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Development of digital mathematics teaching materials to improve student learning outcomes in junior high school

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Abstract: This research aims to 1) Identify the needs of math digital teaching materials, 2) Design digital teaching materials for mathematics, 3) Measure the level of validity, 4) Measure the level of practicality, and 5) Measure the level of effectiveness. This research uses an R&D (Research and Development) approach. The development model used, namely ADDIE. This research was conducted at SMP Negeri 4 Sungguminasa class VII. The developed digital teaching materials were validated by material experts and media experts. Trials on 1 teacher, 3 students (individual) and 12 students (small group) to see the practicality of digital teaching materials. Meanwhile, 45 students were involved in the effectiveness test learning. The results of the level of validity of digital teaching materials from the assessment of media expert validators (98.3%) are at a very valid stage and material experts (92.5%) are at a very valid stage. The results at the practicality level obtained (range 91-94%) which was declared very practical. Furthermore, the level of effectiveness of digital math teaching materials was measured by a pretest which obtained 54 in the "low" category and the posttest obtained 91 in the "high" category which showed an increase in student learning outcomes so that it was declared very effective. Based on the results of the analysis, it can be concluded that digital math teaching materials are proven to be valid, practical, and effective in improving student learning outcomes.

Keywords: Digital, learning outcomes, mathematics, teaching materials

Abstrak: Penelitian ini bertujuan untuk 1) Mengidentifikasi analisis kebutuhan bahan ajar digital matematika, 2) Mendesain bahan ajar digital matematika, 3) Mengukur tingkat kevalidan, 4) Mengukur tingkat kepraktisan, dan 5) Mengukur tingkat keefektifan. Penelitian ini menggunakan pendekatan R&D (*Research and Development*). Model pengembangan yang digunakan, yaitu ADDIE. Penelitian ini dilakukan di SMP Negeri 4 Sungguminasa kelas VII. Bahan ajar digital yang dikembangkan divalidasi oleh ahli materi dan ahli media. Uji coba pada 1 guru, 3 siswa (perorangan) dan 12 siswa (kelompok kecil) untuk melihat kepraktisan bahan ajar digital. Sementara itu, 45 siswa dilibatkan dalam pembelajaran uji keefektifan. Hasil tingkat kevalidan bahan ajar digital dari penilaian validator ahli media (98,3%) berada pada tahap sangat valid dan ahli materi (92,5%) berada pada tahap sangat valid. Hasil pada tingkat kepraktisan memperoleh (rentang 91-94%) yang dinyatakan sangat praktis. Selanjutnya tingkat keefektifan bahan ajar digital matematika diukur dengan *pretest* yang memperoleh 54 dengan kategori "rendah" dan *posttest* memperoleh 91 dengan kategori "tinggi" yang menunjukkan terjadinya peningkatan hasil belajar siswa sehingga dinyatakan sangat efektif. Berdasarkan perolehan analisis maka dapat disimpulkan bahwa bahan ajar digital matematika terbukti valid, praktis, dan efektif dalam meningkatkan hasil belajar siswa.

Kata kunci: Digital, hasil pembelajaran, matematika, materi pengajaran

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INTRODUCTION

Mathematics is a fundamental subject imparted to students from elementary through high school. Mathematics learning is abstract and requires logical thinking that is not always simple for all students to understand (Fatimah et al., 2020; Gravemeijer et al., 2017). Complex and interrelated mathematical concepts can make students feel overwhelmed, especially if they do not have a strong foundation in previous concepts (Mazana et al., 2018).

Mathematics is a crucial subject in human life; it was developed by ancient scholars for daily problems and is integral to our lifestyle due to its symbols, language, and technology (Acharya, 2017). It is important to realize that mathematics is very much needed in the world of education because it has an impact on life. Learning mathematics requires significant effort to ensure that students can be successful in the future.

The results of the National Assessment of Numeracy Skills of Junior High School Students in Indonesia in 2024 obtained a result of 65%, where the results this year increased by 21.97% from 2023 (43.03%), but the results are still in the moderate category (range 40.00% - 70.00%) with students who still achieve minimum numeracy competencies (Kemendikbudristek, 2024). Despite the increase, efforts to develop junior high school students' numeracy skills are still very much needed. Based on a preliminary study conducted in August 2024 at SMP Negeri 4 Sungguminasa, it was found that the main learning resource used in learning activities was the use of printed mathematics books. The use of printed books available in the library has limitations; in this case, the number of printed books available in the school library is not comparable to the number of students in each class. Additionally, observations in the classroom indicate that face-to-face learning using printed books is significantly constrained by time.

The findings of interviews with mathematics teachers conducted in August 2024 at SMP Negeri 4 Sungguminasa showed that the printed books used still have limited references in terms of the mathematics subject matter itself. In addition, the printed books provided are only a guide for teachers, so students do not have their learning resources to use as a reference in learning. Based on the accumulated data from the numeracy competency assessment of grade VII students at SMP Negeri 4 Sungguminasa, an average of 75.6% of students understood the material well enough, with a score range of 75-81. Meanwhile, 24.4% of students did not understand the subject matter, with a score range of 68-74. Although the independent curriculum no longer uses minimum completion criteria as a benchmark for learning achievement, the proportion of students without a comprehensive understanding of the content is significantly elevated.

Technology is currently developing rapidly, which presents education with both challenges and opportunities to transform the learning process by utilising it to create engaging teaching materials that may enhance student learning achievement (Arifuddin et al., 2025; Damopolii & Kurniadi, 2019; Dita et al., 2023; Kunwar et al., 2025; Setyantoko et al., 2023). Digital teaching materials are learning resources that are produced and presented in an electronic version, which can be accessed online with computers and smartphones (Ahliana et al., 2025; Mustofa et al., 2024; Nahri et al., 2024; Pratiwi et al., 2024). Ramadani and Anwar (2025) created an e-module product to enhance learning, allowing students to engage more actively in independent and collaborative learning. It offers advantages such as easy operation, accessible videos, and portable accessibility.

The development of digital teaching materials in learning activities can foster independent learning due to their portable and anytime-use nature. Interviews with several students at SMP Negeri 4 Sungguminasa indicate a necessity for teaching materials that facilitate distance learning, allowing for flexible access to visually and interactively comprehend the material during emergencies and for enrichment purposes. Teaching materials are needed that provide flexibility in helping students understand complex material in a more practical and interactive way that can be used independently.

Previous research done by Nurhikmah et al. (2022) showed that the developed teaching materials had met the validity test of teaching material experts. Based on student assessments, the practicality of this teaching material reached 75.22% with a good category so that it was suitable for use and did not need to be revised. Research by Febriati et al. (2022) on the development of teaching materials demonstrated a positive impact from its use in learning. Researchers have conducted practicality tests of teaching materials on both lecturers and students, and the results are in the practical category. Dita et al. (2024) have conducted an effectiveness test of digital books on students, and the results can improve learning achievement.

Several previous studies indicate that developing digital-based teaching materials is necessary. Thus, the problems related to mathematics learning that have been described can be overcome by creating digital-based teaching materials. The digital mathematics teaching materials developed are equipped with animations, interactive graphics, and simulations that can help students visualize and understand abstract mathematical concepts better, as well as simulation videos to help learners who have different learning styles in increasing student activity and creativity by producing satisfactory learning outcomes. Digital mathematics teaching materials equipped with animations, graphics and videos can help increase the effectiveness of mathematics teaching (Purwanto & Rizki, 2015; Radović et al., 2020; Setiawan et al., 2021; Widodo et al., 2021).

This research aims to 1) Identify the needs of math digital teaching materials, 2) Design digital teaching materials for mathematics, 3) Measure the level of validity, 4) Measure the level of practicality, and 5) Measure the level of effectiveness.

METHOD

The research methodology used is research and development (R&D). R&D serves as the cornerstone for new concepts and knowledge generation in the 21st century (Jiang et al., 2024). This study used the ADDIE development approach, which comprises Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009).

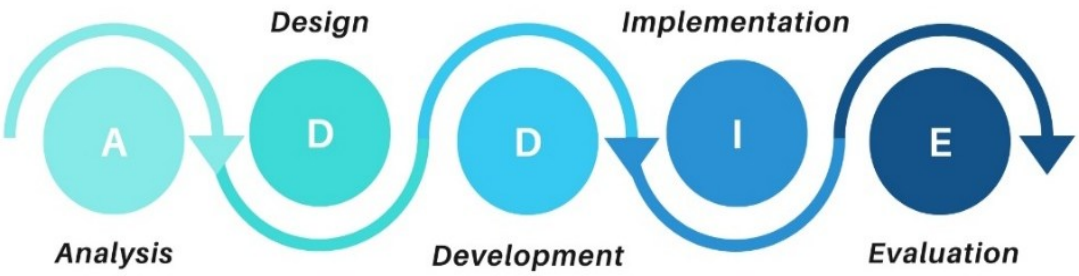


Fig. 1. ADDIE model

This research was located at SMP Negeri 4 Sungguminasa, with the subjects being one class of VII grade students selected based on random sampling. The students involved in the research were 3 students during individual testing, 12 students during small group trials, and 45 students during effectiveness testing. The data collection techniques used were 1) observation and interviews to obtain initial data on school needs analysis, 2) questionnaires used at the needs analysis stage, validity trials by media experts and material experts, and

practicality trials by teachers and students, and 3) learning outcome tests used to obtain supporting data for effectiveness analysis.

This study employs two data analysis procedures: qualitative descriptive analysis, used to examine data derived from notes, comments, or suggestions acquired through validity assessments and trials, and quantitative descriptive analysis, applied to analyse data represented by scores or numerical values obtained from validation questionnaires completed by material and media experts, as well as student and teacher response questionnaires and learning outcome assessments.

RESULTS AND DISCUSSION

The development of digital teaching materials is based on needs analysis, which is the initial stage carried out in this study to identify problems and needs in mathematics learning in junior high schools. Analysis activities provide a foundation for researchers in developing digital teaching materials that are able to answer challenges and meet the needs of mathematics learning in the field. Needs analysis is the main basis for compiling a product in development research (Dita et al., 2023; Setyantoko et al., 2023).

The development of digital teaching materials is carried out by identifying student characteristics by analysing student needs. The findings of the needs questionnaire show that students have a high interest in teaching materials that integrate multimedia, such as dynamic visualisation, interactive simulations, and learning videos. The majority of students agreed if mathematics material is presented using digital teaching materials that combine various learning media. Students are interested because the content presented with various media can make mathematics learning more interesting, interactive, and easy to understand.

The developed digital teaching materials are designed with an initial design that includes prototype design, a storyboard, and a selection of applications used, namely Flip PDF Professional. The preparation of this design greatly influences the overall form of the digital mathematics teaching materials that will be developed. The production of digital mathematics teaching materials is developed by combining text, images, dynamic visualisations, interactive simulations, and learning videos that support understanding mathematical concepts. Digital teaching resources are appropriate for practical lessons since comprehension of the subject matter may be enhanced by examples or specific actions shown in the instructional videos included within them (Arnidah et al., 2020).

Digital teaching materials are designed as attractively as possible to help students understand the learning materials better to improve the learning quality according to the needs of learning objectives and the latest curriculum. Reference materials are taken from various sources, such as mathematics textbooks, scientific journals, and trusted mathematics learning resources, and then designed by highlighting attractive and interactive visualizations. Visually appealing digital-based mathematics learning resources draw students' attention (Scholes, 2017; Sugandi & Kurniawan, 2024; Tania & Siregar, 2022).

The output of this product is to produce digital teaching materials that can be accessed on computers, laptops, tablets, or smartphones. With flexible access through various electronic devices, students can study the material anytime and anywhere according to their needs. Digital teaching materials not only facilitate user-centered

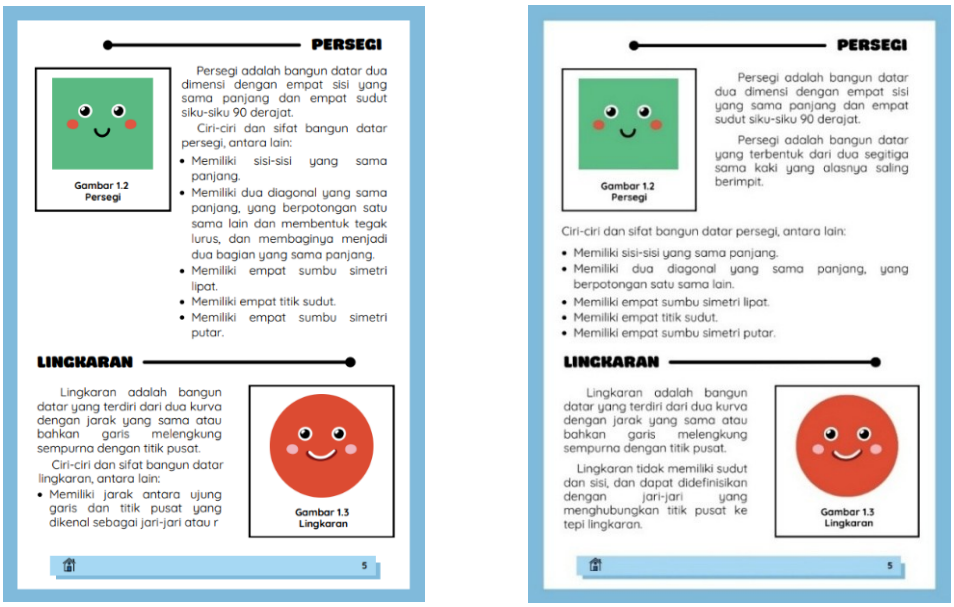
learning but can also be integrated into everyday life. A digital learning resource can be easily accessed from various devices and locations anywhere (Damopolii & Kurniadi, 2019).

After completing the development of digital mathematics teaching materials, the researcher prepares the product for validation to ensure the accuracy of the content. Validation is carried out with the aim of obtaining an assessment in the form of input or criticism related to digital teaching materials, which will later be improved so that the product is worthy of being tested on research subjects. Validation consists of media validation and material validation.

Table 1. Validation results of media experts and material experts

Expert	Percentage Score	Conclusion
Media/Design	98.3%	Very Valid
Material/Content	92.5%	Very Valid

The evaluation findings from the media/design expert validator yielded a total percentage of 98.3%, signifying a highly valid category (Table 1). This indicates that the digital teaching materials created by the researcher merit evaluation in the study. The evaluation findings from the material expert validator yielded a total percentage of 92.5%, signifying a highly valid classification. This indicates that the digital teaching materials created by the researcher merit evaluation in the study. Figure 2 – 3 presents the revisions made to the digital teaching materials by the material experts.



Before Revision After Revision

Fig. 2. Added definition to the square and circle sections

Before Revision After Revision

Fig. 3. Added definition to the cube section

In terms of use and utilisation, the media includes easy-to-understand content, accessible navigation, accurate button functions, support for the learning process, visual appeal, and solutions to time constraints. This is in line with research by Febrianti et al. (2024), which found that the media has a very attractive appearance, complete navigation, more realistic flipping effects, and a clearer video display so that it can motivate student learning and train students' literacy skills.

The results obtained from the validation of the material demonstrated strong validity concerning the assessed aspects, specifically learning, content, completeness, accuracy, and meaningfulness. This encompasses the alignment of the material with learning objectives, student characteristics, the employed communicative language, the appeal of the content in motivating users, the capacity to engage students in comprehending the subject matter, and the facilitation of achieving learning objectives. The produced medium must align with the learning goals and the characteristics of the students to ensure its feasibility and effective use (Utomo et al., 2024).

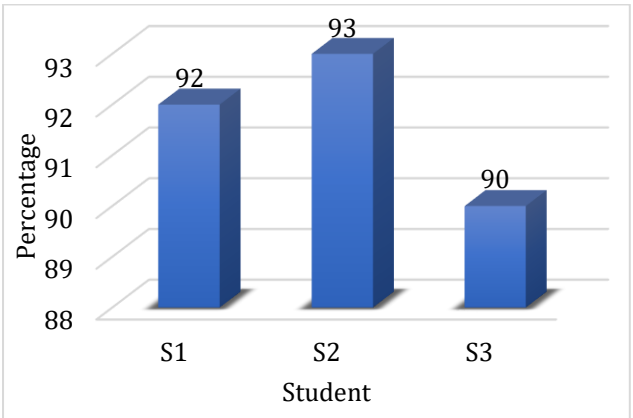


Fig. 4. Individual trial

After the product is declared valid, the digital mathematics teaching materials are ready to be tested on students. The initial trial stage is an individual trial carried out involving 3 students of class VII of SMP Negeri 4 Sungguminasa. The individual testing of the digital mathematics instructional materials resulted in an average score of 92%. The findings reveal that the practicality level falls within the very practical group, indicating that the use of digital teaching resources may enhance the learning process without necessitating additional enhancement. Students did not experience difficulties during the individual trial process because the product has been equipped with a comprehensive digital mathematics teaching material usage guide, making it easier for students to operate it. Digital mathematics books are easy for students to use (Wijaya et al., 2022).

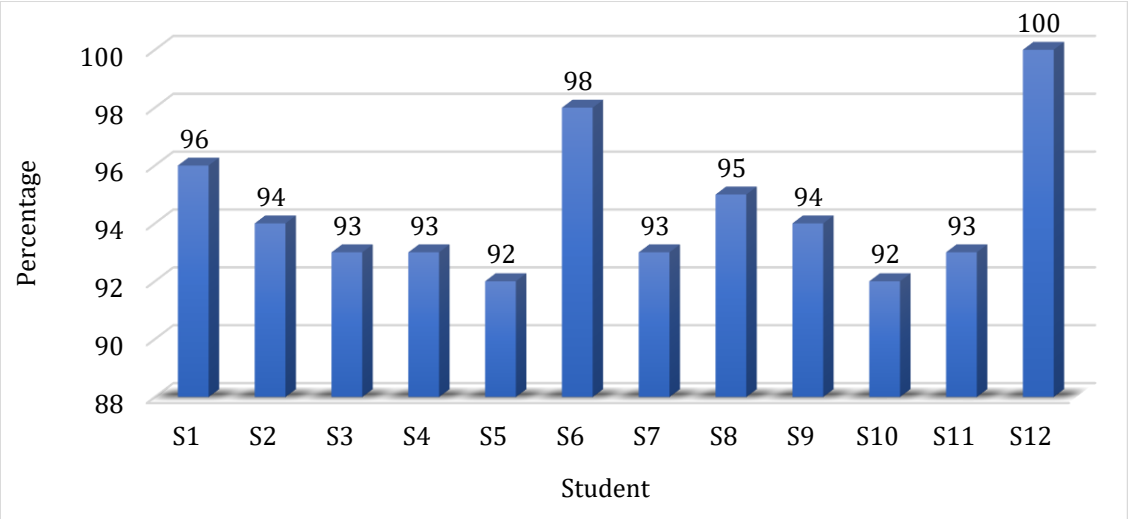


Fig. 5. Small group trial

After completing the individual trial stage, the next step is to conduct a small group trial. Digital mathematics teaching materials were implemented for 12 seventh-grade students of SMP Negeri 4 Sungguminasa. Based on the findings of the evaluation of the small group trial through a questionnaire, the average percentage was 94% (Figure 5). The findings reveal that the practicality level falls within the very practical group, indicating that the use of digital instructional resources may enhance the learning process.

Table 2. Results of mathematics teacher responses

Respondent	Score	Conclusion
Teacher	91%	Very Practical

The digital mathematics teaching materials developed by researchers were then evaluated by mathematics teachers, with assessments covering instructional, linguistic, and material substance aspects. The results of the mathematics teacher assessment obtained an average percentage of 91% (Table 2). These results show that the level of practicality falls into the very practical category, meaning that this digital mathematics teaching material is suitable for use by both teachers and students during mathematics learning activities in the classroom.

Table 3. Pretest and posttest results

No.	Student	Pretest	Posttest
1	S-1	53	93
2	S-2	66	93
3	S-3	60	80
4	S-4	60	93
5	S-5	40	86
6	S-6	46	86
7	S-7	33	93
8	S-8	60	86
9	S-9	60	93
10	S-10	66	93
11	S-11	53	86
12	S-12	46	86
13	S-13	60	86
14	S-14	73	93
15	S-15	60	93
16	S-16	60	80
17	S-17	53	100
18	S-18	40	93
19	S-19	27	93
20	S-20	66	93
21	S-21	53	93
22	S-22	53	100
23	S-23	73	93
24	S-24	66	86
25	S-25	33	93
26	S-26	66	86
27	S-27	60	93
28	S-28	53	86
29	S-29	33	93
30	S-30	60	86
31	S-31	80	100
32	S-32	53	80
33	S-33	40	100
34	S-34	60	86
35	S-35	60	93
36	S-36	73	93
37	S-37	66	93
38	S-38	27	86
39	S-39	33	100
40	S-40	33	93
41	S-41	46	93
42	S-42	46	93
43	S-43	53	86
44	S-44	73	93
45	S-45	40	93
Total		2,415	4,090
Average		54	91

Evaluation of effectiveness is done by analyzing student learning outcomes; the data used are pretests and posttests. The pretest is done before students use digital teaching materials to measure their initial understanding of the material to be taught, while the posttest is done by implementing digital teaching materials in learning activities. We carry out pretest and posttest activities to assess the increase in student understanding and achievement in the same material. The data obtained from student learning outcomes through pretest and posttest activities, which are then calculated and analyzed, get a total student pretest score of 2,415 and an average student pretest score of 54, and a total student posttest score of 4,090 and an average posttest score of 91 (Table 3). This indicates a 37-point improvement in learning outcomes between the pretest and posttest scores, culminating in a score of 91, categorizing the degree of effectiveness as highly successful. So it can be concluded that the use of digital mathematics teaching materials for class VII of SMP Negeri 4 Sungguminasa has been proven effective and ready to be applied in the learning process.

The findings of this study indicate that digital-based mathematics teaching materials have benefits for improving student achievement in learning mathematics. These teaching materials facilitate the learning of mathematics for students. Educators and learners agree that a digital book may facilitate mathematical comprehension for them, conform to the academic curriculum, and be user-friendly, engaging, and enjoyable, including elements such as mobile gameplay and videos (Suarsana, 2021). The development of digital textbooks for mathematics aligns with the needs of students. They no longer have difficulty learning mathematics. This is evidenced by the increase in their scores, which reached 91. This study has succeeded in developing digital textbooks for teaching mathematics

CONCLUSION

The results of the needs analysis obtained through interviews and questionnaires by teachers and students of class VII at SMP Negeri 4 Sungguminasa are that students need digital teaching materials, where the digital teaching materials to be developed are equipped with pictures/photos, audio, and learning videos that are packaged attractively so that they can support an interesting learning process. Digital mathematics teaching materials have gone through a validation process tested by media experts and material experts. The product's validity received a very valid classification, and the outcomes of the material's validity also attained a highly valid classification. The evaluation of the efficacy of digital mathematics instructional resources included administering questionnaires to both teachers and students. The instructor answer questionnaire yielded a very pragmatic category, similar to the student response form. The efficacy of digital teaching materials was assessed by pretests and posttests administered to students, with the objective of ascertaining any improvement in student learning outcomes after the use of digital mathematics teaching resources. The pretest and posttest findings indicated an improvement in learning outcomes, classifying it as very effective.

REFERENCES

Acharya, B. R. (2017). Factors Affecting Difficulties in Learning Mathematics by Mathematics Learners. *International Journal of Elementary Education*, *6*(2), 8–15.

https://doi.org/10.11648/j.ijeedu.20170602.11
Ahliana, A., Nurhikmah, N., & Anwar, C. R. (2025). Development of digital art and culture book for improving students learning outcomes. *Journal of Research in Instructional*, *5*(1), 40–51. https://doi.org/10.30862/jri.v5i1.520
Arifuddin, A., Khoiriyah, S., Sugianto, H., & Karim, A. R. (2025). Integrating technological pedagogical content knowledge in Learning: A systematic review. *Journal of Research in Instructional*, *5*(1), 16–39. https://doi.org/10.30862/jri.v5i1.429
Arnidah, A., Anwar, C. R., & Hasfat, H. (2020). Pengaruh Pemanfaatan Buku Elektronik Berbasis Multimedia Mata Pelajaran Simulasi dan Komunikasi Digital di SMK. *Journal of Curriculum Indonesia*, *3*(2), 101–105. https://doi.org/10.46680/jci.v3i2.35
Branch, R. M. (2009). *Instructional Design: The ADDIE Approach*. Springer US. https://doi.org/10.1007/978-0-387-09506-6
Damopolii, I., & Kurniadi, B. (2019). Training students metacognitive skill using mobile learning. *Journal of Physics: Conference Series*, *1317*(1), 012185. https://doi.org/10.1088/1742-6596/1317/1/012185
Dita, K. I., Nunaki, J. H., Nasir, N. I. R. F., Winarno, N., Damopolii, I., & Latjompoh, M. (2024). Flipbook digital sistem peredaran darah manusia: Dampaknya terhadap hasil belajar siswa. *Biogenesis*, *20*(2), 55–70. http://dx.doi.org/10.31258/biogenesis.20.2.55-70
Dita, K. I., Tuririday, H. T., Damopolii, I., & Latjompoh, M. (2023). Designing the human circulatory system e-module to increase student achievement. *Inornatus: Biology Education Journal*, *3*(2), 75–84. https://doi.org/10.30862/inornatus.v3i2.422
Fatimah, S., Johar, R., & Zubainur, C. M. (2020). Students' logical mathematical intelligence in completing mathematical problems with natural disaster context. *Journal of Physics: Conference Series*, *1470*(1), 012022. https://doi.org/10.1088/1742-6596/1470/1/012022
Febrianti, F. A., Rokhmaniyah, R., Salimi, M., & Asy'ari, L. (2024). Analisis Kebutuhan Buku Digital Berbasis Etnotematik untuk Meningkatkan Literasi Budaya dan Kewargaan. *Social, Humanities, and Educational Studies (SHES): Conference Series*, *7*(3), 694–703. https://doi.org/10.20961/shes.v7i3.91643
Febriati, F., Jaya, D., Nurhikmah, N., & Sujarwo, S. (2022). English Teaching Materials With Flipped Learning Model in English Course. *Journal of Education Technology*, *6*(4), 643–651. https://doi.org/10.23887/jet.v6i4.45652
Gravemeijer, K., Stephan, M., Julie, C., Lin, F.-L., & Ohtani, M. (2017). What Mathematics Education May Prepare Students for the Society of the Future? *International Journal of Science and Mathematics Education*, *15*(S1), 105–123. https://doi.org/10.1007/s10763-017-9814-6
Jiang, Y., Hossain, M. R., Khan, Z., Chen, J., & Badeeb, R. A. (2024). Revisiting Research and Development Expenditures and Trade Adjusted Emissions: Green Innovation and Renewable Energy R&D Role for Developed Countries. *Journal of the Knowledge Economy*, *15*(1), 2156–2191. https://doi.org/10.1007/s13132-023-01220-0
Kemendikbudristek. (2024). *Asesmen Nasional & Rapor Pendidikan*. https://data.kemdikbud.go.id/publikasi/p/rapor-pendidikan-indonesia/rapor-pendidikan-indonesia-2024

Kunwar, R., Shrestha, S. K., & Adhikari, S. (2025). The innovative evolution of teaching materials: Trends and future prospects. *Journal of Research in Instructional*, *5*(1), 142–152. https://doi.org/10.30862/jri.v5i1.600

Mazana, M. Y., Montero, C. S., & Casmir, R. O. (2018). Investigating Students' Attitude towards Learning Mathematics. *International Electronic Journal of Mathematics Education*, *14*(1), 207–23. https://doi.org/10.29333/iejme/3997

Mustofa, A., Hayuana, W., Damopolii, I., Ibrohim, I., & Susilo, H. (2024). The discovery learning and Google sites: Its application in learning the process of urine formation for high school students. *Inornatus: Biology Education Journal*, *4*(2), 132–150. https://doi.org/10.30862/inornatus.v4i2.711

Nahri, M. H. A., Abidin, Z., & Soepriyanto, Y. (2024). Development of augmented reality human skeleton to improve students' cognitive learning outcomes on movement systems practice. *Journal of Research in Instructional*, *4*(2), 453–464. https://doi.org/10.30862/jri.v4i2.459

Nurhikmah, N., Aris, M., Arismunandar, A., Sujarwo, S., & Sukmawati, S. (2022). Development of Local Content Teaching Material for the History of Wajo. *Journal of Innovation in Educational and Cultural Research*, *3*(2), 264–270. https://doi.org/10.46843/jiecr.v3i2.82

Pratiwi, S. N. A., Nurhikmah, N., & Anwar, C. R. (2024). Development of digital modules for English subjects for fourth grade elementary school students. *Journal of Research in Instructional*, *4*(2), 586–600. https://doi.org/10.30862/jri.v4i2.504

Purwanto, Y., & Rizki, S. (2015). Pengembangan Bahan Ajar Berbasis Kontekstual Pada Materi Himpunan Berbantu Video Pembelajaran. *AKSIOMA Journal of Mathematics Education*, *4*(1). https://doi.org/10.24127/ajpm.v4i1.95

Radović, S., Radojičić, M., Veljković, K., & Marić, M. (2020). Examining the effects of Geogebra applets on mathematics learning using interactive mathematics textbook. *Interactive Learning Environments*, *28*(1), 32–49. https://doi.org/10.1080/10494820.2018.1512001

Ramadani, P., & Anwar, C. R. (2025). A valid and practical electronic digital security module for educational technology study program students. *Journal of Research in Instructional*, *5*(1), 246–257. https://doi.org/10.30862/jri.v5i1.505

Scholes, L. (2017). Books Are Boring! Books Are Fun! *Boyhood Studies*, *10*(2), 77–98. https://doi.org/10.3167/bhs.2017.100205

Setiawan, W., Hakim, L. F. N., & Filiestianto, G. (2021). Pengembangan Bahan Ajar Trigonometri Berbasis Animasi Pada Masa Pandemi Covid-19. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *4*(2), 435–444. https://doi.org/10.22460/jpmi.v4i2.p%p

Setyantoko, E., Nunaki, J. H., Jeni, J., & Damopolii, I. (2023). Development of human digestive system e-module to improve students' learning outcomes during pandemic. *AIP Conference Proceedings*, *2540*, 020002. https://doi.org/10.1063/5.0105782

Suarsana, I. M. (2021). Developing Interactive Digital Mathematics Book with Multi Representation Approach for Deaf Students. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(13), 128–141. https://doi.org/10.3991/ijet.v16i13.22459

Sugandi, E., & Kurniawan, A. (2024). Development of FLOC (Flipbook Competence) as a

Means of Teaching Mathematical Counting for Early Childhood Education Teacher Prospective Students. *Edunesia : Jurnal Ilmiah Pendidikan*, *5*(2), 910–924. https://doi.org/10.51276/edu.v5i2.891

Tania, W. P., & Siregar, N. (2022). The Development of E-book Based on Realistic Mathematics Education (PMR) Approach to Improve Mathematical Communication Skills in Class VIII Junior High School Students. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *6*(1), 91–106. https://doi.org/10.31331/medivesveteran.v6i1.1910

Utomo, A. C., Pamungkas, T. B. S., & Rigianti, H. A. (2024). Pengembangan Media Pembelajaran KAUN (Karakter Unggul) Sebagai Penguatan Nilai-Nilai Pancasila Di Kelas 5 Sekolah Dasar. *Elementary School: Jurnal Pendidikan Dan Pembelajaran Ke-SD-An*, *11*(2), 538–549. https://doi.org/10.31316/esjurnal.v11i2.4317

Widodo, C. A., Sukendra, I. K., & Sumandya, I. W. (2021). Pengembangan Bahan Ajar Digital Matematika Sma Kelas X Berbasis STEM. *Widyadari*, *22*(2), 478–486.

Wijaya, T. T., Zhou, Y., Houghton, T., Weinhandl, R., Lavicza, Z., & Yusop, F. D. (2022). Factors Affecting the Use of Digital Mathematics Textbooks in Indonesia. *Mathematics*, *10*(11), 1808. https://doi.org/10.3390/math10111808