



Depelovment of an Interactive E-module using the Problem Based Learning Approach for the Topic of Systems of Linear Equations in Two Variables

Astri Rully Rizky¹, Leni Pebriantika², Heni Rita Susila³

^{1,2,3}Universitas Baturaja, Baturaja, Indonesia

Corresponding author email: astrianandias@gmail.com

Info Article

Received: 6 March 2026

Revised: 24 March 2026

Accepted: 19 April 2026

Online Version: 27 April 2026

Abstract

This study aims to develop an interactive e-module based on the PBL approach for teaching Systems of Linear Equations in Two Variables. The study employed a Research and Development (R&D) design using the Dick and Carey model, adapted into eight stages, including needs analysis, instructional design, material development, and formative evaluation. The developed e-module integrates multimedia elements and PBL syntax to support student-centered learning and problem-solving skills. The product was evaluated through expert validation, one-to-one evaluation, small group evaluation, and field trials involving junior high school students. The validation results showed that the e-module achieved a high level of validity, with an average score of 88%, indicating that it is highly appropriate in terms of content, instructional design, and media quality. The practicality of the e-module was also confirmed through one-to-one, small group, and field testing, with an average score of 89%, categorized as very practical. These findings indicate that the developed e-module is both valid and practical for use in mathematics learning. The integration of digital media and PBL provides an effective alternative to enhance student engagement and support problem-solving-oriented learning in secondary education. These findings indicate that the e-module is valid, practical, and effective, and can serve as an innovative digital learning medium to support student-centered learning in junior high school.

Keywords: Digital Learning ; Interactive E-module; Problem Based Learning; Mathematics Learning

This is open access article under the [CC-BY](#) licence



INTRODUCTION

Education is a continuous and comprehensive process aimed at developing individuals' potential in terms of knowledge, skills, and attitudes. In the context of modern education, learning is expected to create meaningful experiences that enable students to actively construct knowledge and adapt to the rapid advancement of science and technology. According to Government Regulation of the Republic of Indonesia Number 57 of 2022, education is a conscious and planned effort to create learning conditions that allow students to actively develop their potential across cognitive, affective, and psychomotor domains. This implies that learning practices must shift from teacher-centered approaches toward more student-centered and interactive models.

Learning, as an interaction between students, teachers, and learning resources, plays a crucial role in shaping students' understanding and mindset (Wahab & Rosnawati, 2021). The effectiveness of this process is strongly influenced by the selection and utilization of appropriate learning resources. In this regard, teaching materials serve as essential components that facilitate independent and meaningful learning experiences. According to Aliah et al. (2024), learning resources encompass all elements that support learning, including materials, media, and environments. However, the rapid development of educational technology demands innovation in teaching materials, particularly those that integrate digital and interactive elements.

One form of innovative teaching material aligned with current technological developments is the interactive e-module. E-modules are systematically designed digital learning materials that can be accessed independently through electronic devices (Asri & Dwiningsih, 2022; Lauhi et al., 2023). Compared to conventional printed modules, e-modules offer several advantages, including flexibility, accessibility, and the integration of multimedia elements such as images, audio, and video, which enhance student engagement and motivation (M. Rasyid, 2022; Harahap & Eliza, 2022). It is hoped that technology can improve the quality of learning and with technology learning can be more easily obtained by students (Pebriantika, 2021). Despite these advantages, the implementation of interactive digital teaching materials in classroom practice remains limited, particularly in mathematics learning.

Mathematics is a compulsory subject at all levels of education in Indonesia and plays a significant role in developing students' higher-order thinking skills, including problem-solving abilities. Problem-solving is a fundamental mathematical competence that involves analyzing, interpreting, and applying strategies to solve contextual problems (Setiyani et al., 2025; Boas et al., 2020). However, empirical evidence from classroom observations indicates that students often experience difficulties in solving mathematical problems, especially in topics such as Systems of Linear Equations in Two Variables. These difficulties include challenges in understanding problem statements, selecting appropriate strategies, and verifying solutions.

Furthermore, learning practices observed in junior high schools reveal that instructional methods are still predominantly one-directional, resulting in low student engagement and motivation. The use of conventional media, such as textbooks and whiteboards, does not sufficiently support interactive learning experiences. In addition, the integration of technology-based learning materials is minimal, limiting opportunities for students to engage in meaningful and self-directed learning. This condition highlights a critical gap between the demands of 21st-century learning and the actual implementation in classrooms.

To address this issue, an instructional approach that promotes active learning and problem-solving is required. Problem Based Learning (PBL) is recognized as an effective approach that uses real-world problems as a starting point for learning, enabling students to develop critical thinking, communication, and problem-solving skills (Thesalonika, 2024). Previous studies have demonstrated that the integration of PBL in digital learning materials, such as e-modules, can significantly improve students' problem-solving abilities (Herdianto, 2021; Juniantari, 2022). Nevertheless, the development of interactive e-modules that specifically integrate PBL in the context of SPLDV learning at the junior high school level remains underexplored.

Based on the aforementioned gaps, this study aims to develop an interactive e-module based on the Problem Based Learning approach for teaching Systems of Linear Equations in Two Variables. The development of this e-module is expected to provide an innovative digital learning resource that enhances students' engagement, supports independent learning, and improves mathematical problem-solving skills. Moreover, this study contributes to the advancement of technology-enhanced pedagogy by integrating interactive digital media with constructivist learning approaches in mathematics education.

RESEARCH METHODS

This study employed a Research and Development (R&D) design aimed at producing and evaluating an interactive e-module based on the PBL approach for the topic of SPLDV. The development process followed the Dick and Carey instructional design model, which was adapted into eight main stages to suit the research objectives.

Research Design

This study employed a Research and Development (R&D) approach aimed at producing and evaluating a digital learning product in the form of a Digital Smart Book for cultural diversity material in Pancasila Education. The development process adopted the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). To strengthen the evaluation process, this study integrated formative evaluation based on Tessmer's model, enabling iterative revisions through expert validation and user testing (Tessmer, 1993).

Research Design and Development Procedure

The development procedure consisted of the following stages: (1) identifying instructional goals through needs analysis based on classroom observations and teacher interviews; (2) conducting instructional analysis to determine the required knowledge and skills; (3) analyzing learners and learning contexts, including students' prior knowledge, learning characteristics, and available technological facilities; (4) formulating performance objectives using the ABCD (Audience, Behavior, Condition, Degree) framework; (5) developing assessment instruments aligned with the objectives; (6) designing instructional strategies using the Problem Based Learning approach; (7) developing and selecting instructional materials in the form of an interactive e-module using Canva integrated with multimedia elements; and (8) conducting formative evaluation to refine the product.

The developed e-module integrates PBL syntax, including problem orientation, investigation, solution development, and reflection, and incorporates multimedia features such as text, images, animations, videos, and interactive quizzes to support student engagement and independent learning.

Participants

The participants of this study were Grade IX students of SMP Negeri 7 OKU. The product trials were conducted in three stages: one-to-one evaluation involving three students with varying ability levels (high, medium, and low), small group evaluation involving six students, and field testing involving 30 students in a full-class setting.

Validation and Evaluation

The product validity was assessed through expert validation, involving subject matter experts, media experts, and instructional design experts. These experts evaluated the e-module in terms of content accuracy, instructional design, media quality, and alignment with PBL principles. Formative evaluation followed a modified Dick and Carey model, incorporating four stages: expert review, one-to-one evaluation, small group evaluation, and field testing. This iterative process enabled continuous refinement of the product to ensure its validity, practicality, and effectiveness before wider implementation.

Data Collection Techniques

Data were collected using both qualitative and quantitative approaches. Qualitative data were obtained through observations and interviews during the need's analysis phase, while quantitative data were collected using questionnaires administered to experts and students. The instruments included validation sheets for experts and response questionnaires for students, focusing on aspects such as clarity, relevance, interactivity, usability, and instructional impact of the e-module.

Data Analysis

Quantitative data were analyzed using descriptive statistics in the form of percentage scores to determine the level of product validity and practicality. The percentage was calculated by comparing the obtained score with the ideal score and then categorized into four levels: very feasible (86–100%), feasible (76–85%), less feasible (56–75%), and not feasible ($\leq 55\%$). Qualitative data from expert feedback and student responses were analyzed descriptively to identify strengths and weaknesses of the product, which were then used as the basis for revision and improvement of the e-module.

RESULTS AND DISCUSSION

RESULT

Product Development Results

The study resulted in the development of an interactive e-module based on the PBL approach for the topic of Systems of Linear Equations in Two Variables. The development process followed eight stages of the Dick and Carey model, including needs analysis, instructional design, material development, and formative evaluation. The needs analysis revealed that approximately 30% of students demonstrated low problem-solving ability, while 40% were at a moderate level, indicating significant challenges in understanding contextual mathematical problems and selecting appropriate solution strategies. These findings justified the need for an interactive and problem-oriented learning resource.

The resulting e-module was designed as a web-based interactive learning resource using Canva, integrating multimedia elements (text, images, videos, and interactive quizzes) with PBL syntax.

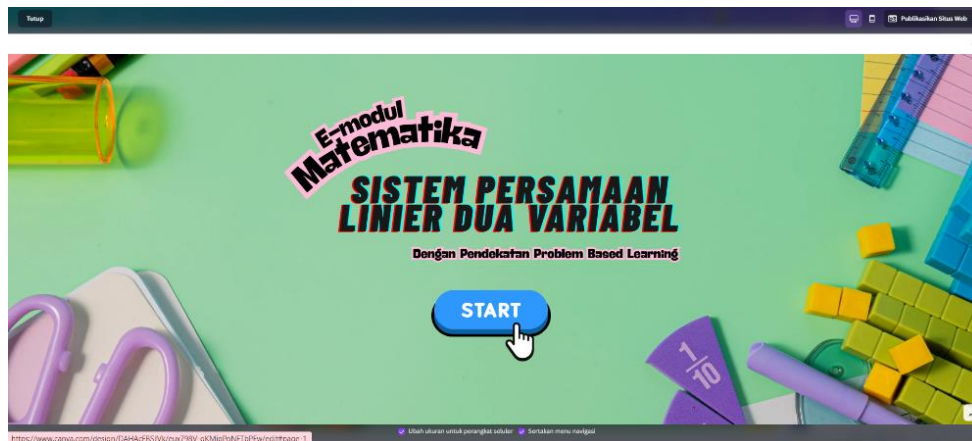


Figure 1. Homepage and navigation menu

The structure of the e-module includes introduction pages, learning objectives, sequential materials, interactive exercises, evaluation features, and supporting resources.



Figure 2. Learning Material Pages

The main interface and navigation structure of the developed e-module can be seen in Figure 1, Figure 2 and Figure 3.



Figure 3. Interactive Quiz Features

Expert Validation Results (Validity)

The developed e-module was evaluated by three experts: subject matter experts, instructional design experts, and media experts. The validation results are summarized in Table 1.

Table 1. Summary of expert validation results

Validator	Percentage (%)	Category	Interpretation
Subject Matter Expert	88.6	A	Very Good
Instructional Design Expert	88.8	A	Very Good
Media Expert	86.8	A	Very Good
Average	88.0	A	Highly Valid

The results indicate that the developed e-module meets the criteria of high validity, particularly in terms of content accuracy, instructional design alignment with PBL, and media usability, with expert feedback also contributing to product refinement. For example, the subject matter expert recommended adding feedback to practice questions, the instructional design expert suggested improving learning objectives using the ABCD format, and the media expert highlighted the need for improvements in navigation clarity, font consistency, and interface design.

Revisions based on these suggestions are illustrated in Figure 4, Figure 5, Figure 6.



Figure 4. Homepage and navigation menu (interface improvements and navigation updates)



Figure 5. Learning Material Pages (revision of learning objectives)

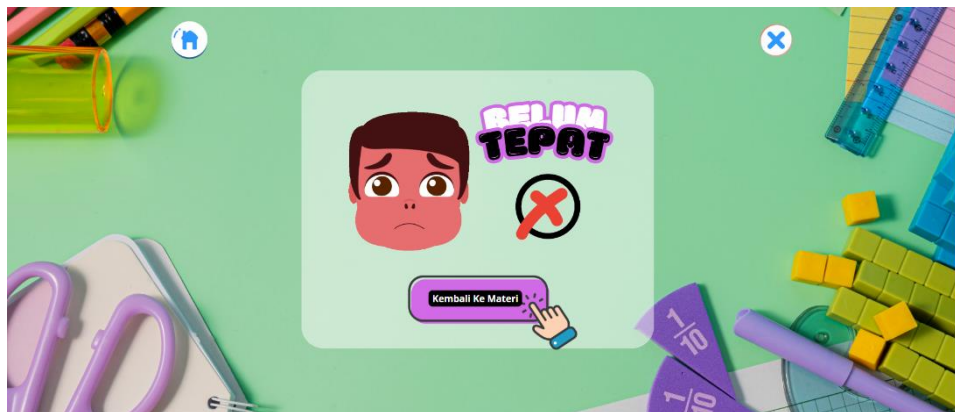


Figure 6. Interactive Quiz Features (addition of feedback in quizzes)

One-to-One Evaluation Results

The one-to-one evaluation involved three students with different ability levels. The results are presented in Table 2.

Table 2. One-to-one evaluation results

Indicator	Percentage (%)
Clarity of language	90.0
Organization of material	89.0
Information clarity	89.3
Instruction clarity	90.7
Contextual relevance	89.0
Visual support	90.3
Interface attractiveness	89.7
Ease of use	90.0
Learning support	90.3
Average	89.3

The results show that the e-module is categorized as “**Very Good**”, indicating high readability, usability, and attractiveness. Students were able to operate the e-module independently without significant difficulty.

Small Group Evaluation Results

The small group evaluation involved six students. The results are presented in Table 3.

Table 3. Small group evaluation results

Indicator	Percentage (%)
Clarity of language	89.5
Organization of material	90.8
Information clarity	87.6
Instruction clarity	88.6
Contextual relevance	87.0
Visual support	89.6
Interface attractiveness	89.0
Ease of use	90.0
Learning motivation	91.2
Learning support	89.0
Average	89.2

The findings indicate that the e-module is highly practical, with strong student engagement and motivation, particularly in problem-based learning activities.

Field Testing Results

The field test was conducted with 30 students to evaluate the practicality and usability of the e-module in a real classroom setting. The results are shown in Table 4.

Table 4. Field test results

Indicator	Percentage (%)
Language clarity	89.2
Terminology clarity	89.3
Material organization	89.2
Instruction clarity	90.0
Accessibility	89.1
Visual support	89.7
Navigation usability	89.5
Interface comfort	89.9
Contextual relevance	88.4
Concept understanding	89.4
Problem-solving support	89.0
Learning motivation	89.2
Critical thinking stimulation	89.1
Average	89.4

The field test results confirm that the e-module is highly practical and feasible for classroom implementation, with consistently high scores across all indicators.

DISCUSSION

The findings of this study indicate that the developed interactive e-module based on the Problem Based Learning (PBL) approach demonstrates high validity and practicality, as reflected in expert validation (average 88%) and student responses ($\approx 89\%$). These findings confirm that the integration of instructional design, multimedia technology, and constructivist pedagogy can produce a high-quality digital learning resource.

Instructional Validity and Design Coherence

The high validity scores obtained from subject matter, instructional design, and media experts indicate that the e-module fulfills essential criteria of instructional quality, including content accuracy, alignment with learning objectives, and design consistency. This aligns with the principles of systematic instructional design proposed by Dick et al. (2015) and Suparman (2014), which emphasize the importance of structured development processes and iterative evaluation to ensure product feasibility.

The use of clearly defined performance objectives based on the ABCD model further strengthens instructional alignment, ensuring that learning activities, assessments, and outcomes are coherently connected (Muthmainnah et al., 2022; Nugroho & Kurniasih, 2022). In addition, the validation results support the notion that a learning product is considered valid when it meets both content and construct requirements (Soviani, 2021; Wulandari & Prasetyo, 2023). From a content perspective, the organization of Systems of Linear Equations in Two Variables material from basic concepts to contextual applications reflects effective sequencing in mathematics instruction (Kristanto et al., 2021; Fitriani & Wulandari, 2024). This hierarchical structuring supports conceptual understanding and reduces cognitive load during learning.

Multimedia Integration and Digital Learning Effectiveness

The high practicality scores across all trial stages indicate that the e-module is user-friendly, engaging, and accessible, which are key characteristics of effective digital learning media. These findings are consistent with the theory that digital learning resources enhance student engagement when they integrate multimedia elements effectively (Mayer, 2021; Nugraha & Sari, 2024). This is further supported by studies highlighting the role of digital literacy and technology-integrated learning in fostering active student participation and engagement in contemporary educational contexts (Japar et al., 2023). The integration of text, visuals, animation, and interactive quizzes aligns with the Cognitive Theory of Multimedia Learning, which posits that learning is more effective when information is presented through dual channels (visual and verbal) (Mayer, 2021). Similarly, previous studies have shown that interactive e-modules improve learning motivation and outcomes due to their flexibility and accessibility (Asri & Dwiningsih, 2022; Lauhi et al., 2023; Harahap & Eliza, 2022). In line with this, research on mobile learning and web-based instructional materials demonstrates that technology-enhanced learning environments can significantly improve students' cognitive development and learning outcomes (Pebriantika et al., 2019; Pebriantika et al., 2021; Pebriantika & Negara, 2018), while more recent approaches such as microlearning have been shown to further optimize learning effectiveness through concise and structured content delivery (Pebriantika et al., 2024).

The use of Canva as a development platform also contributes to visual design quality and usability, which are important factors in attracting learners' attention (Pelangi, 2020; Monoarfa, 2021; Supradaka, 2022). Visual consistency, typography, and layout design play a crucial role in maintaining learner focus and improving comprehension (Manurung, 2020). Furthermore, the accessibility of the e-module across devices supports flexible learning environments and promotes self-directed learning, which is a key aspect of 21st-century education (Putra et al., 2024; Hidayat et al., 2023; Nugraha et al., 2024). This flexibility is consistent with findings that digital learning platforms enable learners to access content anytime and anywhere, thereby supporting personalized and independent learning pathways (Pebriantika et al., 2019; Pebriantika et al., 2021).

Role of Problem Based Learning in Enhancing Higher-Order Thinking

The integration of PBL within the e-module plays a significant role in supporting students' problem-solving and critical thinking skills, as reflected in positive student responses during field testing. This finding is consistent with previous research indicating that PBL enhances mathematical reasoning and problem-solving abilities (Thesalonika, 2024; Firdaus & Asikin, 2021; Salsabila & Wicaksono, 2022; Sianturi & Dirgantoro, 2023).

PBL positions learners as active problem solvers who engage in analyzing real-world situations, formulating hypotheses, and evaluating solutions. This approach aligns with constructivist learning theory, where knowledge is constructed through active engagement with meaningful tasks (Aunurrahman, 2022; Wahab & Rosnawati, 2021). In the context of Systems of Linear Equations in Two Variables, the use of contextual problems is particularly important, as students often face

difficulties in translating real-life situations into mathematical models (Takalao et al., 2022; Setiyani et al., 2025). By embedding contextual scenarios into the e-module, students are encouraged to connect abstract concepts with practical applications, thereby improving conceptual understanding and problem-solving competence.

Practicality as an Indicator of Usability and Learning Experience

The consistently high practicality scores ($\approx 89\%$) across one-to-one, small group, and field testing indicate that the e-module is highly usable and well-received by students. According to Fitrahtunnisa et al. (2022), practicality reflects the ease of use, clarity, and attractiveness of a learning product, which are essential for successful implementation.

The iterative formative evaluation process applied in this study ensured continuous refinement of the product, resulting in improved usability and learning experience (Firmansyah et al., 2023; Suparman, 2014). This process also aligns with R&D principles, where product development involves repeated testing and revision to achieve optimal quality (Sugiyono, 2023; Oktarina, 2022). The positive student responses also indicate that the e-module enhances learning motivation and engagement, which are critical factors in achieving meaningful learning outcomes (Sabrina, 2025; Febriantika et al., 2024).

Contribution to Technology-Enhanced Mathematics Learning

This study contributes to the field of educational technology by demonstrating that the integration of interactive digital media and PBL can produce an effective learning resource for mathematics education. The findings support previous studies on the development of e-modules and digital learning tools (Irawati & Setyadi, 2021; Rahmawati, 2020; Kholiya, 2023; Pemimaizita, 2022).

The developed e-module not only facilitates content delivery but also supports the development of higher-order thinking skills, including critical thinking, problem-solving, and independent learning. This aligns with the demands of 21st-century learning, which emphasize the integration of technology and pedagogy to create meaningful learning experiences (Branch, 2009; Bakhrudin et al., 2021). Moreover, the findings reinforce the importance of using interactive and contextual learning resources to overcome the limitations of traditional instruction, particularly in mathematics learning, which often relies on procedural approaches (Isrok'atun & Rosmala, 2022; Purnamasari & Riska, 2020). E-Module based on problem-based learning is feasible and effective to be applied in learning (Vidianti, et al., 2024).

CONCLUSION

This study developed an interactive e-module based on the Problem Based Learning (PBL) approach for the topic of Systems of Linear Equations in Two Variables using a systematic Research and Development framework. The results indicate that the e-module is highly valid, as evidenced by expert validation scores averaging 88%, and highly practical, as reflected in consistent student response scores of approximately 89% across all trial stages.

The integration of structured instructional design, multimedia elements, and PBL pedagogy successfully produced a digital learning resource that is engaging, accessible, and aligned with student-centered learning principles. The e-module supports students' understanding of mathematical concepts and facilitates problem-solving processes through contextual and interactive learning experiences. These findings suggest that interactive e-modules based on PBL have strong potential as technology-enhanced learning tools in mathematics education. Future studies are recommended to further examine the effectiveness of such e-modules in improving students' learning outcomes through experimental or quasi-experimental designs.

REFERENCES

- Aliah, F., Fitria, F., Mira Sari, & Zubaidah, Z. (2024). Pentingnya Sumber Belajar Dalam Pendidikan Di Sekolah. *Jurnal Pendidikan Kita*, 1(1), 42–50.
- Ariani, N., Masruro, Z., Saragih, S. Z., Hasibuan, R., Simamora, S. S., & Toni. (2022). *Buku Ajar Belajar Dan Pembelajaran* (Cetakan Pertama). Bandung: Widina Bhakti Persada.

- Asri, A. S. T., & Dwiningasih, K. (2022). Validitas E-Modul Interaktif Sebagai Media Pembelajaran Untuk Melatih Kecerdasan Visual Spasial Pada Materi Ikatan Kovalen. *Pendipa Journal Of Science Education*, 6(2).
- Aunurrahman. (2022). *Belajar Dan Pembelajaran* (Cetakan Ke-12). Bandung: Alfabeta.
- Bakhrudin, M., Shoffa, S., Holisin, I., Ginting, S., Fitri, A., Lestari, I. W., Pudyastuti, Z. E., Zainuddin, M., Alam, H. V., & Kurniawati, N. (2021). *Strategi Belajar Mengajar: Konsep Dasar Dan Implementasinya*. Cv. Agrapana Media.
- Boas, B., Suryani, M., & Yunita, A. (N.D.). Analisis Kemampuan Pemahaman Konsep Matematis Siswa Pada Materi Persamaan Dan Pertidaksamaan Linear Satu Variabel. *Jurnal Pendidikan Matematika*, 9. Universitas PGRI Sumatera Barat.
- Branch, R. M. (2009). *Instructional Design: The Addie Approach*. Springer.
- Dick, W., Carey, L., & Carey, J. O. (2015). *The Systematic Design Of Instruction* (6th Ed.). Upper Saddle River, Nj: Pearson Education, Inc.
- Fadli, M., Mirunnisa, & Muhsin. (2023). Penerapan Model Pembelajaran Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Penalaran Matematis Siswa. *Jurnal Biomafika (Jbf)*, 1(1), 10.
- Febriantika, R. A., Dkk. (2024). Analisis Penerapan Strategi Dan Metode Pembelajaran Aktif, Kreatif, Dan Menyenangkan. *Jurnal Pendidikan Dan Pembelajaran*, 9(1), 45–58.
- Firmansyah, M., & Atiqoh, L. (2024). Prosedur Uji Coba Produk Dalam Penelitian Dan Pengembangan Pendidikan. *Jurnal Penelitian Pendidikan*, 8(1), 33–42.
- Firdaus, A., & Asikin, M. (2021). Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Matematika Siswa. *Jurnal Pendidikan Sosial Dan Agama*, 13(2), 187–200.
- Fitriani, R., & Wulandari, A. (2024). Analisis Pemahaman Konseptual Siswa Dalam Menyelesaikan Sistem Persamaan Linier Dua Variabel. *Jurnal Pendidikan Matematika Dan Sains*, 12(1), 33–42.
- Fitrahtunnisa, Adnan, & Daud, F. (2022). Kepraktisan Lembar Kerja Peserta Didik Berbasis Pendekatan Sains (Practicality Of Science Approach-Based Learner Worksheets). *Jurnal Amal Pendidikan*, 3(3), 189–197.
- Harahap, M., & Eliza, D. (2022). E-Modul Pembelajaran Coding Berbasis Pengenalan Budaya Indonesia Untuk Meningkatkan Computational Thinking. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 6(4), 3063–3077.
- Herdianto, E. N. (2021). *Pengembangan E-Modul Menggunakan Mobile Learning Dengan Pendekatan Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Pada Materi Statistika Kelas Viii Smpn 1 Wonoasri* [Tesis, Universitas Sebelas Maret].
- Hidayat, R., Anwar, M., & Lestari, D. (2023). Pengembangan E-Modul Interaktif Berbasis Multimedia Untuk Meningkatkan Motivasi Dan Hasil Belajar Peserta Didik. *Jurnal Teknologi Pendidikan*, 11(2), 145–158.
- Irawati, A. E., & Setyadi, D. (2021). Pengembangan E-Modul Matematika Pada Materi Perbandingan Berbasis Android. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(3), 3148–3159.
- Isrok'atun, & Rosmala, A. (2022). *Model-Model Pembelajaran Matematika*. Jakarta: Pt Bumi Aksara.
- Japar, M., Hermanto, H., Muyaroah, S., Susila, H. R., & Alfani, H. (2023). Digital literacy-based multicultural education through civic education in Indonesian junior high schools. *Journal of Social Studies Education Research*, 14(4), 328–349.
- Jayanti, M. A., & Pertiwi, K. R. (2023). Pengembangan E-Modul Berbasis Pbl Untuk Meningkatkan Kemampuan Analisis Dan Rasa Ingin Tahu Siswa. *Jinop (Jurnal Inovasi Pembelajaran)*, 9(1), 112–127.
- Juniantari, N. P. (2022). *Pengembangan E-Modul Interaktif Berbasis Problem Based Learning (Pbl) Untuk Meningkatkan Kemampuan Pemecahan Masalah Pada Siswa Kelas X*. Tesis, Universitas Pendidikan Ganesha.
- Kholiya, S. N. (2023). *Pengembangan E-Modul Berbasis Aplikasi Canva Pada Pembelajaran Ips Kelas Iv Sekolah Dasar Baiturrohman Griya Mangli Indah Jember*. Skripsi, Universitas Islam Negeri Kiai Haji Achmad Siddiq Jember.
- Kristanto, Y. D., Taqiyuddin, M., Yulfiana, E., & Rukmana, I. (2021). *Matematika Untuk Smp/Mts Kelas Ix*. Jakarta: Pusat Perbukuan, Bskap Kemendikbudristek.
- Lauhi, M., Maryati, S., & Lahay, R. J. (2023). Digital Literacy Boost: Modul Digital Berformat Epub Sebagai Media Pembelajaran Efektif. *Jurnal Paedagoria*, 14(3), 345–351.

- M. Rasyid, R. (2022). *Pengembangan E-Modul Menggunakan Aplikasi Flip Pdf Professional Pada Kelas Iv Sd/Mi*.
- Manurung, R. (2020). Pengaruh Desain Visual Media Pembelajaran Terhadap Perhatian Dan Hasil Belajar Siswa. *Jurnal Teknologi Pendidikan*, 12(2), 145–156.
- Masruroh. (2024). *Teori Belajar Dan Pembelajaran*. Blog Dosen Universitas Negeri Gorontalo. <https://Dosen.Ung.Ac.Id/>
- Mayer, R. E. (2021). *Multimedia Learning* (3rd ed.). Cambridge University Press.
- Meldiani, D., & Nurhamidah. (2023). Pemanfaatan Google Sites Sebagai Media Pembelajaran Interaktif Di Sekolah. *Jurnal Inovasi Pendidikan*, 5(1), 23–31.
- Monoarfa. (2021). Pengembangan Media Pembelajaran Canva Dalam Meningkatkan Kompetensi Guru. *Seminar Nasional Hasil Pengabdian*, 1–7.
- Mubarok, A. (2023). Pengembangan Media Pembelajaran Couple Card Untuk Meningkatkan Pemahaman Konsep Matematika Siswa. *Jurnal Pendidikan Matematika*, 7(2), 98–110.
- Muthmainnah, M., Udin, T., Sianturi, M. K., Nasution, S. I., Purnomo, A., Rifai, A., Nur, S., Awaru, A. T., & Syamsuddin, N. (2022). *Sistem, Model, Dan Desain Pembelajaran*. Aceh: Yayasan Penerbit Muhammad Zaini.
- Nugraha, A., & Sari, P. D. (2024). Desain Komponen E-Modul Digital Interaktif Dalam Pembelajaran Abad 21. *Jurnal Inovasi Pembelajaran Digital*, 5(1), 33–47.
- Nugraha, R., & Sari, M. (2023). Analisis Validitas Pengembangan Media Pembelajaran Interaktif Berbasis Teknologi Pada Pembelajaran Matematika. *Jurnal Teknologi Pembelajaran*, 11(2), 77–85.
- Nugroho, B., & Kurniasih, D. (2022). Validitas Perangkat Pembelajaran Ditinjau Dari Aspek Isi Dan Konstruksi Dalam Pengembangan Desain Pembelajaran. *Jurnal Evaluasi Dan Desain Pembelajaran*, 9(3), 120–129.
- Nurgiyantoro, B. (2012). *Penilaian Pembelajaran Bahasa Berbasis Kompetensi*. Yogyakarta: Bpfe-Yogyakarta.
- Nurwahid, M., & Shodikin, A. (2021). Komparasi Model Pembelajaran *Problem Based Learning* Dan *Inquiry Based Learning* Ditinjau Dari Kemampuan Pemahaman Konsep Dan Pemecahan Masalah Matematika Siswa Dalam Pembelajaran Segiempat. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 5(3), 2218–2228.
- Oktaria, I. (2022). *Implementasi Model Pembelajaran Tandem Berbantuan Media Untuk Meningkatkan Keterampilan Berpikir Kritis*. Skripsi, Universitas Negeri Makassar.
- Oktarina, S. (2022). *Pengembangan Model Pembelajaran Dalam Research And Development (R&D)*. Palembang: Bening Media Publishing.
- Pamiluwati, Nurwiani, & Hidayati, W. S. (2021). Deskripsi Kemampuan Peserta Didik Dalam Memecahkan Masalah Matematika Berdasarkan Teori John Dewey Pada Penerapan Pendekatan Pmri. Dalam *Prosiding Third Conference On Research And Community Services Stkip PGRI Jombang*, 179.
- Pebriantika, L., & Negara, A. P. (2018). Pengembangan Bahan Ajar Berbasis Web Mata Pelajaran Biologi Kelas XI. *Jurnal BAJET (Baturaja Journal of Educational Technology)*, 2(2).
- Pebriantika, L., Rahmi, J., Adesti, A., & Eriyanti, E. (2024). Efektifitas penerapan metode microlearning untuk meningkatkan hasil belajar mahasiswa. *Edu Cendikia: Jurnal Ilmiah Kependidikan*, 4(02), 767–773. <https://doi.org/10.47709/educendikia.v4i02.4870>
- Pebriantika, L., Oktariyana, Aminah, Kusumastuti, H., & Fajarianto, O. (2021). The use of mobile learning to improve students' cognitive development. In *Proceedings of the 1st International Conference on Science and Technology in Administration and Management Information, ICSTIAMI 2019, 17–18 July 2019, Jakarta, Indonesia*. EAI. <https://doi.org/10.4108/eai.17-7-2019.2303529>
- Pebriantika, L., Wibawa, B., & Paristiowati, M. (2019). Mobile learning: Learning model to improve student learning outcomes. *Asia Proceedings of Social Sciences*, 4(3), 37–39.
- Pebriantika, L., Wibawa, B., & Paristiowati, M. (2021). Adoption of Mobile Learning: The Influence And Opportunities For Learning During The Covid-19 Pandemic. *International Journal of Interactive Mobile Technologies (iJIM)*, 15(05), 222–230.

- Pebriantika, L., Wibawa, B., & Paristiowati, M. (2021). Adoption of Mobile Learning: The Influence And Opportunities For Learning During The Covid-19 Pandemic. *International Journal of Interactive Mobile Technologies (IJIM)*, 15(05), 222–230.
- Pelangi, G. (2020). Pemanfaatan Aplikasi Canva Sebagai Media Pembelajaran Bahasa Dan Sastra Indonesia Jenjang Sma/Ma. *Jurnal Sasindo Unpam*, 8, 81–82.
- Pemimaizita. (2022). Pengembangan E-Modul Berbasis Canva Pada Pembelajaran Matematika Di Masa Pandemi Covid-19 Siswa Kelas Xi Man 1 Bungo. *Jurnal Mat-Edukasia: Jurnal Pendidikan Matematika*, 7(1), 15.
- Purnamasari, A., & Riska. (2020). Model Pembelajaran Osborn Pada Materi Sistem Persamaan Linear Dua Variabel (Spldv). *Jurnal Pendidikan Pemuda Nusantara*, 2(1), 9–17.
- Putra, A., dkk. (2024). Pemanfaatan Media Pembelajaran Digital Dalam Meningkatkan Motivasi Dan Hasil Belajar Siswa. *Jurnal Pendidikan dan Teknologi*, 9(1), 55–67.
- Raaihani, R. (2021). Penggunaan Media Pembelajaran Infografis (Canva) Pada Materi Ekosistem Untuk Meningkatkan Hasil Belajar Siswa.
- Rahmah, S. (2020). *Pengembangan E-Modul Interaktif Menggunakan Aplikasi Canva Pada Mata Pelajaran Fiqih Kelas Vi Di Mis As'adiyah No. 29 Wele Kabupaten Wajo*. Tesis, Institut Islam Negeri Parepare.
- Rahmawati, D. (2020). *Pengembangan Media Pembelajaran E-Modul Dengan Menggunakan Sigil Software Pada Materi Pembelajaran Fisika*. Skripsi, Universitas Islam Negeri Raden Intan Lampung.
- Rahmawati, D., & Lestari, S. (2024). Aspek Validitas Dalam Pengembangan Bahan Ajar Digital Berbasis Teori Pembelajaran Modern. *Jurnal Teknologi Pendidikan Digital*, 5(2), 88–97.
- Ricu Sidiq, & Najuah. (2020). Pengembangan E-Modul Interaktif Berbasis Android Pada Mata Kuliah Strategi Belajar Mengajar. *Jurnal Pendidikan Sejarah*, 9(1).
- Ritonga, A. P., Andini, N. P., & Ikmlah, L. (2022). Pengembangan Bahan Ajaran Media. *Jurnal Multi Disiplin Dehasen (Mude)*.
- Sabrina, N. (2025). Efektivitas Media Pembelajaran Dalam Meningkatkan Kualitas Proses Belajar Siswa. *Jurnal Pendidikan Modern*, 10(1), 12–20.
- Salsabila, L., & Wicaksono, A. (2022). Pengembangan E-Modul Interaktif Berbasis Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Matematika Dan Sains*, 10(2), 134–142.
- Sastrawan, K. B., & Suardipa, I. P. (2021). Pembelajaran Berkualitas Berbasis Nine Instructional Events Teori Belajar Gagne. *Haridracarya: Jurnal Pendidikan Agama Hindu*, 1(2), 161–172.
- Selvi, D., Dkk. (2020). Kajian Model Pembelajaran Problem Based Learning (Pbl) Dalam Pembelajaran Di Sekolah. *Jurnal Pendidikan Biologi Dan Sains*, 3(2).
- Setiyani, A., Kustiana, Y., Wantini, S., Wibowo, S. A., Sugeng, K. A., & Susanto, D. (2025). *Panduan Mata Pelajaran Matematika: Fase A–F Dan Fase Tingkat Lanjut SD/MI/Program Paket A, SMP/Mts/Program Paket B, SMA/MA/Program Paket C, Dan SMK/MAK*. Badan Standar, Kurikulum Dan Asesmen Pendidikan.
- Sianturi, E. Y., & Dirgantoro, K. P. S. (2023). Penerapan Model Problem Based Learning Untuk Mengembangkan Kemampuan Pemecahan Masalah Siswa Dalam Pembelajaran Matematika Secara Hybrid. *Jurnal Pendidikan Matematika Indonesia*, 8(2), 90–101.
- Slawantya, Y. R. (2024). *Pengembangan E-Modul Dengan Pendekatan Problem Based Learning Integratif Untuk Meningkatkan Penalaran Aljabar Dan Sikap Spiritual Peserta Didik*. Tesis, Universitas Islam Negeri Maulana Malik Ibrahim Malang.
- Soviani, R. (2021). Validitas Dan Reliabilitas Dalam Pengembangan Media Pembelajaran. *Jurnal Evaluasi Pendidikan*, 6(2), 75–84.
- Sugiyono. (2023). *Metode Penelitian Pendidikan (Kuantitatif, Kualitatif, Kombinasi, R&D Dan Penelitian Tindakan)*. Bandung: Alfabeta.
- Suparman, M. A. (2014). *Desain Instruksional Modern: Panduan Para Pengajar Dan Inovator Pendidikan* (Edisi Ke-4). Jakarta: Erlangga.
- Supradaka, S. (2022). Pemanfaatan Canva Sebagai Media Perancangan Grafis. *Jurnal Ikra-Ith Teknologi*, 6(1), 1–8.

- Susila, H. R., Qosim, A., Eriyanti, E., & Elfiana, E. (2024). Pengembangan Alat Evaluasi Pembelajaran Menggunakan Aplikasi Quizizz Pada Mata Pelajaran Bahasa Indonesia. *Jurnal Petik*, 10(1), 45–55.
- Takalao, D., Regar, V. E., & Sulistyaningsih, M. (2022). Analisis Kemampuan Pemahaman Matematis Pada Materi Sistem Persamaan Linear Dua Variabel. *Adiba: Journal Of Education*, 2(4).
- Thesalonika, P. (2024). Pengaruh Model Pbl Dalam Meningkatkan Kemampuan Pemecahan Masalah Dan Komunikasi Siswa Pada Kurikulum Merdeka Smp Negeri 1 Yogyakarta. *Jurnal Pendidikan Nusantara*, 25(2).
- Vidianati, A., Adesti, A., & Pebriantika, L. (2024). The Effectiveness of E-Modules Based on Problem-Based Learning toward Student Learning Outcomes in Educational Profession Courses. *Teknodika*. 22(2).
- Wahab, G., & Rosnawati. (2021). *Teori-Teori Belajar Dan Pembelajaran*. Indramayu: Penerbit Adab.
- Wardana, & Djamaluddin, A. (2021). *Belajar Dan Pembelajaran*. Parepare: Cv Kaaffah Learning Center.
- Wijaya, J. E., Dkk. (2022). Pengembangan Bahan Ajar E-Modul Pada Mata Pelajaran Bahasa Indonesia Kelas X Sma. *Jurnal Bajet*, 6(2), 389–394.
- Wulandari, F., & Prasetyo, A. (2023). Analisis Validitas Produk Pengembangan Pembelajaran Berbasis Teori Dan Keterpaduan Komponen Desain. *Jurnal Inovasi Pembelajaran Dan Evaluasi Pendidikan*, 12(1), 45–54.