Journal of General Education and Humanities
Vol. 5, No. 1, February 2026, pp. 1783 – 1791, https://doi.org/10.58421/gehu.v5i1.1097
ISSN 2963-7147

Meta-analysis: The Effectiveness of Physics Learning Media on Students' Creative Thinking Abilities

Nur Aulyatun Hasanah[1], Ai Nurlaela[2], Fuji Hernawati Kusumah[3]
[1]Physics Education Study Program, UIN Syarif Hidayatullah Jakarta

Article Info

Article history:

Received 2026-01-31
Revised 2026-02-14
Accepted 2026-02-27

Keywords:

Creative Thinking
Effect Size
Learning Media
Meta-Analysis
Physics Education

ABSTRACT

Indonesian students' creative thinking achievement remains low (PISA 2022: 19/60; 31% reached baseline proficiency), indicating an urgent need for effective physics learning media. This meta-analysis aimed to determine the overall effectiveness of physics learning media in improving students' creative thinking skills and to compare effects by media type and education level. Following PRISMA guidelines, we systematically searched and screened quantitative quasi-experimental studies published in 2017–2025, yielding 10 eligible articles, and calculated effect sizes using Cohen's *d* to synthesise results. The findings showed a high overall effect of physics learning media on creative thinking (mean ES = 1.06), with moving audio-visual/interactive media producing the highest mean effect (ES = 1.33) and stronger effects in senior high school than junior high school (ES = 1.15 vs. 0.69). These results indicate that interactive and technology-supported physics media are effective for strengthening students' creative thinking and should be prioritised in classroom practice.

Corresponding Author:

Nur Aulyatun Hasanah
Physics Education Study Program, UIN Syarif Hidayatullah Jakarta
E-mail:nurauliyatunhasanah@gmail.com

1. INTRODUCTION

Creative thinking is an essential skill that needs to be developed early in physics learning, because this subject is rich in abstract concepts and formulas that require the exploration of innovative ideas and creative problem-solving [1]. Although physics offers great opportunities to develop students' creativity through an interactive approach, the reality on the ground shows that only a small proportion of Indonesian students reach the initial stage of this ability, as reflected in low learning interest and minimal achievement results [2].

The 2022 Programme for International Student Assessment (PISA) results revealed that Indonesian students' creative thinking scores were only 19 out of 60 points, far below the OECD average, with only 31% of students achieving baseline proficiency [3]. Students'

disinterest in physics exacerbates this phenomenon due to the perceived difficulty of the material and its lack of relevance to everyday life, thus hampering the development of higher-order thinking skills such as fluency, flexibility, originality, and elaboration [4], [5].

The main problem lies in the dominance of conventional lecture methods by teachers, which makes the learning process passive, monotonous, and less interesting for students [6]. Teachers often have difficulty choosing appropriate learning models and media, so that students fail to be trained to solve physics problems creatively and scientifically in real contexts [7].

Various empirical research results indicate that physics learning media have the potential to improve creative thinking, but their effectiveness varies depending on the type of media, student background, and implementation in the classroom [8]. A meta-analysis approach is needed to systematically integrate these findings to obtain a comprehensive picture and optimal recommendations [9], [10].

This study aims to analyse the effectiveness of physics learning media on students' creative thinking skills through a meta-analysis approach based on the PRISMA guidelines [11]. The urgency lies in the need for practical recommendations for teachers and policy developers to optimise media in addressing the low creativity of physics students in Indonesia, in line with the demands of the independent curriculum [12]. Its novelty is the latest synthesis of 2017-2025 studies with a focus on media classification (moving audio-visual vs. print) and moderators such as school level, which have not been comprehensively explored [8].

2. METHOD

This study uses a quantitative meta-analysis approach to integrate the results of various empirical studies on the effectiveness of physics learning media on students' creative thinking skills. Meta-analysis was chosen because it can systematically combine quantitative data from independent studies, resulting in more accurate and robust effect estimates than single studies, in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This approach includes four main stages: data retrieval, data screening, data quality evaluation, and final analysis, ensuring transparency and reproducibility of the process. Retnawati et al. [10] and Nindrea [13] emphasise that meta-analysis is an advanced quantitative method for synthesising empirical evidence, while Rizky et al. [3] and Latifah et al. [14] emphasise the integration of data from quasi-experimental studies in educational contexts. Emzir [15] and Sudaryono [16] also support the use of this design to test aggregate hypotheses across broad populations.

The main instruments in this study were scientific journal articles selected based on strict inclusion and exclusion criteria, including a quasi-experimental quantitative study with pretest-posttest data on junior high and senior high school physics students in 2017-2025. Data analysis techniques involved calculating effect sizes using Cohen's d formula in three variants: posttest-only, pretest-posttest with pooled SD, and conversion of t-values, classified as low (0-0.2), medium (0.2-0.8), or high (>0.8). PRISMA flowcharts and summary tables were used to visualise the selection process from 5,259 initial articles to 10

final studies. Rizky et al. [3] recommend Cohen's d for educational meta-analyses because it is sensitive to group differences.

The study population included all quantitative studies on the effects of technology-based physics learning media (such as PhET, VR, e-modules) on the creative thinking skills of junior and senior high school students in Indonesia. The sample consisted of 10 high-quality articles that passed screening: 6 from mobile audio-visual media (mean ES 1.33, high), 4 from print/still visual media (mean ES 0.65, medium), with a total participant population of thousands of students from a quasi-experimental design. Inclusion criteria: sample size >10 students, available effect data, physics focus; exclusion criteria: qualitative, non-physics studies, or small sample sizes.

The procedure began with a search in Google Scholar and Mendeley using the keywords "physics learning media" and "creative thinking skills", resulting in 5,259 articles. The screening stage removed duplicates (n=2,457) and irrelevant articles via title/abstract (n=2,802), followed by full-text eligibility to 10 final articles through methodological quality evaluation. The final analysis calculated ES, heterogeneity, and subgroups (media type, level), with a PRISMA diagram for transparency [17].

3. RESULTS AND DISCUSSION

In the initial phase of this research, 5,259 articles were obtained as initial study material. All articles selected based on inclusion and exclusion criteria were then systematically analysed. This screening process was carried out to ensure that only relevant articles, those that met the requirements, and those that had the necessary data were included in further analysis. This stage is crucial to maintain the quality and validity of the meta-analysis results. The results of the study are presented in Table 1:

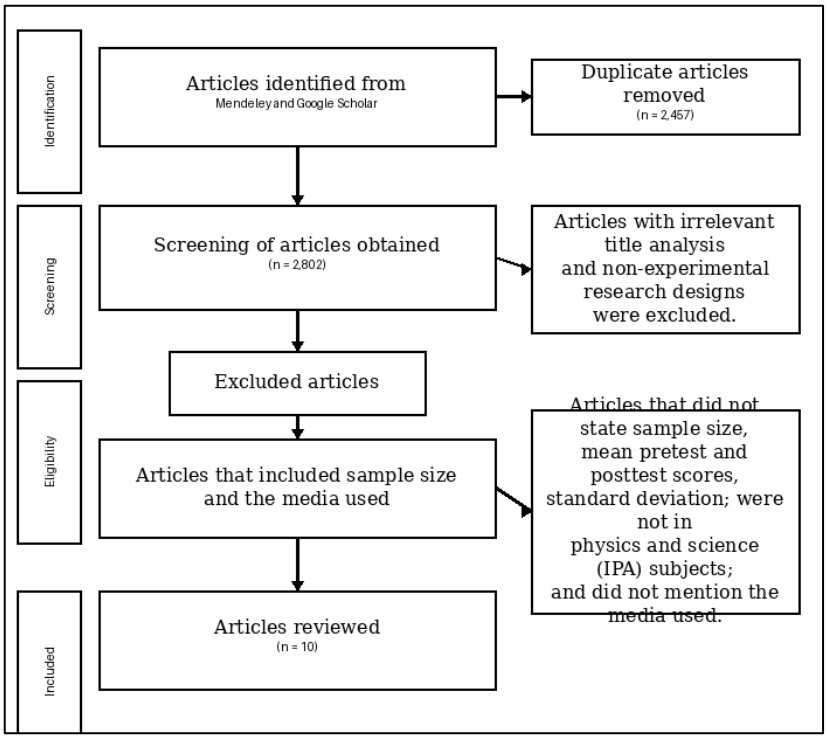

Figure 1. The Stage of This Study

Table 1. List of Articles and Article Codes

No	Article Code	Article Title	Researchers
1	A1	The Effect of Problem-Based Learning Model with Flipped Classroom on Creative Thinking Skills[1]	Sinta Ayu Damayanti, I Wayan Santyasa, and AAIA Rai Sudiatmika
2	A2	The Effect of PhET-Assisted Guided Discovery Model on Creative Thinking Ability and Physics Learning Achievement[2]	Baiq Nabila Saufika Zainuri, Syahrial Ayub, Aris Doyan, and Gunawan
3	A3	The Effectiveness of Implementing Interactive Learning Media with Autorun Software to Improve Physics Competence of Students at SMK Negeri 1 Padang[3]	Ismi Laili, Ganefri, Usmeldi
4	A4	The Influence of Virtual Reality Media Assisted by Millealab Software on Science Learning on Junior High School Students' Creative Thinking Skills[4]	Andining Dewi Sekar Langit, Pramudya Dwi Aristya Putra, Zainur Rasyid Ridho
5	A5	The Influence of Discovery Learning Model Assisted by Physics Learning Video Media on Students' Creative Thinking Skills at SMA Negeri 4[5]	Wulan Pratiwi, I Wayan Darmadi, and Muslimin
6	A6	The Effectiveness of Using the PjBL Model Assisted by Whatsapp Messenger on Students' Creative Thinking Skills in Grade XI of Senior High School in Physics Subjects[6]	Herman Jufri Andi, Ulfatul Fitriyah, Nilna Mely Dina, Mohammad Lutfiyadi
7	B1	The Effectiveness of CTL-based Physics E-module on the Improvement of the Creative and Critical Thinking Skills of Senior High School Students[7]	Desnita Desnita, Festiyed Festiyed, Fuja Novitra, Andini Ardiva, Mutia Yussavel Navis
8	B2	The Effect of Electronic Modules Based on Problem-Based Learning on Creative Thinking Ability[8]	Fahrul Juanda, Festiyed, Asrizal, Wahyuni Satria Dew
9	B3	Implementation of the Pop-up Book-Assisted Guided Inquiry Model to Improve Students' Creative Thinking Skills[9]	Ruqoyyah, M. Aji Fatkhurrohman, Yuni Arfiani
10	B4	The Influence of Student Worksheets with the React Strategy on Renewable Energy Material on Improving Students' Creative Thinking Skills[10]	Mala Pratiwi, Eko Suyanto, Nengah Maharta

Based on the table above, the effect size values obtained according to the type of learning media used are as follows:

Table 2. Effect Size Based on Types of Instructional Media

Media Types	Media Name	Article code	Number of Articles	Effect Size	Category
Moving Audio-visual	Flipped Classroom	A1	6	2.23	High
	PhET Simulation	A2		1.27	High
	Autorun Software	A3		1.27	High
	Virtual Reality (Millealab)	A4		1.37	High
	Video Media	A5		0.69	Currently
	WhatsApp Messenger	A6		1.15	High
Mean Effect Size				1.33	High
Print Media / Silent Audio-visual	CTL (Contextual Teaching and Learning) E-Module	B1	4	0.29	Currently
	PBL (Problem Based Learning) E-Module	B2		0.79	Currently
	Pop-up Book	B3		0.00097	Low
	LKPD (Student Worksheet)	B4		1.5	High
Mean Effect Size				0.645243	Currently
Total/Mean Effect Size			**10**	**1.056097**	**High**

This study is a meta-analysis that aims to evaluate the extent to which various types of physics learning media influence students' creative thinking skills. The analysis was conducted by referring to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and integrating findings from 10 relevant articles. In the analysis process, learning media were classified based on Rudy Bretz's categories, including still visual media/print media and moving audio-visual media. Each type of media was analysed based on data such as article code, number of articles, effect size value, and category. The results showed that the average effect size reached 1.05, which is considered high. This indicates that overall, physics learning media make a significant contribution to developing students' creative thinking skills [18], [19].

The main findings of the analysis indicate that moving audio-visual media have the strongest impact. Moving audio-visual media such as Flipped Classroom, PhET Simulation, Autorun Software, Virtual Reality (Millealab), learning videos, and WhatsApp Messenger had an average effect size of 1.33, which is considered high. Interactive media allows students to play an active role in learning through independent exploration, design, and manipulation of objects. This active engagement has been shown to stimulate higher-order thinking skills and creativity [11]. In contrast, still visual media (print) such as Pop-up Books

showed very little effect. With an effect size of only 0.00097, this media is considered very low in effectiveness. Although visually appealing, its passive nature makes students less motivated to think creatively or critically. This indicates that visual displays alone are not enough; media must be able to encourage cognitive engagement to have a maximum impact on the development of student creativity [20].

Interestingly, printed media, such as student worksheets (LKPD), also showed very positive results. With an effect size of 1.5 (high category), LKPD proved highly effective, especially when designed using a learning approach that encourages exploration, problem-solving, and creative thinking. This demonstrates that, despite its passive nature, printed media can have a significant impact if well-designed and encourages students to think creatively [21], [22].

Overall, the average effect size value obtained from the various learning media described was 1.04, which, according to Cohen's categories, is included in the high category. This finding indicates that the use of learning media generally has a strong influence on improving students' creative thinking skills. Among all types of media, moving audio-visual media has the best impact in improving creative thinking skills, with an average effect size of 1.33. Meanwhile, print media/still visual media only fell into the medium category with an average effect size of 0.64. This variation indicates that the level of media effectiveness is greatly influenced by the extent to which the media is able to activate student engagement and stimulate in-depth thinking processes. In addition, aspects such as the quality of media design, its application in teaching and learning activities, and differences in student characteristics also have the potential to influence the extent of the media's influence on the development of creativity.

In calculating effect size, researchers adapt the method to the type of data available in each article. For articles with complete quantitative data, a formula like Cohen's d is used. Meanwhile, if the article already includes an effect size value, that value is accepted without modification. This strategy is chosen to maintain objective and proportional analysis while maintaining data integrity [23].

Table 3. Effect Size of Using Physics Instructional Media on Students' Creative Thinking Ability by Category

Article Code	ICE	$\overline{ES}$	Category	N Article
B3	0.00097	0.001	Low	1
B1	0.29	0.59	Currently	3
A5	0.69			
B2	0.79			
A1	2.23	1,465	High	6
A2	1.27			
A3	1.27			
A4	1.37			
A6	1.15			
B4	1.5			
Mean ES		**1.0561**	**High**	**10**

Based on the table above, data analysis from 10 articles shows that each article has a varying effect size value. Of all the articles described, six of them showed a high effect size, three articles were in the medium category, and one article was in the low category. The average effect size value was 1.0561, which, according to Cohen's interpretation, is in the high category. This finding indicates that learning media generally has a significant and strong influence on improving students' creative thinking skills. This is in line with research by [8], which stated that learning media helps facilitate the teaching and learning process. Media also plays a role in increasing student interest in learning and encouraging active participation, not only from students but also from teachers. Teachers are required to be more creative and innovative in designing learning media, so that they can help students understand the material more easily and interestingly [24].

Several articles even showed effect sizes above 1.5, indicating that the use of certain learning media, such as constructivist-based student worksheets or interactive media, is highly effective in encouraging students to think more creatively. Thus, the findings of this meta-analysis confirm that the use of appropriate and innovative learning media can create a more active, challenging learning environment and encourage the exploration of ideas, ultimately improving students' creative thinking skills in physics learning [25].

Table 4. Relationship between Effect Size and Education Level

Educational level	N Article	$\overline{ES}$	Category
JUNIOR HIGH SCHOOL	2	0.685485	Currently
SENIOR HIGH SCHOOL	8	1.14875	High

Based on the analysis results, the junior high school level had an average effect size of 0.68, which is included in the medium category, while the senior high school level showed an average effect size of 1.14, which is in the high category. These findings indicate that physics learning media have a greater influence on improving creative thinking skills in senior high school students compared to junior high school students. This difference is due to the more advanced and mature cognitive development of senior high school students. This progress allows senior high school students to think abstractly, logically, and critically, and is supported by more diverse and broad learning experiences [12].

Table 5. Relationship between Effect Size and Subject Matter

Material	N Article	$\overline{ES}$	Category
Global warming	1	0.29	Currently
Effort and Energy	1	2.23	High
Magnitude and Vectors	1	0.79	Currently
Renewable energy	1	1.5	High
Momentum and Impulse	1	1.27	High
Optical Instruments (Magnifying Glass/Loop)	1	1.15	High
Physics	2	0.98	Currently
Science	2	0.685485	Currently

Table 5 above shows the variation in effect size values from several articles examining the influence of learning media on students' creative thinking skills. These different effect size values indicate differences in the level of effectiveness of each medium used in each study. In general, the highest effect size value was obtained from the Student Worksheet (LKPD) media with a value of 1.5, which is classified as high. This indicates that LKPD can have a significant impact on encouraging students to think creatively, especially because this medium allows students to explore concepts, solve problems, and work collaboratively actively. Conversely, the lowest effect size value came from the Pop-up Book media, which was only 0.00097, falling into the low category. This low effect could be due to the media's nature, which emphasises visualisation rather than in-depth problem-solving, thus not honing students' creativity much.

4. CONCLUSION

This meta-analysis, reported in line with PRISMA 2020, indicates that physics learning media are generally effective for enhancing Indonesian secondary students' creative thinking, with the strongest benefits tending to occur when instruction uses interactive and technology-supported media and when implementation matches students' developmental level. These findings imply that teachers and schools should prioritise learning media that actively engage learners in exploration, problem-solving, and idea generation, and education stakeholders should support this through lesson-design guidance, teacher training, and equitable access to digital infrastructure so that creative-thinking outcomes can be strengthened in regular classroom practice. However, the conclusions of this synthesis are bounded by the characteristics of the available evidence, including reliance on a small set of quasi-experimental studies, variation in outcome measurement and reporting across studies, and the possibility of publication and reporting biases that can affect the precision and generalizability of summary effects. Future research should expand the evidence base by incorporating more diverse regions and study designs (including more rigorous controlled trials where feasible), testing additional moderators (e.g., topic difficulty, duration of exposure, teacher support, school resources, and student characteristics), and improving reporting completeness to enable stronger sensitivity and bias analyses in subsequent meta-analyses. For the broader public, this work supports the practical message that well-designed physics learning media—especially those that foster active interaction—can help cultivate creative thinking as a transferable skill that is relevant beyond physics, contributing to students' preparedness for problem solving in everyday and future work contexts.

REFERENCES

[1] H. J. Andi, U. Fitriyah, N. M. Dina, and M. Lutfiyadi, "The Effectiveness of Using the PjBL Model Assisted by Whatsapp Messenger on Students' Creative Thinking Skills in Grade XI of Senior High School in Physics Subjects," *Journal of Educational Sciences*, vol. 1, no. 3, pp. 223–231, 2018.

[2] W. Ode Sakinah, "Improving the physics learning outcomes of class XI MIA3 students of SMA Negeri 1 Kabawo using the application of the CinQASE model assisted by Animaker-based media on the subject matter of sound waves," *Journal of Physics Education Research*, vol. 8, no. 4, 2023, doi: 10.36709/jipfi.v8i4.97.

[3] M. Rizky, I. T. Jadidah, W. Eprilia, A. N. Shawmi, and A. D. Saputra, "Seberapa Besar Pengaruh Metode Pembelajaran Talking Stick Pada Hasil Belajar Siswa SD/MI?," *JURMIA*, vol. 4, no. 1, pp. 1–10, Feb. 2024, doi: 10.32665/jurmia.v4i1.2530.
[4] S. Latifah, Y. Yuberti, and V. Agestiana, "Pengembangan Media Pembelajaran Interaktif Berbasis Hots Menggunakan Aplikasi Lectora Inspire," *Jurnal Penelitian Pembelajaran Fisika*, vol. 11, no. 1, pp. 9–16, 2020, doi: 10.26877/jp2f.v11i1.3851.
[5] Miterianifa Miterianifa, A. Ashadi, S. Saputro, and S. Suciati, "Higher Order Thinking Skills in the 21st Century: Critical Thinking," *Proceedings of the 1st International Conference on Social Science, Humanities, Education and Society Development, ICONS 2020, 30 November, Tegal, Indonesia*, 2021, doi: 10.4108/EAI.30-11-2020.2303766.
[6] E. Nurjanah, "Analisis Minat Belajar Dan Hasil Belajar Siswa Dalam Pembelajaran Matematika Di Sekolah Dasar," *creative of learning Stud. elementary education*, vol. 5, no. 6, pp. 1231–1240, Nov. 2022, doi: 10.22460/collase.v5i6.14532.
[7] I. Widiasanti, N. A. Ramadhan, M. Alfarizi, A. N. Fairus, A. W. Oktafiani, and D. Thahur, "Utilization of multimedia and internet media as effective learning tools," *Edukatif: Journal of Educational Sciences*, vol. 5, no. 3, pp. 1355–1370, 2023, doi: 10.31004/edukatif.v5i3.4939.
[8] S. Nurfadhillah, D. A. Ningsih, P. R. Ramadhania, and U. N. Sifa, "The role of learning media in increasing students' interest in learning at Kohod III Public Elementary School," *PENSA: Journal of Education and Social Sciences*, vol. 3, no. 2, pp. 243–255, 2021.
[9] R. N. Damanik, B. Sinaga, and E. E. Napitupulu, "Meta-analysis of the influence of learning models on students' mathematical creative thinking abilities," *Paradikma: Journal of Physics Education*, vol. 14, no. 2, 2021.
[10] H. Retnawati, E. Apino, Kartianom, H. Djidu, and R. D. Anazifa, *Pengantar Analisis Meta*. Yogyakarta: Parama Publishing, 2018.
[11] M. H. Ridho and D. Dasari, "Systematic literature review of mathematical identity in mathematics learning," *Jurnal Cendekia: Jurnal Pendidikan Matematika*, vol. 7, no. 1, pp. 631–644, 2023, doi: 10.31004/cendekia.v7i1.1989.
[12] K. Umam, "Development of Senior High School (SMA) students," *Jurnal Ilmiah Nusantara (JINU)*, vol. 1, no. 3, pp. 75–85, 2024, doi: 10.61722/jinu.v1i3.1532.
[13] R. D. Nindrea, *Pengantar Langkah-langkah Praktis Studi Meta Analisis*, 1st ed. Yogyakarta: Gosyen Publishing, 2016.
[14] P. I. Widyastuti and T. S. Rahayu, "Meta-Analisis Efektivitas Penggunaan Model Pembelajaran Tipe TPS dan TSTS Terhadap Kemampuan Memecahkan Masalah Matematika SD," *Mimb. Ilmu*, vol. 26, no. 1, p. 17, Apr. 2021, doi: 10.23887/mi.v26i1.33565.
[15] Emzir, *Qualitative Research Methods: Qualitative Data Analysis*. Prenada Media Group, 2022.
[16] Sudaryono, *Educational Research Methods*. Prenada Media Group, 2021.
[17] M. F. B. Paloloang, D. Juandi, M. Tamur, B. Paloloang, and A. M. G. Adem, "Meta-Analisis: Pengaruh Problem-Based Learning terhadap Kemampuan Literasi Matematis Siswa di Indonesia Tujuh Tahun Terakhir," *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, vol. 9, no. 4, pp. 851–851, Dec. 2020, doi: 10.24127/ajpm.v9i4.3049.
[18] M. Rizky, A. Ihwanah, M. Aldri, P. Pratama, and A. Muthmainnah, "The Influence of Learning Media Using the Assemblr Edu Application on Student Learning Interest in Class V Science Subjects at SD Palembang," *INNOVATIVE: Journal Of Social Science Research*, vol. 3, pp. 9552–9562, 2023.
[19] I. Harun, M. Latief, R. Takdir, and J. Pakaja, "Rancang Bangun Media Pembelajaran Interaktif Pada Mata Pelajaran Teknologi Informasi Dan Komunikasi Di Sma Negeri 7 Prasetya Gorontalo," *Inverted*, vol. 3, no. 2, 2023, doi: 10.37905/inverted.v3i2.18752.
[20] Y. Mariyati, "Students' level of activity and cognitive abilities through the use of learning videos," *TODO*, vol. 4, no. 1, pp. 27–31, 2021, doi: 10.31764/TODO.
[21] A. M. Ali, "Analisis Penggunaan Media Konkret Dalam Pembelajaran Matematika Kelas 2 Materi Pengukuran Di Sd Supriyadi 02 Kota Semarang," *Didaktik Jurnal Ilmiah PGSD Stkip Subang*, 2023, doi: 10.36989/didaktik.v9i2.1086.
[22] F. Fatimah and A. Widiyatmoko, "Pengembangan Science Comic Berbasis Problem Based Learning Sebagai Media Pembelajaran Pada Tema Bunyi Dan Pendengaran Untuk Siswa SMP," *Jurnal Pendidikan Ipa Indonesia*, 2014, doi: 10.15294/jpii.v3i2.3114.
[23] Y. Yunita, D. Juandi, A. Hasanah, and M. Tamur, "Studi Meta-Analisis: Efektivitas Model Project-Based Learning Terhadap Kemampuan Berpikir Kreatif Matematis Siswa," *AJPM*, vol. 10, no. 3, p. 1382, Oct. 2021, doi: 10.24127/ajpm.v10i3.3705.
[24] S. E. Smaldino, D. L. Lowther, and J. D. Russell, *Instructional technology and media for learning*, Tenth edit. Harlow: Pearson Education Limited, 2014.
[25] M. Abi Hamid *et al.*, *Media pembelajaran*. Yayasan kita menulis, 2020.

 https://doi.org/10.58421/gehu.v5i1.1097