia modules must also be combined with suitable learning models so that learning delivery is effective. Using a learning model with the help of multimedia modules can make students understand concepts better and at the same time can train their thinking skills, especially critical thinking skills. One model that is suitable to be combined with a multimedia module

is discovery learning. Discovery learning requires students to actively discover concepts or prove their hypotheses through the process of discovery or experimentation independently [16][17]. The discovery learning model aims to increase active student involvement in obtaining information, reducing dependence on teachers so that learning becomes active and creative. This model also trains students to explore and utilize information sources other than teachers, so that students will be motivated in the learning process [18][19][20].

The multimedia module exposes students to a variety of media-based learning materials, including videos, audio, simulations, and virtual laboratories. This facilitates the process of discovering and acquiring knowledge through the use of discovery learning methods. Students may engage in exploratory tasks by examining the multimedia module's simulation or virtual laboratory. Even if students do not participate in actual discovery activities in the environment, they can observe and practice in the multimedia module's simulations or virtual labs. This enhances efficiency and indirectly fosters the development of pupils' critical thinking abilities. Furthermore, an additional benefit is the inclusion of a critical thinking assessment within the multimedia module, allowing students to promptly evaluate their comprehension and proficiency after completing the module. This research seeks to investigate the impact of utilizing the discovery learning model, with the assistance of a multimedia module, on the development of critical thinking skills.

B. Method

This quasi-experiment determines that the independent variable does not have an exclusive influence on the creation of the dependent variable. The research examines the impact of the discovery learning model, supported by multimedia modules, on critical thinking skills. The discovery learning model is the independent variable, while critical thinking ability is the dependent variable. This research used a pretest-posttest control group design. The applied sampling technique was purposive sampling to intentionally select students with similar initial skills. The study involved a total of 68 students, with 34 in the control class and 34 in the experimental class. The researchers subjected the experimental group to multimedia-assisted discovery learning, while the control group received no treatment and followed standard learning methods. Table 1 elucidates the study design employed.

Table 1. Research Design

Class Type	Pretest	Treatment	Posttest
Control	O_1	X_1	P_1
Experiment	O_2	X_2	P_2

O_1 represents the initial assessment score for the control class, while O_2 represents the initial assessment score for the experimental class. X_2 refers to the experimental class's learning using discovery learning with the assistance of a multimedia module, while X_1 represents conventional learning. P_1 represents the control class's final assessment score, and P_2 represents the experimental class's final assessment score.

The researchers conducted this investigation at SMAK St. Francis Xaverius Ruteng, located in East Nusa Tenggara in multiple stages, such as a pretest, three face-to-face learning sessions, and a final test as the concluding stage. The data collecting method was a critical thinking assessment consisting of five test items. The data analysis was an independent t-test to examine the impact of the treatment on the experimental group in comparison to the control group. Then, the researchers used an N-Gain assessment to measure the specific impact of the intervention with a multimedia module to facilitate discovery learning, on the enhancement of students' critical thinking skills. This assessment determined the improvement in each critical thinking indicator. Table 2 displays the N-Gain criteria utilized [21].

Table 2. N-Gain Score Interpretation

Interval Score N-Gain	Category
$0.70 \leq g \leq 1.00$	High
$0.30 \leq g < 0.70$	Medium
$0.00 \leq g < 0.30$	Low

C. Result and Discussion

The goal of this study is to investigate the impact of using the discovery learning approach with multimedia modules on the development of student's critical thinking skills. The early activities involved administering a pretest to assess the basic skills of students in the two courses selected for the study. Then, the researchers subjected the students to the two groups. The students in the experimental class acquired knowledge through the method of discovery learning with the assistance of multimedia modules. Students in the control group received instruction through traditional methods. The learning procedure consisted of three meetings, followed by a posttest to assess the critical thinking skills of the students in both groups. The administered critical thinking assessment comprised five descriptive questions based on the critical thinking indicators. Then, the researchers used SPSS 25 to examine the outcomes of the critical thinking assessment in the posttest. Table 3 presents the results.

Table 3. Comparison of Average Scores

Group Statistics			
Type Class	**N**	**Mean**	**Std. Deviation**
Experiment	34	81.992	7.579
Control	34	70.317	9.675

Table 3 clearly demonstrates that the experimental group has a higher mean score than students in the control class. The experimental group, with the implementation of multimedia, has a mean score of approximately 82. Conversely, the control class achieves an approximate mean score of 70. Then, the researchers conducted an independent t-test analysis to examine the difference in critical thinking skills between students in the experimental class and those in the control class, as indicated in Table 4.

Table 4. Independent t-Test Result

	Levene's Test		**Independent t Tes**	
Category	**F**	**Sig.**	**Sig. (2-tailed)**	**df**
Homogeneous	0.963	0.330	0.000	66

Table 4 shows the significance (2-tailed) value is 0.00 lower than 0.05, indicating the significant influence of multimedia-assisted discovery learning on students' critical thinking skills in the context of momentum and impulse material. Discovery learning enabled pupils to actively seek solutions to their issues, thereby enhancing their cognitive abilities. Discovery learning involves more than simply providing students with materials, akin to spoon-feeding a baby. However, this learning approach emphasizes students actively pursuing the truth of their beliefs through scientific methods, such as conducting experiments or making observations using virtual laboratories or simulations. This type of learning process gradually cultivates students' critical thinking abilities as they directly engage in it and actively seek to refine their own notions. Research demonstrates that the use of multimedia in discovery-based learning improves student learning outcomes. Utilizing multimedia enhances students' skills to visualize and comprehend information, thereby facilitating their acquisition of knowledge [22]. The use of multimedia-assisted discovery learning models helps the learning process in the classroom. Learning becomes two-way and more interesting [23]. To see the effect of multimedia-assisted discovery learning, see Table 5 below.

Table 5. N-Gain of Critical Thinking among Experimental Class Students

Critical Thinking Indicator	Score N-Gain	Category
Identify	0.41	Medium
Analysis	0.57	Medium
Problem-Solving	0.42	Medium
Inference	0.69	Medium
Evaluation	0.33	Medium

Table 5 demonstrates the increase in each critical thinking indicator within the medium group, indicating the positive effects of the applied learning on the student's critical thinking skills in the subject of impulse-momentum. Various factors, such as the recent introduction of new learning models and media, contributed to the limited progress in students' critical thinking. Students were receiving their initial training in critical thinking skills. Previously, the learning process consisted solely of information transmission. Furthermore, utilizing multimedia modules in conjunction with the discovery learning paradigm could serve as an additional approach to improving students' critical thinking abilities. The discovery learning model has the advantage of encouraging students' engagement and retention of topics through active participation in conversations or activities with their peers. As a result, the use of superior learning models and learning materials directly correlated with a more substantial improvement in students' critical thinking abilities [24]. Other research concludes that the use of discovery learning can increase students' learning motivation so that their critical thinking skills also increase [25]. The use of media-assisted discovery learning can train students' cognitive skills to find and solve problems and can train students to learn independently [26]. Students enjoy learning when using the multimedia module because there are interesting simulations and animations and it can explain concepts they don't understand [27].

D. Conclusion

The data analysis and discussion outcomes suggest that the discovery learning paradigm, enhanced by multimedia modules, positively influences students' critical thinking abilities. Utilizing multimedia modules to facilitate exploration learning is more efficacious than traditional classroom instruction. Students in classrooms that utilize multimedia modules for discovery learning demonstrate enhanced critical thinking skills, surpassing their critical thinking skills in traditional classes. Specifically, the study demonstrates that students' critical thinking skills improve after engaging in discovery learning with the assistance of a multimedia module. On average, the improvement falls within the medium range. Furthermore, it is evident that students display greater enthusiasm for learning when exposed to multimedia modules because there are numerous captivating simulations. Nevertheless, it is

important to acknowledge that utilizing this multimedia module necessitates a significant amount of time for preparation and a comprehensive understanding of technology.

References

[1] M. S. Zohro, E. W. Winarni, and I. Koto, "Pengaruh Model Discovery Learning Berbantuan Multimedia Interaktif terhadap Kemampuan Berpikir Tingkat Tinggi pada Materi Pubertas Kelas VI SD," *J. Kapedas Kaji. Pendidik. Dasar*, vol. 3, no. 1, pp. 58–64, 2024.

[2] I. Sakti, A. Defianti, and N. Nirwana, "Implementasi Modul Ipa Berbasis Etnosains Masyarakat Bengkulu Materi Pengukuran Melalui Discovery Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Mahasiswa," *J. Kumparan Fis.*, vol. 3, no. 3, pp. 232–238, 2020, doi: 10.33369/jkf.3.3.232-238.

[3] F. Fadlina, W. Artika*, K. Khairil, C. Nurmaliah, and A. Abdullah, "Penerapan Model Discovery Learning Berbasis STEM pada Materi Sistem Gerak Untuk Meningkatkan Keterampilan Berpikir Kritis," *J. Pendidik. Sains Indones.*, vol. 9, no. 1, pp. 99–107, 2021, doi: 10.24815/jpsi.v9i1.18591.

[4] A. A. Afiesta, M. Syam, and R. Qadar, "Pengaruh Model Discovery Learning Terhadap Kemampuan Berpikir Kritis Siswa SMA Negeri 9 Samarinda Materi Suhu dan Kalor," *J. Literasi Pendidik. Fis.*, vol. 3, no. 2, pp. 84–94, 2022.

[5] M. N. Majid, H. R. Achmadi, and N. Suprapto, "Studi Literatur Pemanfaatan Interactive Multimedia Related To Real Life Untuk Meningkatkan Keterampilan Berpikir Kritis Peserta Didik," *IPF Inov. Pendidik. Fis.*, vol. 9, no. 3, pp. 382–393, 2020, doi: 10.26740/ipf.v9n3.p382-393.

[6] P. Hendrajanti and S. Rochmiyati, "Peningkatan Keterampilan Berpikir Kritis dengan Discovery Learning Berbantuan Virtual Chemistry Laboratory," *J. Pendidik. dan Pembelajaran Sains Indones.*, vol. 6, no. 1, pp. 30–38, 2023.

[7] Y. D. Wicaksana, S. Widoretno, and S. Dwiastuti, "The use of critical thinking aspects on the module to enhance students' academic achievement," *Int. J. Instr.*, vol. 13, no. 2, pp. 303–314, 2020, doi: 10.29333/iji.2020.13221a.

[8] Rumiyati, "Optimalisasi Keterampilan Berpikir Kritis dan Hasil Belajar Melalui Implementasi Model Discovery Learning," *Acad. J. Inov. Ris. Akad.*, vol. 1, no. 1, pp. 1–10, 2021.

[9] N. A. Novitasari and A. M. Laili, "Pengaruh Model Discovery Learning Berbantuan Media Powerpoint Terhadap Kemampuan Berpikir Kritis IPA Siswa Kelas VIII," *LENSA (Lentera Sains) J. Pendidik. IPA*, vol. 13, no. 1, pp. 30–38, 2023, doi: 10.24929/lensa.v13i1.257.

[10] C. Ferreira, M. Baptista, and A. Arroio, "Teachers' pedagogical strategies for integrating multimedia tools in science teaching," *J. Balt. Sci. Educ.*, vol. 12, no. 4, pp. 509–524, 2013, doi: 10.33225/jbse/13.12.509.

[11] I. G. D. Buana, M. Putra, and I. G. S. Abadi, "Dampak Penggunaan Model Discovery Learning Berbantuan Multimedia Interaktif terhadap Kompetensi Pengetahuan PPKn Siswa Kelas IV Sekolah Dasar," *Indones. J. Instr.*, vol. 3, no. 2, pp. 54–63, 2022, doi: 10.23887/iji.v3i2.44508.

[12] O. Alpindo, "Validitas Handout Fisika Berbentuk Multimedia Interaktif dalam Model Discovery Learning untuk Meningkatkan Critical Thinking Skill Peserta Didik Kelas X SMA," *J. Edu Res.*, vol. 1, no. 2, pp. 1–10, 2020.
[13] U. Hasanah, I. M. Astra, and M. S. Sumantri, "Exploring the Need for Using Science Learning Multimedia to Improve Critical Thinking Elementary School Students: Teacher Perception," *Int. J. Instr.*, vol. 16, no. 1, pp. 417–440, 2023, doi: 10.29333/iji.2023.16123a.
[14] M. Rogti, "The Effect of Mobile-based Interactive Multimedia on Thinking Engagement and Cooperation," *Int. J. Instr.*, vol. 17, no. 1, pp. 673–696, 2024, doi: 10.29333/iji.2024.17135a.
[15] C. U. Ugwuoke *et al.*, "Effects of Multimedia Application on Students' Academic Achievement in Agricultural Science," *J. Balt. Sci. Educ.*, vol. 22, no. 6, pp. 1074–1088, 2023, doi: 10.33225/jbse/23.22.1074.
[16] M. Astika, Hikmawati, Sutrio, and Gunawan, "Pengembangan Perangkat Pembelajaran Model Discovery Learning untuk Meningkatkan Kemampuan Berpikir Kritis Fisika Peserta Didik," *J. Penelit. dan Pembelajaran Fis. Indones.*, vol. 3, no. 1, pp. 1–5, 2021.
[17] L. Septiaahmad, I. Sakti, and I. Setiawan, "Pengembangan Lembar Kerja Peserta Didik (LKPD) Fisika Berbasis Etnosains Menggunakan Model Discovery Learning Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Sma," *J. Kumparan Fis.*, vol. 3, no. 2, pp. 121–130, 2020, doi: 10.33369/jkf.3.2.121-130.
[18] S. Laeni, Zulkarnaen, and S. Efwinda, "Pengaruh Model Discovery Learning terhadap Kemampuan Berpikir Kritis Siswa SMA Negeri 13 Samarinda Materi Impuls dan Momentum," *J. Literasi Pendidik. Fis.*, vol. 3, no. 2, pp. 105–115, 2022.
[19] L. U. A. Nababan, M. A. Zulmi, M. J. Sihombing, and S. P. R. Harahap, "Meta Analisis Pengaruh Model Discovery Learning pada Mata Pelajaran Fisika terhadap Berpikir Kritis Siswa," *J. Inov. Pendidik. Sains dan Terap.*, vol. 2, no. 1, pp. 1–8, 2023.
[20] R. Surya, "Pengaruh Model Discovery Learning Berbantuan Multimedia Terhadap Keterampilan Proses Sains , Berpikir Tingkat Tinggi Dan Keterampilan Bertanya Pada Materi Sistem Pernapasan Di SMA Negeri 5 Langsa," *J. Biolokus*, vol. 3, no. 1, pp. 234–244, 2020.
[21] Z. Hidayatullah, M. Makhrus, and I. W. Gunada, "Pengaruh Pendekatan Konflik Kognitif Terhadap Hasil Belajar Gelombang Mekanik Peserta Didik MAN 2 Mataram," *J. Ilm. Profesi Pendidik.*, vol. 3, no. 2, pp. 171–175, 2018, doi: 10.29303/jipp.v3i2.27.
[22] R. Ihwono, A. Mariono, and U. Dewi, "Multimedia Web Learning Berbasis Model Pembelajaran Discovery Learning Untuk Meningkatkan Kemandirian Belajar Siswa Sma," *J. Educ. Dev.*, vol. 11, no. 2, pp. 413–419, 2023, doi: 10.37081/ed.v11i2.4566.
[23] T. S. Maria and Y. U. Lede, "Meningkatkan Keterampilan Bernalar Kritis Siswa SMP Pangudi Luhur Wedi Kelas 8B Menggunakan Model DIscovery Learning Berbantuan Multimedia," in *SEMNASPA: Prosiding Seminar Nasional Pendidikan Dan Agama*, 2023, pp. 1441–1446. doi: https://doi.org/10.55606/semnaspa.v4i2. 1378.

[24] A. N. Djepy, A. R. Tolangara, and T. D. Nur, "Pengaruh Penerapan Model Pembelajaran Discovery Learning Berbantuan Video Pembelajaran Terhadap Kemampuan Berpikir Kritis Dan Pemahaman Konsep Ipa Siswa Smp Negeri 44 Halmahera Barat," *J. Bioedukasi*, vol. 5, no. 2, pp. 124–133, 2022, doi: 10.33387/bioedu.v5i2.5403.
[25] Sholikhan, T. N. Amul, and N. Ain, "Memberdayakan Motivasi Belajar dan Keterampilan Berpikir Kritis Siswa Melalui Penerapan Model Pembelajaran Discovery pada Materi Getaran dan Gelombang," *J. Ris. Pendidik. dan Pengajaran*, vol. 2, no. 2, pp. 259–274, 2023.
[26] Nurfadillah, W. Cahyana, and D. P. Putra, "Penerapan Model DIscovery Learning Berbantuan Media Flipbooks dalam Pembelajaran Fisika untuk Melatih Keterampilan Metakognisi Siswa SMAN 10 Gowa," *J. Pendidik. MIPA*, vol. 12, no. 1, pp. 29–34, 2022, doi: https://doi.org/10.37630/jpm.v12i1.534 Penerapan.
[27] P. Nyirahabimana, E. Minani, M. Nduwingoma, and I. Kemeza, "Students' Perceptions of Multimedia Usage in Teaching and Learning Quantum Physics: Post-Assessment," *J. Balt. Sci. Educ.*, vol. 22, no. 1, pp. 37–56, 2023, doi: 10.33225/jbse/23.22.37.