Al-Jabar: Jurnal Pendidikan Matematika
Volume 15, Number 02, 2024, Pages 481 – 492
DOI: 10.24042/ajpm.v15i2.23484

Development of blended learning media on similarity and congruence topics

Ismet*, Yerizon, Ahmad Fauzan, Ali Asmar
Department of Mathematics Education, Universitas Padang, Indonesia
✉ ismet42@guru.smp.belajar.id*

Article Information
Submitted July 18, 2024
Accepted Oct 28, 2024
Published Dec 12, 2024

Keywords
Critical Thinking;
Logical Mathematical Intelligence;
M6 Learning Model;
Realistic Mathematics Education.

Abstract

Background: The integration of technology in education has become increasingly important in enhancing student engagement. Mathematics, as a foundational subject, often requires innovative approaches to improve students' problem-solving skills and conceptual understanding. Blended learning combines traditional and digital methods, offering a flexible and effective solution for teaching complex mathematical topics.

Aim: This research aims to develop valid, practical, and effective learning media for teaching the topics of similarity and congruence, enabling students to better understand these mathematical concepts. The media is designed based on the Blended Learning approach.

Method: The development process follows the Plomp model, which consists of three stages: (1) the initial investigation stage to identify needs and context, (2) the product development stage where the media is designed and refined, and (3) the assessment stage to evaluate its validity, practicality, and effectiveness.

Results: The developed learning media was validated with a validity score of 86.99, categorized as very valid. It also achieved a practicality score of 87.01, indicating it is very practical, and an effectiveness score of 83.33, categorized as effective.

Conclusion: Blended Learning-based media for teaching similarity and congruence is a valid, practical, and effective tool that can enhance students' understanding of the topics.

INTRODUCTION

The rapid advancements of the digital era have significantly influenced the education sector in Indonesia, particularly in the teaching and learning processes. To adapt to these changes, improving the quality of education through the integration of technology is essential. Technology in education enables learning to occur beyond the limitations of space and time, fostering active, creative, and engaging learning experiences for students (Pratiwi & Silalahi, 2021). However, the shift from traditional teaching methods to technology-based approaches is a gradual process that varies among teachers and schools (Puspitarini, 2022). Observations in the field indicate that many schools still rely heavily on conventional methods and lack the teaching tools or media necessary to support technology-integrated learning.

Another challenge in the current education system is the low mathematical problem-solving ability of students, which remains a significant concern. Research conducted by Hermawati et al. (2021) on students at SMP Negeri 15 Palembang revealed that the average percentage of students' mathematical problem-solving abilities fell into

How to cite Ismet, I., Yerizon, S., Fauzan, A., & Asmar, A. (2024). Development of blended learning media on similarity and congruence topics. *Al-Jabar: Pendidikan Matematika*, *15*(2), 481-492.
E-ISSN 2540-7562
Published by Mathematics Education Department, UIN Raden Intan Lampung

the low category. Similarly, a study by Ulfa et al. (2022) found that students' overall mathematical problem-solving skills scored an average of 50.47, categorized as poor. Specific problem-solving indicators, such as executing problem-solving plans and interpreting solutions or conclusions, were identified as particularly weak. These findings highlight the urgent need for effective strategies to enhance students' mathematical problem-solving abilities in schools.

Expanding on these concerns, evaluations of students' mathematical problem-solving skills at several schools have revealed ongoing challenges. For instance, tests administered to class IX students at SMP Negeri 2 Pariaman, SMP Negeri 3 Pariaman, and SMP Negeri 7 Pariaman indicated that their abilities were far from optimal. In particular, less than 50% of students were able to solve problems as planned or review their answers effectively. Such findings emphasize the urgent need for targeted strategies to improve problem-solving skills, which are essential for equipping students to face the complexities of a rapidly changing world. As a critical component of mathematics education, problem-solving not only supports academic achievement but also fosters lifelong skills that students can apply in various contexts (Ismayanty et al., 2024). To overcome these issues, innovative teaching approaches tailored to students' needs in the digital age are required.

Incorporating digital tools into mathematics instruction presents a viable solution, especially for topics like congruence. Studies by Marthani & Ratu (2022) demonstrated that technology-enhanced learning resources significantly improved student performance in this area. Similarly, research by Kania et al. (2020) highlighted the effectiveness of the Geogebra application in enhancing problem-solving skills related to congruence. A promising instructional model to complement these tools is Blended Learning, which integrates online resources with conventional classroom methods, offering a dynamic and flexible learning experience. This approach has been shown to not only improve academic outcomes but also nurture positive attitudes and behaviors among students (Yulianti & Sulistiyawati, 2020). To address the identified gaps, this study proposes developing a Blended Learning-based media solution focused on the topics of similarity and congruence, aimed at improving students' mathematical problem-solving abilities.

Blended Learning has been widely recognized for its ability to enhance student engagement, improve learning outcomes, and provide flexibility in learning while reducing educational costs (Kömür et al., 2023). Its implementation in mathematics education, as shown in studies by Indrapangastuti et al. (2021), Pratiwi & Silalahi (2021), Azimmah & Murtiyasa (2022), Yang & Rao (2022), and Ismayanty et al. (2024), has demonstrated positive impacts on students. Additionally, technological tools such as Articulate Storyline have proven effective in enabling accessible, flexible learning while enhancing problem-solving skills and academic performance (Octavia et al., 2021; Wahyuni et al., 2024). Other studies, including those by Salsabila & Pradipta (2021), Waluyo & Nuraini (2021), and Handayani et al. (2022), emphasize the role of technology-based media in developing students' mathematical problem-solving abilities. Moreover, specific topics like relations and functions (Setiyani et al., 2020), three-dimensional geometry (Darmayanti et al., 2022), and quadratic equations (Carballo et al.,

2022) have been effectively taught using technological approaches, further validating their benefits. However, despite this growing body of research, there remains a gap in studies that integrate digital learning media, the Blended Learning model, and the topic of similarity and congruence to enhance mathematical problem-solving skills. This study addresses this gap by developing Blended Learning-based media specifically designed for similarity and congruence topics to improve students' mathematical problem-solving abilities.

METHODS

Design:

This study is a development research project aimed at creating Blended Learning-based instructional media for the topic of similarity and congruence to enhance students' mathematical problem-solving skills. The research follows the development model proposed by Plomp and Nieveen (2013), which comprises three main phases: the preliminary phase, the development phase, and the assessment phase. The detailed procedures of this research are illustrated in Figure 1 below.

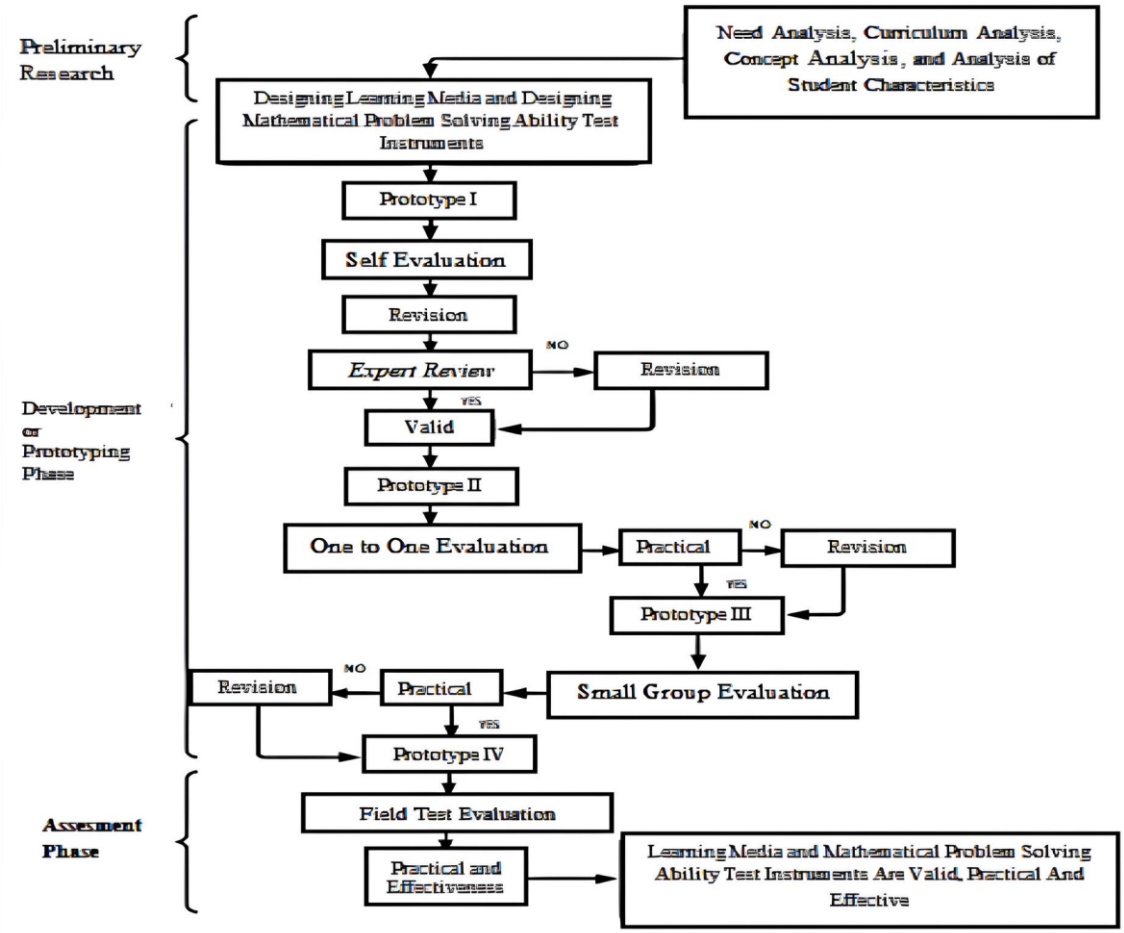

Figure 1. Research Procedure

Participants:

The designed media was first validated by experts, including two Mathematics Education lecturers as content validators, one Indonesian Language lecturer as a language validator, and one Educational Technology lecturer as a design or appearance validator. Once the media was deemed valid, product testing was conducted with six students, consisting of two high-ability students, two medium-ability students, and two low-ability students.

Instruments:

The instruments used in this study include media validation sheets, practicality questionnaires, and mathematics test instruments. The validation sheets, which had been reviewed by two mathematics experts and one language expert, were utilized to assess the validity of the developed media. Practicality questionnaires were distributed to six students to evaluate the ease of use and applicability of the media, while the mathematics test instruments were employed to measure its effectiveness.

Data Analysis:

The validation assessment by the validator of the designed media is guided by the validity criteria modified from the validity category by Riduwan (2010) which can be seen in Table 1 below.

Table 1. Validity Category

Percentage Range	Category
$25 \leq \mathbf{V} \leq 40$	Invalid
$40 < \mathbf{V} \leq 55$	Less Valid
$55 < \mathbf{V} \leq 70$	Fairly Valid
$70 < \mathbf{V} \leq 85$	Valid
$85 < \mathbf{V} \leq 100$	Very Valid

Based on the validity criteria above, it can be seen that the Blended Learning-based learning media that has been designed in this research can be said to be valid if it meets the criteria with a validity score ≥ 70, namely the media is in the valid category. Furthermore, to analyze the level of practicality of the designed media, it is assessed based on the practicality category by Riduwan (2010) which can be seen in Table 2 below.

Table 2. Practicality Category

Percentage Range	Category
$25 \leq \mathbf{P} \leq 40$	Impractical
$40 < \mathbf{P} \leq 55$	Less Practical
$55 < \mathbf{P} \leq 70$	Quite Practical
$70 < \mathbf{P} \leq 85$	Practical
$85 < \mathbf{P} \leq 100$	Very Practical

The practicality of the Blended Learning-based learning media developed in this study is evaluated using specific criteria. According to the standards outlined, the media can be considered practical if it achieves a practicality score of ≥ 70, placing it in the "practical" category. This score indicates that the media is sufficiently user-friendly and

suitable for the intended audience. Furthermore, the effectiveness of the designed media is analyzed by referring to the effectiveness categories established by Riduwan (2010), which provide a comprehensive framework for assessing whether the media achieves its educational objectives. These categories, detailed in Table 3 below, serve as a benchmark for determining the success of the media in enhancing students' learning experiences and outcomes. By applying these criteria, this study aims to ensure that the developed media is not only practical for implementation but also effective in improving students' mathematical problem-solving skills.

Table 3. Effectiveness Category

Percentage Range	Category
$25 \leq \mathbf{E} \leq 40$	Ineffective
$40 < \mathbf{E} \leq 55$	Less effective
$55 < \mathbf{E} \leq 70$	Effective enough
$70 < \mathbf{E} \leq 85$	Effective
$85 < \mathbf{E} \leq 100$	Very Effective

Based on the effectiveness criteria above, it can be seen that the Blended Learning-based learning media that has been designed in this research can be said to be effective if it meets the criteria with an effectiveness score ≥ 70, namely the media is in the effective category.

RESULTS AND DISCUSSION

Result

This research uses a development model by Plomp which consists of three stages, namely the initial investigation stage, the product design stage and the assessment stage. At the initial investigation stage, needs analysis, curriculum analysis, concept analysis and student characteristics analysis were carried out. The results of the initial investigation show that there is a need for learning media that can assist in learning and can improve students' mathematical problem solving abilities.

The next stage carried out is the product design or manufacturing stage. The product designed is a Blended Learning-based learning media to improve the mathematical problem solving abilities of class IX SMP students on the topic of similarity and congruence. Learning media designed using Articulate Storyline so that it can be easily accessed from students' smartphones. The designed learning media consists of several pages with various components, such as the title and purpose of the media, student identity, basic competencies, did you know, learning objectives, instructions for use, materials, examples and practice questions. The designed learning media can be seen in Figure 2 and Figure 3 below.

Figure 2. Appearance and Components of Learning Media

Figure 3. Material, examples and practice questions on learning media

The media that has been designed is then given to the validator to be validated both in terms of content, appearance and language used. After being validated by the validator, improvements are made to the media with adjustments based on suggestions from the validator. The results of media validation by validators can be seen in table 4 below.

Table 4. Learning Media Validation Results by Validators

No.	Aspects Assessed	Percentage	Category
1.	Content Aspect	84,38	Valid
2.	Language Aspects	95,83	Very Valid
3.	Display Aspects	80,77	Valid
	Overall Average	**86,99**	**Very Valid**

Based on Table 4, the results of validation of learning media by validators for the content aspect have a valid category, for the language aspect have a very valid category, and for the display aspect have a valid category. Overall the learning media developed has a score of 86.99 with a very valid category. Next, valid learning media is tested on students. After the trial was carried out, students were given practicality questionnaires and tests and obtained results as in Table 5 and Table 6.

Table 5. Practicality Questionnaire Results

No	Aspects Assessed	Percentage	Category
1	Can be Used	88,33	Very Practical
2	Easy to Use	88,89	Very Practical
3	Interesting	89,58	Very Practical
4	Efficient	81,25	Practical
	Overall Average	**87,01**	**Very Practical**

Table 6. Recapitulation of Test Results

Student	Test Scores	Description
S1	70	Complete
S2	82,5	Complete
S3	67,5	Not Complete
S4	77,5	Complete
S5	87,5	Complete
S6	77,5	Complete

Based on table 5, it was found that the learning media that was tested met the very practical category with a practicality value of 87.01. Furthermore, table 6 also shows that there are five students who meet the school's minimum completion criteria, namely 70 or have a completion percentage of 83.33%. This means that the learning media designed is effective in improving students' mathematical problem solving abilities.

Discussion

The research product, in the form of Blended Learning-based media for teaching similarity and congruence, underwent rigorous validation processes to ensure its quality. Validation was conducted from three key aspects: content, language, and appearance. The results indicated that the learning media achieved a "very valid" category, signifying that the content aligns with curriculum standards, the language used is clear and accessible to students, and the visual design supports effective learning. According to Nieveen (2013), validity is a critical factor in ensuring that educational tools meet pedagogical goals and are relevant to learners' needs. This emphasizes the importance of rigorous validation processes in the development of instructional media to ensure their effectiveness and alignment with educational objectives.

In addition to its validity, the research findings show that the media fulfilled the "practical" category for use in learning environments. Practicality, as defined by Plomp and Nieveen (2013), reflects the ease of use and adaptability of a product in real

classroom settings. The practicality score, supported by students' feedback, suggests that the media is user-friendly and facilitates a smooth learning experience. The interactive elements within the media allow students to engage more actively with the material, which aligns with findings from Mayer (2014), who emphasized the importance of interactive learning environments in improving student outcomes. This underscores the value of integrating interactive features into educational tools, as they not only enhance student engagement but also foster deeper understanding and retention of the material.

Furthermore, the teaching media was tested with students of varying abilities, and the results revealed that it was effective in improving their mathematical problem-solving skills. This aligns with prior studies, such as those by Wahyuni et al. (2024), which demonstrated that technology-based learning tools enhance problem-solving abilities by allowing students to visualize and interact with abstract mathematical concepts. The students reported that the media made learning more engaging and helped them revisit and reinforce previously learned material. This is consistent with the theory of retrieval practice (Karpicke & Roediger, 2008), hich highlights that repeated exposure to content aids in long-term retention and understanding. Such findings reinforce the need to design learning media that enable students to revisit and review material independently, ensuring sustained academic progress and mastery of concepts over time.

Several factors contributed to this effectiveness. Firstly, the structured design of the media allows for step-by-step guidance in solving mathematical problems, which helps students develop a systematic approach to problem-solving. This aligns with the findings of Mayer (2014), which emphasize that guided instruction in multimedia learning fosters deeper cognitive engagement. Secondly, the integration of interactive visual elements, such as animations and diagrams, played a significant role in helping students grasp abstract concepts like similarity and congruence. These features not only enhance students' conceptual understanding but also support cognitive load reduction, as suggested by Sweller's (1994) Cognitive Load Theory. By minimizing unnecessary mental effort, the media enables students to focus on the core mathematical processes. Thirdly, the inclusion of problem-based learning scenarios encourages students to apply mathematical concepts to real-life situations. This approach helps bridge the gap between theory and application, making the learning experience more meaningful (Wijnia et al., 2024). Problem-based learning enhances students' analytical and critical thinking skills, which are crucial for solving complex mathematical problems.

Additionally, the media promotes active engagement by allowing students to explore and experiment with different problem-solving strategies. This interactive nature fosters deeper involvement in the learning process, which is critical for retaining knowledge and building problem-solving confidence. The effectiveness of such active learning methods has been highlighted in research by Theobaldet al., (2020), which shows that active learning significantly improves students' academic performance compared to traditional methods. This highlights the importance of incorporating active learning strategies in classroom practices to enhance student engagement and achieve better academic outcomes.

Implication

The Blended Learning-based learning media designed in this article meets the valid, practical and effective categories for use in learning, so it is hoped that it can be used sustainably, especially in delivering congruency and congruence material.

Limitation and Suggestion for Further Research

The researchers had limited time and energy so this research produced Blended Learning-based learning media which only focused on the topics of similarity and congruence. Learning media is also designed only to improve one of the mathematical abilities, namely students' mathematical problem solving abilities.

CONCLUSIONS

The blended learning-based instructional media developed in this study has been proven to be valid, practical, and effective for teaching mathematics to ninth-grade students on the topics of similarity and congruence. This media aligns with student curriculum standards and demonstrates the potential to serve as a valuable tool for educators seeking to integrate technology into their teaching practices. Future research is encouraged to explore the development of similar instructional media for other mathematical topics and to investigate its long-term impact on students' academic achievement and engagement across diverse educational settings.

ACKNOWLEDGMENT

The researcher would like to express his deepest gratitude to Dr. Elita Zusti Jama'an, MA, M. Si Prof. Dr. Darmansyah, M.Pd, and Dr. Abdurahman, M.Pd as product validator used in completing this article. The researcher extends heartfelt gratitude to a junior high school in Pariaman that served as the research site, especially the six students who participated in this research.

AUTHOR CONTRIBUTIONS STATEMENT

I : Conceptualization, media design, implementation, data curation, project administration, visualization, and review.
Y : Supervision, guidance, methodology validation, and review.
AF : Media and instrument validation and formal analysis
AA : Media and instrument validation, resource management, and editing.

REFERENCES

Azimmah, A. N., & Murtiyasa, B. (2022). Implementation of blended learning model in mathematics subject. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(2), 423–431. https://doi.org/10.24042/ajpm.v13i2.13943

Carballo, A. M., Damián Mojica, A., & Marmolejo Vega, J. E. (2022). Hypothetical learning trajectory for assimilating the articulated concepts of quadratic function and equation through variational ideas and the use of geogebra in pre-university students. *International Electronic Journal of Mathematics Education*, *17*(2),

em0678. https://doi.org/10.29333/iejme/11714

Darmayanti, R., Sugianto, R., Baiduri, B., Choirudin, C., & Wawan, W. (2022). Digital comic learning media based on character values on students' critical thinking in solving mathematical problems in terms of learning styles. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(1), 49–66. https://doi.org/10.24042/ajpm.v13i1.11680

Handayani, E. D., Kusnawati, E., Sari, N. M., Yaniawati, P., & Zulkarnaen, M. I. (2022). Implementation of geogebra-assisted creative problem-solving model to improve problem solving ability and learning interest students. *Al-Jabar : Jurnal Pendidikan Matematika*, *13*(1), 33–48. https://doi.org/10.24042/ajpm.v13i1.11341

Helsa, Y., Darhim, D., Juandi, D., & Turmudi, T. (2021). Blended learning in teaching mathematics. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(2), 733. https://doi.org/10.24127/ajpm.v10i2.3447

Hermawati, H., Jumroh, J., & Sari, E. F. P. (2021). Analisis kemampuan pemecahan masalah matematis pada materi kubus dan balok di SMP. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(1), 141–152. https://doi.org/10.31980/mosharafa.v10i1.874

Indrapangastuti, D., Surjono, H. D., Sugiman, & Yanto, B. E. (2021). Effectiveness of the blended learning model to improve students achievement of mathematical concepts. *Journal of Education and E-Learning Research*, *8*(4), 423–430. https://doi.org/10.20448/journal.509.2021.84.423.430

Ismayanty, I., Siregar, H., & Siagian, P. (2024). Development of android media based on a realistic approach in blended learning to improve students' problem solving and mathematical critical thinking skills. *Proceedings of the 5th International Conference on Science and Technology Applications, ICoSTA*. https://doi.org/10.4108/eai.2-11-2023.2343265

Istiqomarie, N., Hapizah, H., & Mulyono, B. (2023). Design of google site-based learning media for circle material to support critical thinking skills. *Al-Jabar : Jurnal Pendidikan Matematika*, *14*(2), 527–544. https://doi.org/10.24042/ajpm.v14i2.18081

Kania, E. S., Yaniawati, P., Indrawan, R., & Firmansyah, E. (2020). Peningkatan kemampuan pemecahan masalah matematis siswa melalui pendekatan pembelajaran berbasis masalah dengan geogebra. *Pasundan Journal of Mathematics Education : Jurnal Pendidikan Matematika*, *10*(Vol 10 No. 2), 65–81. https://doi.org/10.23969/pjme.v10i2.3151

Kömür, İ. A., Kılınç, H., & Okur, M. R. (2023). The rotation model in blended learning. *Asian Journal of Distance Education*, *18*(2), 63–74. https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/704

Karpicke, J. D., & Roediger III, H. L. (2008). The critical importance of retrieval for learning. S*cience*, *319*(5865), 966-968.

Kusuma, D. A. C., Sujadi, I., & Slamet, I. (2023). Pengembangan model blended learning

berbasis etnomatematika untuk meningkatkan kemampuan pemecahan masalah matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 256. https://doi.org/10.24127/ajpm.v12i1.5911

Marthani, G. Y., & Ratu, N. (2022). Media pembelajaran matematika digital "BABADA" pada materi kesebangunan bangun datar. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(2), 305–316. https://doi.org/10.31980/mosharafa.v11i2.1410

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.

Nieveen, N., & Folmer, E. (2013). Formative evaluation in educational design research. *Design Research*, *153*(1), 152-169.

Octavia, A. D., Surjanti, J., & Suratman, B. (2021). Pengembangan media m-learning berbasis aplikasi articulate storyline untuk meningkatkan hasil belajar peserta didik Sekolah Menengah Atas. *Edukatif : Jurnal Ilmu Pendidikan*, *3*(5), 2380–2391. https://edukatif.org/index.php/edukatif/article/view/797

Plomp, T., & Nieveen, N. (2013). An introduction to educational design research. *Proceedings of the Seminar Conducted at the East China Normal University, Shanghai (PR China)*.

Pratiwi, I. R., & Silalahi, P. (2021). Pengembangan media pembelajaran matematika model blended learning berbasis moodle. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(1), 206. https://doi.org/10.24127/ajpm.v10i1.3240

Puspitarini, D. (2022). Blended learning sebagai model pembelajaran abad 21. *Ideguru: Jurnal Karya Ilmiah Guru*, *7*(1), 1–6. https://doi.org/10.51169/ideguru.v7i1.307

Riduwan. (2010). *Skala pengukuran variabel-variabel penelitian*. Alfabeta.

Salsabila, A., & Pradipta, T. R. (2021). Mathematical problem solving ability: The impact of mathematics learning videos on an e-learning platform. *Al-Jabar : Jurnal Pendidikan Matematika*, *12*(1), 83–88. https://doi.org/10.24042/ajpm.v12i1.8708

Setiyani, Putri, D. P., Ferdianto, F., & Fauji, S. H. (2020). Designing a digital teaching module based on mathematical communication in relation and function. *Journal on Mathematics Education*, *11*(2), 223–236. https://doi.org/10.22342/jme.11.2.7320.223-236

Suanto, E., Khainingsih, F. G., & Hutapea, N. M. (2022). Pengembangan LKPD berbasis problem based learning berkonteks budaya melayu untuk meningkatkan kemampuan berpikir kritis matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(3), 1805. https://doi.org/10.24127/ajpm.v11i3.5659

Sweller, J., Ayres, P., Kalyuga, S., Sweller, J., Ayres, P., & Kalyuga, S. (2011). Measuring cognitive load. *Cognitive load theory*, 71-85.

Susanto, A., Setyaningrum, W., Camellia, F., & Asriani, N. W. (2023). Tren Pemanfaatan teknologi dalam meningkatkan kemampuan pemecahan masalah

matematis siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(3), 3088. https://doi.org/10.24127/ajpm.v12i3.7545

Theobald, E. J., Hill, M. J., Tran, E., Agrawal, S., Arroyo, E. N., Behling, S., & Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math. *Proceedings of the National Academy of Sciences*, *117*(12), 6476-6483.

Ulfa, Y. L., Roza, Y., & Maimunah, M. (2022). Kemampuan Pemecahan masalah matematis siswa SMA pada materi jarak pada bangun ruang. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(3), 415–424. https://doi.org/10.31980/mosharafa.v11i3.1426

Wahyuni, M., Medriati, R., & Setiawan, I. (2024). Development of interactive learning media assisted by articulate storyline 3 to train high school students' problem-solving skills. *Asian Journal of Science Education*, *6*(1), 95–107. https://doi.org/doi.org/10.24815/ajse.v6i1.36356

Waluyo, E., & Nuraini, N. (2021). Development CPS integrated TPACK model to improve student problem solving in new normal pandemic covid-19. *Al-Jabar : Jurnal Pendidikan Matematika*, *12*(1), 133–146. https://doi.org/10.24042/ajpm.v12i1.8600

Wijnia, L., Noordzij, G., Arends, L. R., Rikers, R. M., & Loyens, S. M. (2024). The effects of problem-based, project-based, and case-based learning on students' motivation: A meta-analysis. *Educational Psychology Review*, *36*(1), 29.

Yang, F., & Rao, Y. (2022). Practice and research of blended learning model guided by deep learning model. *Mathematical Problems in Engineering*, *2022*. https://doi.org/10.1155/2022/8915162

Yulianti, T., & Sulistiyawati, A. (2020, March). The blended learning for student's character building. In *International Conference on Progressive Education (ICOPE 2019)* (pp. 56-60). Atlantis Press.. https://doi.org/10.2991/assehr.k.200323.089