

COMIC AS A PHYSICS LEARNING MEDIA: A SYSTEMATIC LITERATURE REVIEW

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Abstract: *This study aims to systematically review the literature on using comic as a physics learning media. The Preferred Reporting Items for Systematic Reviews (PRISMA) framework was used as a formal systematic review guideline for data collection. Data were obtained from research results during the period 2015-2024. This analysis includes a total of 27 papers from the Scopus database. Our findings show that most comics used as a media for learning physics are in digital form. The physics materials discussed include electricity, parabolic motion, momentum and impulse, force, work and energy, Newton's laws, global warming, temperature and heat, and optical instruments. Most studies focus on the development of comics, while others focus on the effectiveness and implementation of comics in learning. Using comics as a media for learning physics can improve mathematical representation, vector representation, verbal representation, critical thinking skills, creative thinking skills, conceptual understanding, motivation, scientific attitudes, character, and cognitive achievement. Comics can also map cooperative attitudes, process skills, and motivation and train conceptual understanding.*

Keywords: *Comic, Physics learning media, Systematic literature review*

Introduction

Physics is a branch of science that studies various symptoms and phenomena that occur in nature. By studying physics, students are encouraged to be able to think, analyze, solve problems, and understand multiple phenomena in everyday life (Alia et al., 2023). Physics learning is often considered one of the most challenging subjects for most students. The material in high school physics lessons is mostly abstract concepts, requiring a high level of imagination (Siswoyo et al., 2020). The complexity of the concept and the use of mathematical symbols are often obstacles to student understanding (M. S.I. Rahayu & Kuswanto, 2020), so innovative learning strategies are needed to make physics easier to understand and enjoyable. The use of learning media is expected to facilitate understanding of the concepts taught by teachers (Raisal et al., 2024).

In the learning process, media is a container and channel for messages from message sources (Sitepu et al., 2021). Learning media is anything that can be used to convey messages or information in the teaching and learning process so that it can stimulate students' attention and interest in learning (Satria et al., 2023). Learning media can facilitate the delivery of abstract messages to be more concrete (Pramesti et al., 2021). A learning media is said to be good if the media can increase students' interest in learning (Sakiah & Effendi, 2021). One of the learning media that is starting to be widely developed is visual media, such as comics in learning (A. N. W. Priyadi et al., 2020).

Comics are media presented in the form of images and contain both fictional and non-fictional stories (Serevina et al., 2021). Comics can convey information in a more straightforward and interesting way through a combination of text and images, which can help

clarify abstract concepts and increase students' interest in learning (Anissa Maghfiroh & Kuswanto, 2022). As a learning medium, comics not only provide a fun learning experience but can also present narratives that can improve students' understanding of physics material (Mega Septiana Ika Rahayu & Kuswanto, 2021). Comics display representations in words, diagrams, images, and graphs visually and attractively and are easy for students to understand. Everyday language in comics can also change the rigid language of science into simple language so that it is easy for students to understand (A. Priyadi & Kuswanto, 2023). Several studies have shown that using comics in learning can improve conceptual understanding, critical and creative thinking skills, and verbal and mathematical representations. However, although the potential of comics as a physics learning medium is quite promising, a systematic literature review is still needed to understand its effectiveness comprehensively.

This article aims to review various literature related to using comics as a learning physics media. The results of this study are expected to provide deeper insight into the potential of comics as an innovative media in physics education. This systematic review investigates research trends and identifies similar themes, frameworks, and research samples. To guide the study, research questions (RQs) have been designed as follows:

- a. What types of comics are most popularly used in physics learning?
- b. What are the popular topics discussed when using comics as a physics learning media?
- c. What is the focus of research on comics in physics learning (application, development, and effectiveness)?
- d. What are the benefits of using comics as a learning physics media?

Method

The method used in this study is a systematic literature review. A systematic literature review can help several aspects of the research process, such as establishing context and limiting the research problem; seeking theoretical support; rationalizing the problem and new field investigations; distinguishing what has been done from what needs to be done; identifying key results (and methodologies used in previous studies); and avoiding wasted research (Linnenluecke et al., 2020). The systematic literature review in this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The goal is to analyze the content of selected articles to answer the research questions. The PRISMA flowchart is shown in Fig. 1. The database used is Google Scholar. The articles selected for review have the following criteria:

1. Discussing comics in physics learning
2. Published in the last ten years, namely 2015-2024.
3. Using English.
4. Journal articles or conference proceedings

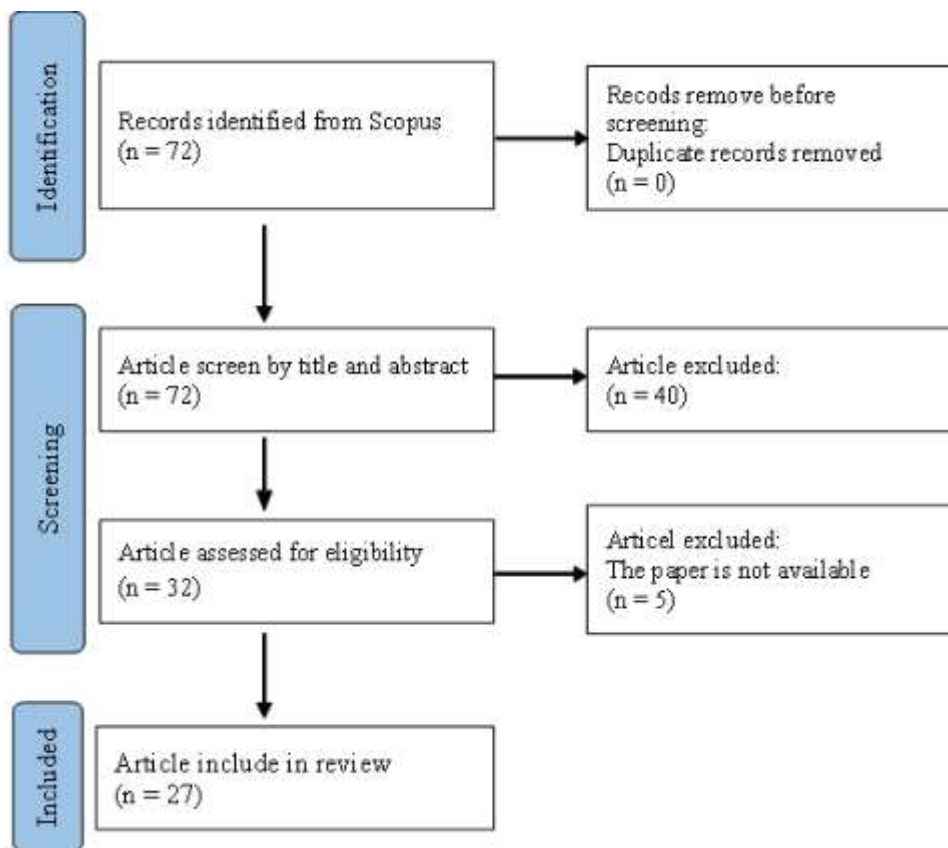


Fig. 1. PRISMA Framework

Result and Discussion

Based on the search results from the Scopus database, there were 72 articles found using the keyword "physics comics". The database only uses Scopus so there is no data duplication. Screening based on title and abstract was done manually, leaving 32 articles. Furthermore, 5 articles were excluded because they did not have full text. After assessing the eligibility of the articles, the remaining 27 articles were then used for this systematic review.

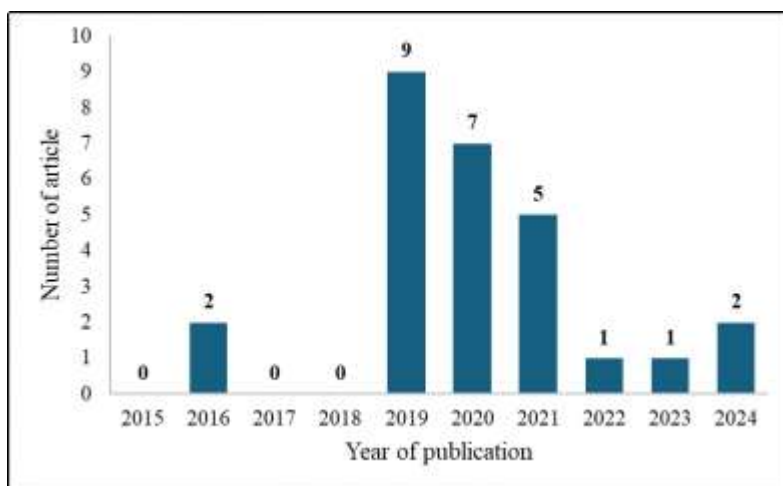


Fig. 2. Number of articles per year

Fig. 2 shows the trend of publications included in this review from 2015 to 2024. The number of articles discussing the use of comics as a physics learning media was the highest in

2019. A total of 8 articles were published in journal articles (29.6%), while 19 other articles were published in seminar proceedings (70.4%) as seen in Fig. 3.

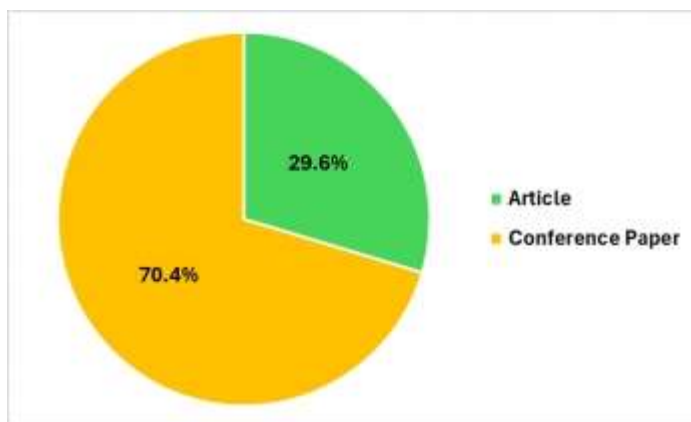


Fig. 3. Percentage of articles published in journals and seminars

Table 1 shows publications that publish articles related to comics as a physics learning media. Journal of Physics: Conference Series is the publication that publishes most articles, namely 18 articles.

Table 1: The publication that published the article

No	Publication	Frequency
1	Journal of Physics: Conference Series	18
2	Journal of Technology and Science Education	2
3	Jurnal Pendidikan IPA Indonesia	1
4	Physical Review Physics Education Research	1
5	Proceedings of Science	1
6	Revista Mexicana de Fisica E	1
7	Science Education	1
8	International Journal of Instruction	1
9	Science Education International	1

RQ1. What types of comics are most popularly used in physics learning?

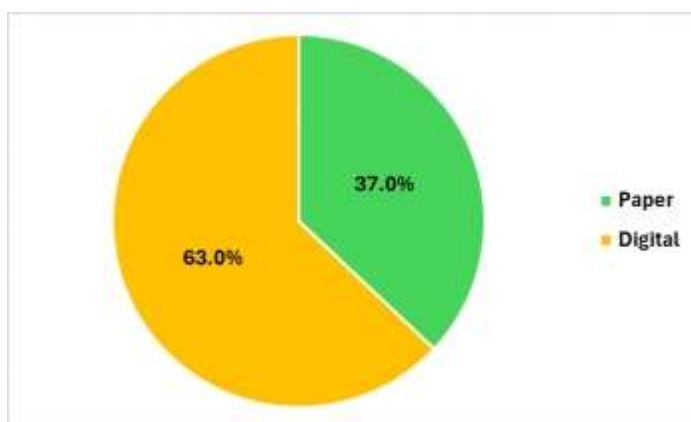


Fig. 4. Types of comics used in physics learning

A total of 10 articles use comics in printed form (37.0%), while 17 articles use comics in digital form (63.0%) in delivering physics material as seen in Fig. 4. Comics can encourage

creative and original ideas from readers, and clarify teaching materials for student worksheets that are commonly used in class, making learning more enjoyable (Ratnaningtyas et al., 2019). Students are more interested in reading comics than academic books (Nikmah et al., 2019). Comics are also addictive for most students in various countries, especially Asia (Ramadhan, Ratnaningtyas, et al., 2019). Comics are generally packaged in printed media using paper. However, along with the development of the times, comics are also available in electronic form known as digital comics (A. Maghfiroh et al., 2020). The distribution of comics can currently use the internet and can even be combined with digital technology (A. N. W. Priyadi et al., 2020). Comic strips and the internet are some of the most easily accessible materials that can be used in science classes as learning aids (Ramadhan, Ratnaningtyas, et al., 2019).

In today's era, students access media not only through personal computers (PCs) but also through mobile devices such as iPads, netbooks, and smartphones, so the use of digital comics provides clear direction regarding the applicable teaching process (Anissa Maghfiroh & Kuswanto, 2022). Rahayu and Kuswanto stated that digital comics can be integrated with a scientific approach so that they are in line with 21st-century learning and are effective and efficient because they are easy to operate on the Android platform anytime, anywhere, both offline and online (M. S.I. Rahayu & Kuswanto, 2020). Digital comics can save paper usage and can be filled not only with learning materials but with animations, learning videos, and tests in large quantities (A. E. Damayanti & Kuswanto, 2020; Mega Septiana Ika Rahayu & Kuswanto, 2021). Digital comics developed by Bertelli et al. can be downloaded from the website, and each episode provides quizzes and games to engage and entertain students in reading (Bertelli et al., 2024). The key to success in learning physics is shown in the educational technology media used because physics is a subject that contributes greatly to the development of science and technology in society (Haroky et al., 2019). Muliwati stated that conservation science teachers believe that digital comics are effective in teaching science considering that digital comics motivate students in physics lessons (Muliwati et al., 2023). Digital comics can create a more meaningful learning environment, where the material taught is directly related to students' lives (Almira Eka Damayanti & Kuswanto, 2021). The use of digital comics as a learning media is expected to be an interesting, creative, and innovative learning media and can make it easier for students to understand the learning material (Serevina et al., 2021).

RQ2. What are the popular topics discussed when using comics as a physics learning media?

Table 2: Topics discussed

No	Topic	Frequency
1	Momentum and Impulse	7
2	Optical Instrument	3
3	Newton's Gravity	2
4	Newton's Law	2
5	Thermodynamics	2
6	Circular Motion	1
7	Sound Wave	1
8	Electric field	1
9	Temperature and Heat	1
10	Parabolic Motion	1
11	Work and Energy	1

Table 2 shows the physics topics discussed using comics. Momentum and impulse are the most discussed topics, with seven articles. Optical Instrument is discussed in three articles. Topics on Newton's Gravity, Newton's Laws, and thermodynamics are each discussed in two articles. Circular motion, sound waves, electric fields, temperature and heat, parabolic motion,

and work and energy are each discussed in one article. Physics learning applies more mathematical mindset than in-depth concepts, this creates a physics learning atmosphere that only leads to memorizing formulas, so that students' conceptual and high-level thinking abilities are less trained (Ramadhan, Ratnaningtyas, et al., 2019). Physics subjects often consist of abstract concepts that require high imagination. Physics concepts will be more fun when packaged in the form of visual media with pictures, especially in visualizing abstract concepts. Pictures can overcome space and time limitations because not all objects, objects, or events can be brought into the classroom, and children cannot always be taken to the object/event (Siswoyo et al., 2020). Sari et al. developed an android-assisted physics comic in thermodynamics practicums so that students are active in scientific activities and invite students to carry out science process skills activities (Sari, Ratnaningtyas, et al., 2019). The subject matter delivered through comics is packaged in an interesting story so that it motivates students to learn and understand the material in depth (M. S.I. Rahayu & Kuswanto, 2020). Comics can help students understand physics theory because the storyline can encourage students to think contextually (A. Maghfiroh et al., 2020). Comics have many benefits in teaching physics, but physics topics that have been discussed using comics are still limited. There are still many physics topics that have not utilized comics as a physics learning media. This can provide an opportunity for other researchers to develop comics on topics of physics that have not been discussed at all.

RQ3. What is the focus of research on comics in physics learning (implementation, development, and effectiveness)?

Fig. 5 shows the focus of research conducted on comics as physics learning. Most of the research focuses on the development of comics as a learning media both in print and digital form, which is 17 articles (63.0%). Furthermore, seven articles (25.9%) focus on the effectiveness of comics as a physics learning media. Finally, three articles (11.1%) focus on the implementation of comics in physics learning. Sari et al. developed comics using an application called Sigil (A. Maghfiroh et al., 2020; Permata Sari et al., 2020; Sari, Ratnaningtyas, et al., 2019). Several comics developed in digital form can be read through the Himawari Riders application (Nikmah et al., 2019; Permata Sari et al., 2020; Sari, Ratnaningtyas, et al., 2019) and Reasily EPUB or EPUB Reader (A. Maghfiroh et al., 2020). Rahayu and Kuswanto developed comics using CorelDraw X7 and Android Studio (M. S.I. Rahayu & Kuswanto, 2020). Damayanti and Kuswanto developed comics using Kodular (Almira Eka Damayanti & Kuswanto, 2021).

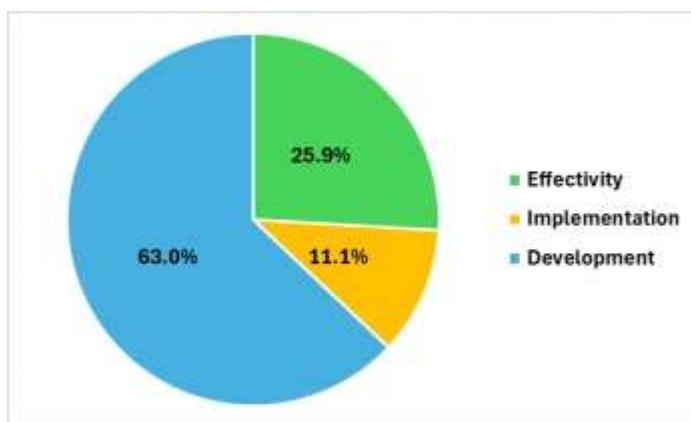


Fig. 5. Research focus

RQ4. What are the benefits of using comics as a physics learning media?

There are several benefits of using comics as a physics learning media. Mutia et al. stated that comics can improve students' scientific attitudes (Mutia et al., 2020). Badeo and Koc stated that comics can improve students' conceptual understanding and motivation in physics learning (Badeo & Ong Kian Koc, 2021). This is like research conducted by Haroky et al. which found that comics can train students' conceptual understanding in the learning process (Haroky et al., 2019). Yulianti stated that comics can improve character and cognitive achievement (Yulianti et al., 2016). Comics as a physics learning media can improve critical thinking skills (A. E. Damayanti & Kuswanto, 2020; Almira Eka Damayanti & Kuswanto, 2021; Anissa Maghfiroh & Kuswanto, 2022; Mega Septiana Ika Rahayu & Kuswanto, 2021). Comics can also improve vector representation (Anissa Maghfiroh & Kuswanto, 2022), verbal representation (Almira Eka Damayanti & Kuswanto, 2021), and mathematical representation (Permata Sari et al., 2020; A. N. W. Priyadi et al., 2020; Mega Septiana Ika Rahayu & Kuswanto, 2021). Sari et al. stated that comics can improve creative thinking skills (Permata Sari et al., 2020). Comics are able to map motivation (Nikmah et al., 2019), cooperative attitudes (Ratnaningtyas et al., 2019), and students' process skills (Sari, Ratnaningtyas, et al., 2019).

Conclusion

There are 27 articles on comics as a physics learning media indexed by Scopus from 2015-2024 which are published through journals and seminar proceedings. This study focuses on the types of comics used, the topics discussed, the focus of research, and the benefits of comics in physics learning. The most widely used type of comic is comic in digital form or digital comic as many as 17 articles (63%) while comic in paper form as many as 10 articles (37%). The physics topics that have been discussed are Momentum and Impulse, Optical Instrument, Newton's Gravity, Newton's Law, Thermodynamics, Circular Motion, Sound Wave, Electric field, Temperature and Heat, Parabolic Motion, and Work and Energy. Most of the articles focus on comic development, while others focus on effectiveness and implementation. The benefits that can be obtained from using comics as a physics learning media are improving character, scientific attitudes, conceptual understanding, motivation, cognitive achievement, critical thinking skills, creative thinking skills, vector representation, verbal representation, and mathematical representation. Comics can also be used to map motivation, cooperative attitudes, and science process skills.

References

- Alia, R., Kuswanto, H., Amir, H. T., & Jumadi, -. (2023). Development of Digital Teaching Materials Assisted by Flipbooks on Momentum and Impulse Materials to Improve Students' Conceptual Understanding. *Jurnal Penelitian Pembelajaran Fisika*, 9(1), 79–85. <https://doi.org/10.24036/jppf.v9i1.121472>
- Alrizal, A., Pathoni, H., & Rinasari, S. (2021). Learning work and energy through Aminuddin and Aminullah Comic. *Journal of Physics: Conference Series*, 1731(1), 1–5. <https://doi.org/10.1088/1742-6596/1731/1/012068>
- Badeo, J. M. O., & Ong Kian Koc, B. C. U. (2021). Use of Comic-based Learning Module in Physics in Enhancing Students' Achievement and Motivation. *Science Education International*, 32(2), 131–136. <https://doi.org/10.33828/sei.v32.i2.6>
- Bertelli, S., Andreotti, M., Antolini, R., Balossino, I., Barone, S., Beretta, M., Diociauti, E., Distefano, C., Domenici, D., Donghia, R., Fabbri, B., & Filomena, L. (2024). Engaging children with science, the INFN Kids project. *Proceedings of Science*, 449(), 1–6.
- Cao, Y., & Brizuela, B. M. (2016). High school students' representations and understandings of electric fields. *Physical Review Physics Education Research*, 12(2), 1–19.

<https://doi.org/10.1103/PhysRevPhysEducRes.12.020102>

- Damayanti, A. E., & Kuswanto, H. (2020). The use of android-assisted comics to enhance students' critical thinking skill. *Journal of Physics: Conference Series*, 1440(1), 1–7. <https://doi.org/10.1088/1742-6596/1440/1/012039>
- Damayanti, Almira Eka, & Kuswanto, H. (2021). The Effect of the Use of Indigenous Knowledge-Based Physics Comics of Android-Based Marbles Games on Verbal Representation and Critical Thinking Abilities in Physics Teaching. *Journal of Technology and Science Education*, 11(2), 581–593. <http://www.jotse.org/index.php/jotse/article/view/110/142>
- Doerr, K., & Bruun, J. (2024). “On Mars, we will speak Arabic”: Negotiating identity in upper secondary physics in Denmark. *Science Education*, 108(6), 1698–1724. <https://doi.org/10.1002/sce.21898>
- Handayani, D. P., Jumadi, Wilujeng, I., & Kuswanto, H. (2019). Development of Comic Integrated Student Worksheet to Improve Critical Thinking Ability in Microscope Material. *Journal of Physics: Conference Series*, 1233(1), 1–8. <https://doi.org/10.1088/1742-6596/1233/1/012069>
- Haroky, F., Nikmah, S., Wilujeng, I., Jumadi, & Kuswanto, H. (2019). Android-Assisted Physics Comic Learning to Train Students' Conceptual Understanding of Newton's Gravity. *Journal of Physics: Conference Series*, 1233(1), 1–9. <https://doi.org/10.1088/1742-6596/1233/1/012045>
- Linnenluecke, M. K., Marrone, M., & Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), 175–194. <https://doi.org/10.1177/0312896219877678>
- Maghfiroh, A., Kuswanto, H., & Susetyo, B. (2020). The development of android-based physics comic on optical devices for high school students. *Journal of Physics: Conference Series*, 1440(1), 1–6. <https://doi.org/10.1088/1742-6596/1440/1/012023>
- Maghfiroh, Anissa, & Kuswanto, H. (2022). Benthik Android Physics Comic Effectiveness for Vector Representation and Critical Thinking Students' Improvement. *International Journal of Instruction*, 15(2), 623–640. <https://doi.org/10.29333/iji.2022.15234a>
- Maharani, L., Rahayu, D. I., Yuberti, Y., Komikesari, H., Sodikin, S., & Hidayah, R. (2019). Toondoo Application Based on Contextual Approach: Development of Comic Learning Media. *Journal of Physics: Conference Series*, 1155(1), 1–12. <https://doi.org/10.1088/1742-6596/1155/1/012023>
- Muliyati, D., Nurcholisah, A., Purwahida, R., Rahmadini, D., Sari, N. L. K., & Sumardani, D. (2023). “philipp Lenard and Cathode Rays” - The development of comics for Physics learning. *Journal of Physics: Conference Series*, 2596(1), 1–6. <https://doi.org/10.1088/1742-6596/2596/1/012056>
- Mutia, D. I., Gani, A., & Syukri, M. (2020). The influences of comics' media application in students' scientific perspectives attitude. *Journal of Physics: Conference Series*, 1460(1), 1–5. <https://doi.org/10.1088/1742-6596/1460/1/012130>
- Nikmah, S., Haroky, F., Jumadi, Wilujeng, I., & Kuswanto, H. (2019). Development of Android Comic Media for the Chapter of Newton's Gravity to Map Learning Motivation of Students. *Journal of Physics: Conference Series*, 1233(1), 1–10. <https://doi.org/10.1088/1742-6596/1233/1/012051>
- Permata Sari, F., Nikmah, S., Kuswanto, H., & Wardani, R. (2020). Development of physics comic based on local wisdom: Hopscotch (engklek) game android-assisted to improve mathematical representation ability and creative thinking of high school students. *Revista Mexicana de Fisica E*, 17(2), 255–262. <https://doi.org/10.31349/REVMEXFISE.17.255>

- Pramesti, P. D., Dibia, I. K., & Ujianti, P. R. (2021). Media Pembelajaran Daring Interaktif Berbasis Power Point dengan Fungsi Hyperlink. *Jurnal Pedagogi Dan Pembelajaran*, 4(2), 258–267. <https://doi.org/10.23887/jp2.v4i2.36524>
- Priyadi, A., & Kuswanto, H. (2023). The Android-Based Comic of Gajah Mungkur Dam: Improving Mathematical Representation and Critical Thinking Abilities. *Journal of Technology and Science Education*, 13(1), 116–129. <https://doi.org/10.3926/jotse.1174>
- Priyadi, A. N. W., Kuswanto, H., & Sumarna. (2020). Android physics comics to train the mathematical representation ability on momentum and impulse of senior high school students. *Journal of Physics: Conference Series*, 1440(1), 1–7. <https://doi.org/10.1088/1742-6596/1440/1/012041>
- Rahayu, M. S.I., & Kuswanto, H. (2020). Development of android-based comics integrated with scientific approach in physics learning. *Journal of Physics: Conference Series*, 1440(1), 1–8. <https://doi.org/10.1088/1742-6596/1440/1/012040>
- Rahayu, Mega Septiana Ika, & Kuswanto, H. (2021). The effectiveness of the use of the android-based carom games comic integrated to discovery learning in improving critical thinking and mathematical representation abilities. *Journal of Technology and Science Education*, 11(2), 270–283. <https://doi.org/10.3926/JOTSE.1151>
- Raisal, A. Y., Rakhmadi, A. J., & Hidayat, M. (2024). The Development of Android-Based Interactive Learning Media on the Topic of Discussing the Atmosphere. *Journal of Physics: Conference Series*, 2773(1), 1–6. <https://doi.org/10.1088/1742-6596/2773/1/012023>
- Ramadhan, R. H., Ratnaningtyas, L., Kuswanto, H., & Wardani, R. (2019). Analysis of Physics Aspects of Local Wisdom: Long Buntung (Bamboo Cannon) in Media Development for Android-Based Physics Comics in Sound Wave Chapter. *Journal of Physics: Conference Series*, 1397(1), 1–8. <https://doi.org/10.1088/1742-6596/1397/1/012016>
- Ramadhan, R. H., Wilujeng, I., Jumadi, & Kuswanto, H. (2019). Development of Student Worksheet through Deep Questions with Physics Comics to Train High Order Thinking Skill in High School Students in Optical Instrument Lup for Maximum Accommodation Eyes. *Journal of Physics: Conference Series*, 1233(1), 1–12. <https://doi.org/10.1088/1742-6596/1233/1/012057>
- Ratnaningtyas, L., Jumadi, Wilujeng, I., & Kuswanto, H. (2019). Android-based Physics Comic Media Development on Thermodynamic Experiment for Mapping Cooperate Attitude for Senior High School. *Journal of Physics: Conference Series*, 1233(1), 1–11. <https://doi.org/10.1088/1742-6596/1233/1/012054>
- Sakiah, N. A., & Effendi, K. N. S. (2021). Analisis Kebutuhan Multimedia Interaktif Berbasis PowerPoint Materi Aljabar Pada Pembelajaran Matematika SMP. *JP3M (Jurnal Penelitian Pendidikan Dan Pengajaran Matematika)*, 7(1), 39–48. <https://doi.org/10.37058/jp3m.v7i1.2623>
- Sari, F. P., Nikmah, S., Kuswanto, H., & Wardani, R. (2019). Developing Physics Comic Media a Local Wisdom: Sulamanda (Engklek) Traditional Game Chapter of Impulse and Momentum. *Journal of Physics: Conference Series*, 1397(1), 1–9. <https://doi.org/10.1088/1742-6596/1397/1/012013>
- Sari, F. P., Ratnaningtyas, L., Wilujeng, I., Jumadi, & Kuswanto, H. (2019). Development of Android Comics media on Thermodynamic Experiment to Map the Science Process Skill for Senior High School. *Journal of Physics: Conference Series*, 1233(1), 1–9. <https://doi.org/10.1088/1742-6596/1233/1/012052>
- Satria, D. A., Firmansyah, R. B., & Basuki, A. A. (2023). Implementasi Augmented Reality Berbasis Filter Instagram Pada Penerapan Media Pembelajaran Tentang Pengenalan Tata Surya. *Jurnal Ilmiah Informatika*, 11(1), 63–68.

- Serevina, V., Astra, I. M., & Syahida, A. F. (2021). The development of digital comic as learning media based on picture-and-picture learning model on global warming materials during distance learning. *Journal of Physics: Conference Series*, 2019(1), 1–6. <https://doi.org/10.1088/1742-6596/2019/1/012014>
- Siswoyo, S., Mustokoweni, G., & Mulyati, D. (2020). “tempera-Tour”: Developing an Alternative Comic as Media Learning for Temperature and Heat Topics Through Traveling Story. *Journal of Physics: Conference Series*, 1491(1), 1–7. <https://doi.org/10.1088/1742-6596/1491/1/012060>
- Sitepu, J. M., Nasution, M., & Masitah, W. (2021). The Development of Islamic Big Book Learning Media For Early Children’s Languages. *Nazhruna: Jurnal Pendidikan Islam*, 4(3), 735–743. <https://doi.org/10.31538/nzh.v4i3.1691>
- Yulianti, D., Khanafiyah, S., & Sulistyorini, S. (2016). Inquiry-based science comic physics series integrated with character education. *Jurnal Pendidikan IPA Indonesia*, 5(1), 38–44. <https://doi.org/10.15294/jpii.v5i1.5787>