

# Supporting Students in Developing Mathematics Learning Media for Fractions Topic

Eka Denti Setiyani<sup>1</sup>, Partono<sup>2</sup>, Duano Sapta Nusantara<sup>3</sup>, Kgaladi Maphutha<sup>4</sup>

<sup>1</sup>Institut Agama Islam Negeri Kudus, Jawa Tengah. e-mail: [ekadenti207@gmail.com](mailto:ekadenti207@gmail.com)

<sup>2</sup>Institut Agama Islam Negeri Kudus, Jawa Tengah. e-mail: [partono@iainkudus.ac.id](mailto:partono@iainkudus.ac.id)

<sup>3</sup>Universitas Jambi, Jambi. e-mail: [duanosaptanusantara@unja.ac.id](mailto:duanosaptanusantara@unja.ac.id)

<sup>4</sup>University of Limpopo, Limpopo. e-mail: [kgaladi.maphutha@ul.ac.za](mailto:kgaladi.maphutha@ul.ac.za)

ARTICLE INFO	ABSTRACT
<p><b>Keywords:</b> Development, Fractions, Learning Media, Training Program, Students' Understanding</p> <p><b>DOI:</b> <a href="http://doi.org/10.22437/jssh.v9i1.38296">http://doi.org/10.22437/jssh.v9i1.38296</a></p> <p><b>Received:</b> Januari 20, 2025</p> <p><b>Reviewed:</b> May 11, 2025</p> <p><b>Accepted:</b> Juni 07, 2025</p>	<p><i>This study aims to address the challenges faced by seventh-grade students in understanding fraction concepts, particularly their difficulties in both conceptualizing and applying fractions in real-life contexts. To tackle these issues, a training program was designed to enhance students' creativity and improve their comprehension of fractions through the development of mathematics learning media. The training was specifically conducted at MTs Miftahul Ulum, and it employed a two-phase methodology. The first phase involved the delivery of instructional content on fractions, while the second phase focused on guiding students in the creation of simple, yet effective, mathematics learning media. The results of the training indicated a high level of engagement and enthusiasm among participants, as demonstrated by their active involvement in the media creation process. This study contributes to the pedagogical field by providing an innovative approach for supporting students in designing and utilizing learning media, ultimately fostering a more interactive and engaging learning environment. It is anticipated that the knowledge gained from this training will empower students to design creative learning tools that can enhance their understanding of mathematical concepts, particularly fractions.</i></p>

## 1. Introduction

Education is a fundamental means of transmitting knowledge, skills, and values from one generation to the next (Sugiarto et al., 2025; Binkley et al., 2012). As a dynamic and evolving process, it typically occurs through teaching, training, and research (Chazan, 2022; Margaliot, 2024; Amdar & Nurjannah, 2024; Alam & Mohanty, 2023). Ki Hajar Dewantara, a prominent figure in Indonesian education, distinguished between teaching and education (Ferary, 2021; Taufikin & Ma'shumah, 2021). While teaching primarily focuses on the transfer of essential knowledge and skills, education takes a more holistic approach, aiming to foster the overall development of individuals, including character building, value formation, and the realization of their full potential (Irawati et al., 2022; Ferary, 2023; Yahya & Salam, 2024).

The call for educational reform in Indonesia has never been more urgent. To cultivate future generations with strong character, aligned with national values, and prepared to face the challenges of a globalized world, education innovation is paramount (Satria & Muntaha, 2022). According to Law No. 20/2003 of the Indonesian National Education System, the goal

of education is to foster an active learning environment where students are encouraged to continually develop their intellectual, moral, and practical skills for the benefit of themselves, their communities, and the nation (Rosser, 2015; Agustina, 2022; Yahya & Salam, 2024). Achieving this goal requires the collective effort of the government, private institutions, and society (Ebekoziem et al., 2025; Sahlberg, 2010), with collaboration being key to enhancing educational outcomes (Liu, 2021; Ain & Mustika, 2021; Valk & Kratoviš, 2021).

A critical component in improving education quality is the effective integration of five interdependent elements: objectives, content, methods, media, and evaluation (Bingimlas, 2009; Nguyen & Habók, 2024). Teaching methods play a pivotal role in shaping the learning process, with traditional lecture-based approaches often proving insufficient when students are passive listeners (Akram et al., 2022; Johnson & Coulter-Kern, 2024). Active student participation, on the other hand, is essential for promoting deeper engagement and comprehension (Fauzi & Arisetyawan, 2020; Lombardi et al., 2024). Moreover, the choice of teaching methods significantly impacts the learning environment, student motivation, and the overall educational atmosphere (Junaidi, 2019; Li et al., 2024). Effective learning media are indispensable for creating an engaging and motivating environment that supports the acquisition of knowledge and skills (Ain & Mustika, 2021; Adipat et al., 2021).

In the context of mathematics education, the use of media is particularly crucial. Mathematical concepts, such as fractions, are often perceived as abstract and difficult to understand, especially at the middle school level (Singh et al., 2021; Copur-Gencturk, 2021; Jarrah et al., 2022; Lee & Lee, 2023). The incorporation of concrete teaching aids or media can alleviate this challenge by making these abstract concepts more accessible and engaging (Hajirasouli & Baniheshemi, 2022; Maroungkas et al., 2023). Sholihah et al. (2017) argue that although mathematics plays a vital role in daily life, it is often regarded as a challenging subject. Telaumbanua (2020) further suggests that visual aids improve the efficiency and effectiveness of mathematics instruction by making abstract concepts more tangible (Widayati et al., 2022). Additionally, students increasingly favor technology-based learning media, particularly for complex topics like fractions (Yanti et al., 2019; Wijaya et al., 2022; Hunt et al., 2025).

At MTs Miftahul Ulum, the teaching and learning of fractions face significant challenges. Observations and discussions with mathematics teachers reveal that many seventh-grade students struggle to grasp the foundational concepts of fractions. The traditional, lecture-based teaching methods that dominate the classroom fail to engage students, resulting in a passive learning environment that hinders their comprehension of mathematical concepts (Makhubele, 2021; Gabriel et al., 2023). This aligns with research suggesting that passive learning environments often impede students' understanding of complex concepts like fractions (Hontarenko et al., 2024; Kassa et al., 2024).

Studies have shown that appropriate media can significantly enhance student motivation and participation in the learning process (Al Mardhiyyah et al., 2021; Ben & Kribushi, 2022; Setyabekti et al., 2022; Al-Said, 2023; Charline et al., 2023). This research seeks to equip students with the skills to design and create their own effective learning media to improve their learning experience. The program will offer both theoretical and practical sessions, where students will learn how to develop engaging and interactive media for teaching fractions. The expected outcome is to foster a more dynamic and enjoyable learning environment, ultimately improving students' comprehension of fractions (Anugerah et al., 2024). By involving students in the creation of learning tools, this initiative not only

empowers them to better understand mathematical concepts but also encourages them to actively participate in the learning process.

While extensive research exists on the role of media in mathematics education, particularly its ability to enhance student engagement and understanding, there remains a gap in studies focused on empowering students to create their own learning media, especially in the context of fractions at the middle school level. Previous studies have primarily focused on the use of pre-made learning materials by teachers, such as those by Yanti et al. (2019), who highlighted the positive impact of technology-based media on student motivation, and Widayati et al. (2022), who demonstrated the effectiveness of visual and interactive media in teaching abstract concepts. Other studies, such as Mertasari (2022), have explored the use of ICT-based media, while Almufarreh & Arshad (2023) identified the potential of emerging educational technologies. Moreover, Tajeddin & Asadnia (2023) discussed the shift of teachers from being consumers of media to developers of digital learning materials, and Winsløw et al. (2023) examined the integration of technology in university-level mathematics education. However, limited attention has been given to involving students in the creation of these learning tools. This research gap presents a unique opportunity to innovate teaching practices by engaging students in the design and development of their own learning media, fostering deeper engagement with challenging concepts like fractions and promoting creativity and critical thinking.

This study aims to address this gap by investigating the impact of a student-centered training program focused on the creation of interactive mathematics learning media. The research objectives are as follows: (1) to foster students' creativity by teaching them how to design and develop engaging learning tools for fractions; (2) to enhance students' understanding of fractions by utilizing media that make learning more tangible and accessible; and (3) to increase student motivation by creating a dynamic and engaging learning environment.

## **2. Literature Review**

### **2.1 Learning Media in Education**

In educational contexts, the term "media" refers to the tools or methods used to communicate messages effectively. In the realm of learning, media are considered essential instruments that help facilitate the transmission of knowledge and stimulate cognitive processes. According to Junaidi (2019), learning media can be understood as any material or tool utilized to deliver educational content and engage students in the learning process. The Association for Educational Communications and Technology (AECT) describes educational media as various resources designed to enhance teaching and learning by fostering communication between the teacher and the students. Gagne (1985) emphasizes the role of media in promoting an active learning environment, where they serve as catalysts that enhance students' learning experiences. Briggs (1977) also suggests that media function as instruments that stimulate student activity and participation, thereby improving overall learning outcomes. These definitions underscore the critical role that learning media play in supporting effective educational practices, both in terms of content delivery and engagement.

The use of creative and innovative media has the potential to transform students' perceptions of traditionally difficult subjects like mathematics. Research has shown that employing engaging learning media can make mathematics more enjoyable, which, in turn, boosts student motivation and achievement (Murni et al., 2023). Furthermore, Ain and Mustika (2021) argue that learning media can spark students' interest and attention, providing a

dynamic and interactive environment for learning. For example, visual learning media have been found to support various cognitive functions such as attention, enjoyment, and memory retention (Yanti et al., 2019). Learning media also enhances the teacher-student interaction, providing a clearer understanding of the material and helping to simplify complex concepts. Sudjana and Rivai (2002) highlight that the inclusion of diverse media in the classroom allows for more effective communication, leading to more engaging and efficient learning experiences. Overall, the use of appropriate media is fundamental for creating a motivating and effective educational environment that can lead to improved student outcomes (Junaidi, 2019).

## **2.2 Fractions in Mathematics Education**

Fractions represent a core concept in mathematics education, covering essential arithmetic operations such as addition, subtraction, multiplication, and division. Fractions are commonly expressed as a ratio of two integers, with the numerator ( $p$ ) divided by the denominator ( $q$ ), where  $q \neq 0$ . This foundational concept is crucial for understanding more advanced mathematical ideas (Ritawati et al., 2024). Despite their importance, many students find fractions challenging to understand due to their abstract nature, particularly at the middle school level. Addressing this challenge requires innovative teaching strategies that help make the concept of fractions more concrete and accessible to learners.

Several studies emphasize the value of visual and interactive media in teaching fractions. Telaumbanua (2020) asserts that incorporating visual aids significantly enhances students' understanding of fractions by providing tangible representations of abstract concepts. Visual media, such as diagrams, digital tools, and videos, enable students to actively engage with fractions, helping them visualize relationships and operations that are otherwise difficult to grasp through traditional methods (Widayati et al., 2022). Moreover, technology-based learning media have been shown to increase student motivation, particularly in subjects like fractions, where students benefit from interactive and hands-on experiences that provide immediate feedback (Yanti et al., 2019; Wijaya et al., 2022). The integration of such media not only helps students better understand mathematical concepts but also fosters creativity and critical thinking. This approach allows students to take ownership of their learning, encouraging independent problem-solving and deeper engagement with the material (Hunt et al., 2025). By utilizing interactive learning tools, students can enhance their understanding of fractions and improve their overall mathematical abilities.

## **3. Research Methodology**

### **3.1 Research Design**

This study follows a qualitative research design aimed at to investigate the effectiveness of hands-on learning media creation in improving students' understanding of fractions at MTs Miftahul Ulum in Dapurno Village, Grobogan Regency, Indonesia. The research design is based on an action research approach, where the participants actively engage in the creation of their own learning tools, with the goal of enhancing their understanding of fractions (Naidoo & Hajaree, 2021; Mania & Alam, 2021). This approach allows for an in-depth exploration of the learning process, including students' experiences and perceptions of the media creation process and its influence on their mathematics learning (Attar & Holmes, 2022). The research design involved a series of steps starting with preparation, followed by the implementation of a hands-on media creation session, and concluded with an evaluation phase. The design allowed for an interactive and participatory environment where students engaged actively in

creating their own learning materials. This approach aligns with the objective of fostering creativity and deepening understanding through active involvement.

### **3.2 Participants**

The participants in this study were 30 seventh-grade students from MTs Miftahul Ulum. The participants were selected through purposive sampling, focusing on students who had a foundational understanding of fractions but encountered difficulties in mastering the topic. The sample size was chosen to ensure practical and manageable engagement throughout the training process. The students were divided into three groups of 5-6 members to work collaboratively on creating the learning media. Their involvement in the training provided insights into how hands-on activities influenced their understanding and engagement with abstract mathematical concepts. Written consent was obtained from both the students and their guardians to ensure ethical compliance with the study. Teachers and the school principal were also involved in the planning and implementation phases of the training.

### **3.3 Instruments**

The primary instrument for data collection was direct observation of students' participation during the media creation workshop, as well as the evaluation of the final media products. Additionally, the researchers used a set of prepared materials for the activity, including origami paper, scissors, glue, markers, and large sheets of paper (Asturo) for the media creation. The materials and tools provided allowed students to engage in the creation of fraction fans, an interactive learning tool designed to represent different fractions visually. These materials were chosen to ensure that students could engage in creative processes while learning complex mathematical concepts.

### **3.4 Training Implementation Process**

The training program was conducted on October 1, 2024, at MTs Miftahul Ulum. The training was designed to use both classroom-based and individualized approaches to suit the diverse learning needs of the students (Ain & Mustika, 2021). The classroom-based approach involved an introduction to the concept of learning media, including the importance of using creative tools to enhance understanding of mathematical concepts. The individualized approach involved guiding students through the practical process of designing and creating their own educational media for teaching fractions.

The training was divided into three phases:

1. Preparation Phase: This included obtaining approval from the school principal and teachers, coordinating logistics (such as timing, venue, and number of participants), and preparing the training materials, including mathematics learning media and educational aids for teaching fractions.
2. Implementation Phase: Students were introduced to different types of learning media and were guided step-by-step in creating media that could help explain fractions in a more engaging and accessible way. The phase involved both theoretical discussions and practical activities, where students created their own media based on the learned concepts.
3. Evaluation Phase: In this phase, the media produced by students were evaluated for creativity, educational effectiveness, and relevance to the teaching of fractions. Feedback was provided to students on their media, and a final survey was administered to assess their perceptions of the usefulness and impact of the training.

### **3.5 Data Analysis Procedures**

Data analysis was conducted through qualitative methods, focusing on students' participation, creativity, and the quality of the learning media produced. The analysis involved reviewing the media created by each group, noting the accuracy and creativity in representing the fraction concepts, and observing students' levels of engagement throughout the process. Feedback was gathered during the evaluation phase, which provided insights into how hands-on media creation influenced their understanding of fractions. The data were then synthesized to identify key patterns in the effectiveness of media creation in enhancing student learning in mathematics.

## **4. Findings**

### **4.1. Preparation Phase**

In the preparation phase, the research team undertook several crucial steps to ensure the success of the training. First, the team coordinated with the mathematics teacher at MTs Miftahul Ulum to gain permission to utilize classroom time for the activity. The teacher was also asked to inform the students about the necessary materials for the hands-on part of the training. These materials included origami paper, scissors, glue, rulers, and markers/pens, all of which were required for the creation of the mathematics learning media.

The team also took the responsibility of preparing the training materials related to teaching fractions and mathematics media. This involved designing instructional content tailored to the specific needs of the participants. Furthermore, necessary tools and resources were procured, ensuring that students would have the materials needed to fully engage in the activities during the training session.



**Figure 1.** Preparation phase for student engagement in mathematics learning media training

### **4.2. Implementation Phase**

The training took place at MTs Miftahul Ulum, located in Dapurno Village, Wirosari District, Grobogan Regency. A total of 19 seventh-grade students from class VII B participated in the training session. The focus of the session was on teaching students how to create mathematics learning media for the topic of fractions. The hands-on session allowed the students to practice designing learning materials while gaining a deeper understanding of the topic.

The training activities began with dividing students into three groups of 5 to 6 members each. Each group was instructed to create 10 circles from the origami paper they had brought. They then drew lines on each circle and labeled them with fraction values ranging from  $\frac{1}{2}$  to  $\frac{1}{10}$ , cutting the circles accordingly—such as halving for  $\frac{1}{2}$  or dividing into three parts for  $\frac{1}{3}$ . Once completed, the groups glued their fractioned circles together in a fan-like structure as a visual representation of fractions. Finally, they attached the fan-shaped circles to a large piece of Asturo paper and decorated the artwork creatively.

Throughout the training, students displayed high levels of enthusiasm and creativity. This activity allowed them to not only learn about fractions in a more engaging and tangible manner but also encouraged them to express their creativity. The training aimed to show students that they could design their own learning media for other mathematical topics in the future, enhancing their ownership and comprehension of abstract mathematical concepts such as fractions.



**Figure 2.** Practical engagement in creating mathematics learning media

The final products of the students' efforts are shown in the following figures.



(a) Group 1



(b) Group 2



(c) Group 3

**Figure 3.** Students' Contribution in creating mathematics learning media

The three mathematics learning media created by the groups share a common structure but differ in several aspects. Group 1's project emphasizes a colorful and creative arrangement, making the fraction fan visually appealing with decorative elements enhancing engagement. Group 2 focuses on precision and clarity, ensuring that each fraction is neatly labeled and proportionally divided for easy understanding. Meanwhile, Group 3 incorporates both accuracy and artistic creativity, presenting a vibrant and interactive display that balances educational value with aesthetic appeal. These differences highlight each group's unique approach to designing an effective and engaging fraction learning tool.

#### **4.3. Evaluation Phase**

During the evaluation phase, the team assessed the outcomes of the students' learning media creations. This evaluation was used to guide discussions with the participants regarding any challenges or obstacles they encountered during the creation process. Additionally, the

evaluation results provided insight into the effectiveness of the training and its impact on student learning.

The evaluation of the training revealed a high level of participation, with an attendance rate of 90%. Only a few students were unable to attend due to personal reasons, indicating strong interest and commitment to the activity. Active participation further enhanced the effectiveness of the training, as students engaged in hands-on tasks and collaborative learning.

In terms of schedule adherence, the training was conducted on time and followed the pre-established plan. Each session progressed smoothly, meeting all planned milestones without significant delays. This ensured that all learning objectives were covered effectively and that students could fully engage with the material within the allocated timeframe.

Furthermore, the training successfully contributed to students' knowledge acquisition. By the end of the sessions, participants reported gaining valuable insights into mathematics learning media, particularly in using tools related to fractions. Their improved understanding reflects the success of the training in making mathematical concepts more accessible and engaging.

The overall evaluation of the training indicated that it was successful in meeting its objectives. The students demonstrated high enthusiasm and engagement throughout the activities, as evidenced by their active participation in both the practical tasks and the final discussions. Feedback from the students suggested that the training had a positive effect on their attitude toward learning mathematics, particularly in terms of their appreciation for the role of creative, hands-on activities in understanding mathematical concepts. One student remarked that learning mathematics had become more enjoyable and accessible through the use of the newly created learning media.



**Figure 3.** Final documentation session with the seventh-grade students of MTs Miftahul Ulum

The image captures a joyful moment as the seventh-grade students of MTs Miftahul Ulum enthusiastically participate in the final documentation session of the training. Their expressions reflect excitement and satisfaction after successfully creating mathematics learning media related to fractions. Throughout the process, the students demonstrated active engagement, collaboration, and creativity in assembling their projects. The session not only served as a reflection of their hard work but also reinforced their understanding of mathematical concepts in an enjoyable and interactive way.

## **5. Discussion**

The findings of this study highlight the critical role of learning media in enhancing student engagement and understanding of abstract mathematical concepts, such as fractions. As Murni et al. (2023) pointed out, creative and innovative learning media can transform students' perceptions of mathematics, making learning more enjoyable and improving their academic outcomes. In line with this, the hands-on activities in this study, such as creating fraction fans, allowed students to visualize and manipulate fractions, making the concept more tangible. This aligns with Gagne's (1992) assertion that media are essential elements in the learning environment that help trigger cognitive processes, particularly when dealing with complex topics. The positive feedback from students reinforces the idea that media-based learning approaches can significantly enhance their grasp of abstract content, a sentiment supported by Ain and Mustika (2021), who emphasized the psychological and motivational benefits of using appropriate media in mathematics instruction.

Furthermore, the results of this study are consistent with the work of Yanti et al. (2019) and Hamalik (1986), who highlighted that media in education not only facilitates knowledge transfer but also creates an engaging and interactive learning environment. In this study, students' active participation during the creation of learning tools, such as the fraction fans, supported the idea that media increases student involvement and fosters a deeper understanding of the content. The high levels of student enthusiasm and involvement suggest that hands-on activities, which incorporate both individual and group learning approaches, contribute significantly to the learning process, echoing Anderson's (1997) categorization of media as tools that support active learning and cognitive engagement.

Moreover, the results support the idea that media creation encourages not only academic learning but also the development of critical thinking and creativity, skills that are crucial for mathematical problem-solving (Murni et al., 2023). This was evident when students were tasked with designing their own fraction tools, which required them to think critically about the mathematical concept and its practical application. According to Gunawan (2016), media can also be instrumental in promoting a positive attitude toward learning by making abstract topics more accessible. As evidenced by this study, students showed improved motivation and a positive shift in their attitudes toward mathematics after engaging in the media creation activity. This finding supports Hamalik's (1986) view that innovative and engaging media can significantly enhance the educational experience and contribute to better learning outcomes.

Despite the positive results, the study has certain limitations. The small sample size and the specific context of the study mean that the findings may not be universally applicable. However, the study's outcomes suggest that using creative and engaging media can enhance the teaching and learning of fractions, a concept that is often perceived as challenging. Future research could expand the sample size and explore the effectiveness of such media in various educational settings, further validating the benefits of media-based learning in diverse contexts (Yanti et al., 2019).

## **6. Conclusion**

This study aimed to explore the impact of hands-on learning media creation on student engagement and understanding of fractions. The results demonstrate that student involvement in creating mathematical media, such as fraction fans, significantly enhanced their comprehension of abstract mathematical concepts. While the study successfully highlights the value of student-created media in improving engagement and motivation, its limitations

include a small sample size and focus on a single mathematical topic. Future research could extend this approach to larger groups, investigate its applicability across different mathematical concepts, and explore its long-term effects on students' attitudes and performance. This work provides a solid foundation for integrating hands-on media creation into mathematics teaching, offering potential for broader implementation in classrooms to foster deeper understanding and creativity in students.

## References

- Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. (2021). Engaging students in the learning process with game-based learning: The fundamental concepts. *International Journal of Technology in Education (IJTE)*, 4(3), 542-552. <https://doi.org/10.46328/ijte.169>
- Agustina. (2022). Meningkatkan Hasil Belajar Siswa Kelas V SD Negeri 004 Belakang Padang Materi Pesawat Sederhana Dengan Menggunakan Metode Demonstrasi dan Media Pembelajaran yang Tepat. *Jurnal Inovasi Pendidikan Dasar*, 2(4), 267–275.
- Ain, S. Q., & Mustika, D. (2021). Pelatihan pembuatan media pembelajaran matematika kepada guru sekolah dasar. *Jurnal Abdidas*, 2(5), 1080–1085. <https://doi.org/10.31004/abdidas.v2i5.427>
- Akram, H, Abdelrady A. H, Al-Adwan, A. S., & Ramzan, M. (2022). Teachers' perceptions of technology integration in teaching-learning practices: A systematic review. *Front. Psychol.* 13:920317. doi: 10.3389/fpsyg.2022.920317
- Alam, A., Mohanty, A. (2023). Learning on the Move: A Pedagogical Framework for State-of-the-Art Mobile Learning. In: Sharma, N., Goje, A., Chakrabarti, A., Bruckstein, A.M. (eds) Data Management, Analytics and Innovation. ICDMAI 2023. Lecture Notes in Networks and Systems, vol 662. Springer, Singapore. [https://doi.org/10.1007/978-981-99-1414-2\\_52](https://doi.org/10.1007/978-981-99-1414-2_52)
- AlMardhiyyah, S., Latief, M. A., & Masduqi, H. (2021). Enhancing the Students' Learning Motivation by Using Instructional Media for Thailand's Municipal School. *Pedagogy: Journal of English Language Teaching*, 9(1).76-91. <https://doi.org/10.32332/joelt.v9i1.3131>
- Almufarreh, A., & Arshad, M. (2023). Promising Emerging Technologies for Teaching and Learning: Recent Developments and Future Challenges. *Sustainability*, 15(8), 6917. <https://doi.org/10.3390/su15086917>
- Al-Said, K. Influence of teacher on student motivation: Opportunities to increase motivational factors during mobile learning. *Educ Inf Technol* 28, 13439–13457 (2023). <https://doi.org/10.1007/s10639-023-11720-w>
- Amdar, F. F., & Nurjannah, N. (2024). Diagnostik Kesulitan Belajar Matematika Siswa Kelas V Pada Materi Penjumlahan Pecahan di Sekolah Dasar. *PEDAGOGY: Journal of Multidisciplinary Education*, 1(1), 33–40.
- Anugerah, A. S., Rusdi, & Amri, A. H. (2024). Pelatihan Pembuatan Media Pembelajaran Matematika Menggunakan Macromedia Flash Guru Mgmp Di Kabupaten Bone. *GLOBAL ABDIMAS: Jurnal Pengabdian Masyarakat*, 4(1), 8–14. <https://doi.org/10.51577/globalabdimas.v4i1.494>
- Attard, C., Holmes, K. (2022). An exploration of teacher and student perceptions of blended learning in four secondary mathematics classrooms. *Math Ed Res J* 34, 719–740. <https://doi.org/10.1007/s13394-020-00359-2>
- Ben A. Y., & Kribushi, R. (2022). Can Electronic Board Increase the Motivation of Students to Study Mathematics?. *Contemporary Educational Technology*, 14(3), ep364. <https://doi.org/10.30935/cedtech/11807>

- Bingimlas, K. A. (2009). Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of Literature. *Eurasia Journal of Mathematics, Science and Technology Education*, 5(3), 235-245. <https://doi.org/10.12973/ejmste/75275>
- Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Ricci, M. M., & Rumble, M. (2012). Defining Twenty-First Century Skills. In: Griffin, P., McGaw, B., Care, E. (eds) *Assessment and Teaching of 21st Century Skills*. Springer, Dordrecht. [https://doi.org/10.1007/978-94-007-2324-5\\_2](https://doi.org/10.1007/978-94-007-2324-5_2)
- Charline, C., Jo, S., & Frédéric, E. (2023). Use of Learning Media to Increase Student Learning Motivation in Junior High Schools. *World Psychology*, 2(3), 176-189. <https://doi.org/10.55849/wp.v2i3.402>
- Chazan, B. (2022). What Is “Education”? In: *Principles and Pedagogies in Jewish Education*. Palgrave Macmillan, Cham. [https://doi.org/10.1007/978-3-030-83925-3\\_3](https://doi.org/10.1007/978-3-030-83925-3_3)
- Copur-Gencturk, Y. (2021). Teachers’ conceptual understanding of fraction operations: results from a national sample of elementary school teachers. *Educ Stud Math* 107, 525–545. <https://doi.org/10.1007/s10649-021-10033-4>
- Ebekozien, A., Aigbavboa, C.O., Samsurijan, M.S., Radin Firdaus, R.B. and Rohayati, M.I. (2025), "Expanded corporate social responsibility framework: companies’ role in improving higher education institutions infrastructure to Sustainable Development Goal 4", *Journal of Facilities Management*, Vol. 23 No. 1, pp. 1-18. <https://doi.org/10.1108/JFM-11-2022-0120>
- Fauzi, I., & Arisetyawan, A. (2020). Analisis Kesulitan Belajar Siswa pada Materi Geometri Di Sekolah Dasar. *Kreano, Jurnal Matematika Kreatif-Inovatif*, 11(1), 27–35. <https://doi.org/10.15294/kreano.v11i1.20726>
- Ferary, D. (2021). On Ki Hadjar Dewantara’s Philosophy of Education. *Nordic Journal of Comparative and International Education (NJCIE)*, 5(2), 65–78. <https://doi.org/10.7577/njcie.4156>
- Ferary, D. (2023). A Philosophical Perspective on the Purpose of Education in Indonesia. In: Hebert, D.G. (eds) *Comparative and Decolonial Studies in Philosophy of Education*. Springer, Singapore. [https://doi.org/10.1007/978-981-99-0139-5\\_4](https://doi.org/10.1007/978-981-99-0139-5_4)
- Gabriel, F., Van Hoof, J., Gómez, D.M., Van Dooren, W. (2023). Obstacles in the Development of the Understanding of Fractions. In: Robinson, K.M., Dubé, A.K., Kotsopoulos, D. (eds) *Mathematical Cognition and Understanding*. Springer, Cham. [https://doi.org/10.1007/978-3-031-29195-1\\_11](https://doi.org/10.1007/978-3-031-29195-1_11)
- Gunawan, I. (2016). *Metode Penelitian Kualitatif*. Jakarta: Bumi Aksara.
- Hajirasouli, A., Banihashemi, S. (2022). Augmented reality in architecture and construction education: state of the field and opportunities. *Int J Educ Technol High Educ* 19, 39 <https://doi.org/10.1186/s41239-022-00343-9>
- Hontarenko, I., & Kovalenko, O. (2024). Enhancing Teaching: The Crucial Role of Effective Preparation and Delivery of Lectures. *Educational Challenges*, 29(1), 72-84. <https://doi.org/10.34142/2709-7986.2024.29.1.05>
- Hunt, J. H., Taub, M., Marino, M., Holman, K., & Womack-Adams, K. (2025). Increasing Student Engagement, Fraction Knowledge, and STEM Interest Through Game-Based Intervention. *Journal of Special Education Technology*, 0(0). <https://doi.org/10.1177/01626434251314014>
- Ikhlas, R. Z., Japakiya, R. ., & Muzayanah, T. (2023). Utilization of Canva Application as a Learning Media Video Creation. *Journal of Social Science Utilizing Technology*, 1(3), 158–169. <https://doi.org/10.70177/jssut.v1i3.558>
- Irawati, D., Masitoh, S., & Nursalim, M. (2022). Filsafat Pendidikan Ki Hajar Dewantara sebagai Landasan Pendidikan Vokasi di Era Kurikulum. *JUPE: Jurnal Pendidikan*

- Mandala, 7(4), 1015–1025. <https://doi.org/10.58258/jupe.v7i4.4493>
- Jarrah, A. M., Wardat, Y., & Gningue, S. (2022). Misconception on addition and subtraction of fractions in seventh-grade middle school students. *Eurasia Journal of Mathematics, Science and Technology Education*, 18(6), em2115. <https://doi.org/10.29333/ejmste/12070>
- Johnson, D. C., & Coulter-Kern, M. (2024). Listening to students: Beliefs and attitudes about active learning and effective lecture-style courses. *Active Learning in Higher Education*, 0(0). <https://doi.org/10.1177/14697874241254465>
- Junaidi. (2019). Peran Media Pembelajaran Dalam Proses Belajar Mengajar. *Diklat Review, Jurnal Manajemen Pendidikan dan Pelatihan*, 3(1), 46-56. <https://ejournal.kompetif.com/index.php/diklatreview/article/view/349>
- Kassa, M. M., Azene, M. K., Mengstie, S. M., & Ferede, M. W. (2024). Effect of using multimedia and dynamic classroom integrated instruction on grade 11 students' biology academic achievement. *Heliyon*, 10(18), e37315. <https://doi.org/10.1016/j.heliyon.2024.e37315>
- Lee, J. E., Lee, M. Y. (2023). How elementary prospective teachers use three fraction models: their perceptions and difficulties. *J Math Teacher Educ* 26, 455–480. <https://doi.org/10.1007/s10857-022-09537-4>
- Li, Y., Chen, D., & Deng X (2024) The impact of digital educational games on student's motivation for learning: The mediating effect of learning engagement and the moderating effect of the digital environment. *PLoS ONE* 19(1): e0294350. <https://doi.org/10.1371/journal.pone.0294350>
- Liu, J. (2021). Building education groups as school collaboration for education improvement: a case study of stakeholder interactions in District A of Chengdu. *Asia Pacific Educ. Rev.* 22, 427–439. <https://doi.org/10.1007/s12564-021-09682-0>.
- Lombardi, D., Shipley, T. F., Bailey, J. M., Bretones, P. S., Prather, E. E., Ballen, C. J., Knight, J. K., Smith, M. K., Stowe, R. L., Cooper, M. M., Prince, M., Atit, K., Uttal, D. H., LaDue, N. D., McNeal, P. M., Ryker, K., St. John, K., van der Hoeven Kraft, K. J., & Docktor, J. L. (2021). The Curious Construct of Active Learning. *Psychological Science in the Public Interest*, 22(1), 8-43. <https://doi.org/10.1177/1529100620973974>
- Makhubele, Y. E. (2021). The Analysis of Grade 8 Fractions Errors Displayed by Learners Due to Deficient Mastery of Prerequisite Concepts. *International Electronic Journal of Mathematics Education*, 16(3), em0645. <https://doi.org/10.29333/iejme/11004>
- Mania, S. & Alam, S. (2021). Teachers' perception toward the use of ethnomathematics approach in teaching math. *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, 9(2), 282-298. <https://doi.org/10.46328/ijemst.1551>
- Margaliot, A. (2024). Preservice teachers' beliefs toward online learning and future teaching: Redesigning teacher training. *Journal of Digital Learning in Teacher Education*, 40(3), 173–184. <https://doi.org/10.1080/21532974.2024.2368050>
- Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics*, 12(13), 2832. <https://doi.org/10.3390/electronics12132832>
- Mertasari, N. M. S. (2022). Summative Evaluation of ICT-Based Learning Media. *Journal of Education Research and Evaluation*, 6(4), 688–695. <https://doi.org/10.23887/jere.v6i4.54695>
- Mujiani, S. (2016). Pengaruh Media Pembelajaran dan kecerdasan Logis Matematis Terhadap Hasil Belajar Matematika Siswa. *Jurnal Pendidikan Dasar*, 7(2), 7.
- Murni, D., Mudjiran, M., & Mirna, M. (2023). Analisis Terhadap Kreativitas dan Inovasi Guru dalam Membuat Media Pembelajaran Matematika Sekolah Dasar. *Jurnal*

- Cendekia : Jurnal Pendidikan Matematika*, 7(2), 1118–1128.  
<https://doi.org/10.31004/cendekia.v7i2.2066>
- Naidoo, J. & Hajaree, S. (2021). Exploring the perceptions of Grade 5 learners about the use of videos and PowerPoint presentations when learning fractions in mathematics', *South African Journal of Childhood Education* 11(1), a846.  
<https://doi.org/10.4102/sajce.v11i1.846>
- Nguyen, L.A.T., Habók, A. (2024). Tools for assessing teacher digital literacy: a review. *J. Comput. Educ.* **11**, 305–346. <https://doi.org/10.1007/s40692-022-00257-5>
- Ritawati, B., Liliana, S., & Tupulu, N. (2024). *Materi Pecahan*.
- Rosser, A. (2015). Law and the Realisation of Human Rights: Insights from Indonesia's Education Sector. *Asian Studies Review*, 39(2), 194–212.  
<https://doi.org/10.1080/10357823.2015.1025462>
- Sahlberg, P. Rethinking accountability in a knowledge society. *J Educ Change* **11**, 45–61 (2010). <https://doi.org/10.1007/s10833-008-9098-2>
- Satria, A. B. A., & Muntaha, A. A. (2022). Inovasi pendidikan abad 21: penerapan design thinking dan pembelajaran berbasis proyek dalam pendidikan Indonesia. *Jurnal Pendidikan Dasar*, 9(2). <https://doi.org/10.20961/jpd.v9i2.59940>
- Setyabekti, R. A., Stani, D., Adawiyah, R., Iffah, J. D. N., & Masrurroh, F. (2022). Penerapan Media Pembelajaran Bilangan Bulat Berbantuan Macromedia Flash Pada Siswa MTs Miftahul Ulum Pelangwot. *Jurnal Pengabdian Masyarakat Universitas Narotama*, 2(2), 50–56. <https://jurnal.narotama.ac.id/index.php/un-penmasxxxxxxxxxxxxx%7C50>
- Sholihah, Zainatu, S., Afriansyah, & Aldila, E. (2017). Analisis Kesulitan Siswa Dalam Proses Pemecahan Masalah Geometri Berdasarkan Tahapan Berpikir Van Hiele. *Jurnal Mosharafa*, 6(2).
- Singh, P., Hoon, T. S., Nasir, N. A. M., Han, C. T., Rasid, S. M. & Hoong, J. B. Z. (2021). Obstacles Faced by Students in Making Sense of Fractions. *The European Journal of Social & Behavioural Sciences*, Volume 30(Issue 1), 34–51. <https://doi.org/10.15405/ejsbs.287>
- Sudjana, N., & Rivai, A. (2002). *Media Pengajaran*. Sinar Baru Algensindo.
- Sugiarto, E., Syarif, M. I., Mulyono, K. B., bin Othman, A. N., & Krisnawati, M. (2025). How is ethnopedagogy-based education implemented? (A case study on the heritage of batik in Indonesia). *Cogent Education*, 12(1).  
<https://doi.org/10.1080/2331186X.2025.2466245>
- Suharsiwi, S., Fikri, M., & Karim, S. (2023). Learning media's role in Islamic religious education teaching and learning?. *AMCA Journal of Religion and Society*, 3(2). <https://doi.org/10.51773/ajrs.v3i2.308>
- Tajeddin, Z., & Asadnia, F. (2023). Teachers' Collaborative Reflections on Classroom Materials: From Traditional Consumers to Digital Materials Developers and Teacherpreneurs. *RELC Journal*, 0(0). <https://doi.org/10.1177/00336882231222036>
- Taufikin, T., & Ma'shumah, L. A. (2021). Ki Hajar Dewantara's Perspective on The Concept of Independent Education and Its Relevance to The Independent Learning in Indonesia. *Edukasia Islamika*, 6(1), 90 – 110. <https://doi.org/10.28918/jei.v6i1.560>
- Telaumbanua, Y. (2020). Efektifitas Penggunaan Alat Peraga Pada Pembelajaran Matematika Pada Sekolah Dasar Pokok Bahasan Pecahan. *Jurnal Darmawangsa*, 4, 709–722.
- Valk, A., Kratoviš, M. (2021). We collaborate with everyone, but with some more than others: evidence of stakeholder collaboration among internal security professional higher education institutions. *Empirical Res Voc Ed Train* **13**, 4.  
<https://doi.org/10.1186/s40461-021-00110-6>
- Wahyuni, F. T. (2018). Berpikir Reflektif Dalam Pemecahan Masalah Pecahan Ditinjau Dari

- Kemampuan Awal Tinggi Dan Gender. *Jurnal Pendidikan Matematika (Kudus)*, 1(1). <https://doi.org/10.21043/jpm.v1i1.4455>
- Wahyuningtyas, D. T., & Shinta, R. N. (2017). Pelatihan Media Pembelajaran Matematika Berdasarkan Kurikulum 2013 Bagi Guru Sekolah Dasar Di Gugus 9 Kecamatan Sukun Malang. *Jurnal Dedikasi*, 14(5), 8–11. <http://ejournal.umm.ac.id/index.php/dedikasi/article/view/4293>
- Widayati, Mujidin, & Rusmining. (2022). Pelatihan Pembelajaran Matematika menggunakan Media Pembelajaran untuk meningkatkan minat belajar bagi guru Sekolah Dasar. In *Seminar Nasional Pengabdian Kepada Masyarakat* (Vol. 0, Issue 0, pp. 851–858). <https://ojs.unm.ac.id/semnaslpm/article/view/18284>
- Wijaya, T. T., Cao, Y., Bernard, M., Rahmadi, I. F., Lavicza, Z., & Surjono, H. D. (2022). Factors influencing microgame adoption among secondary school mathematics teachers supported by structural equation modelling-based research. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.952549>
- Winslów, C., Bosch, M., González-Martín, A.S., Huo, R. (2023). Technology in University Mathematics Education. In: Pepin, B., Gueudet, G., Choppin, J. (eds) *Handbook of Digital Resources in Mathematics Education*. Springer International Handbooks of Education. Springer, Cham. [https://doi.org/10.1007/978-3-030-95060-6\\_34-1](https://doi.org/10.1007/978-3-030-95060-6_34-1)
- Wu, Y.-J. (Ariel), & Chun, D. M. (2025). An exploration of preservice teachers' use of immersive VR to design English lessons. *Educational Technology & Society*, 28(1), 412–428. <https://www.jstor.org/stable/48810729>
- Yahya, Y., & Salam. (2024). Pelatihan dan Pendampingan Pembuatan Media Pembelajaran Berbasis Educaplay Bagi Guru di MTS Al-Hidayah Batulappa. *Mosaic: Jurnal Pengabdian Kepada Masyarakat*, 1(2), 29–37. <https://doi.org/10.61220/mosaic.v1i2.505>
- Yanti, C. O. D., Anggraini, F., & Darwanto. (2019). Media Pembelajaran Matematika Interaktif Dalam Upaya Menumbuhkan Karakter Siswa. *Semnasfip*, 201–206. <https://jurnal.umj.ac.id/index.php/SEMNASFIP/article/view/5128>
- Yongcheng Gan, & Zhiting Zhu. (2007). A Learning Framework for Knowledge Building and Collective Wisdom Advancement in Virtual Learning Communities. *Journal of Educational Technology & Society*, 10(1), 206–226. <http://www.jstor.org/stable/jeductechsoci.10.1.206>