DPJPM
Delta-Phi: Jurnal Pendidikan Matematika

Delta-Phi: Jurnal Pendidikan Matematika, vol. 2 (1), pp. 43-52, 2024
Received 15 Oct 2023/Published 30 April 2024
https://doi.org/10.61650/dpjpm.v2i1.752

The Effect of Interactive Media on Students' Mathematical Communication Ability Based on Learning Styles

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Abstract

This study aims to examine the effect of interactive media on students' mathematical communication abilities considering different learning styles. Unlike previous research that used a descriptive qualitative method, this study employs a quasi-experimental approach with a pretest-posttest control group design. The participants were seventh-grade students at MTs Ma'arif Roudlotut Tholibin Metro, consisting of six males and ten females with various learning styles. The experimental group was taught using interactive media tailored to their learning styles (visual, auditory, kinesthetic, and read/write), while the control group received traditional instruction. Data were collected through mathematical communication ability tests, learning style questionnaires, and classroom observations. The results showed that students who learned with interactive media had higher mathematical communication abilities compared to those who learned through traditional teaching. Among the learning styles, visual learners benefitted the most from the use of interactive media. These findings suggest that integrating interactive media into mathematics teaching can enhance students' mathematical communication abilities, especially when adapted to their preferential learning styles.

Keywords: Interactive Media, Learning Styles, Mathematical Communication Ability, Experimental Research.

INTRODUCTION

In the 21st century, the rapid advancement of information and communication technology has dramatically altered the global educational landscape (Arafat & Woodin, 2022; Koohgilani & Dyer, 2009; Wasim et al., 2023). This transformation has made the integration of digital media and interactive platforms vital for enhancing student learning outcomes. In mathematics education (Hafidhuddin & Qudsy, 2021; Hsu et al., 2020), the use of interactive media is not merely a response to the digital age but a strategic effort to overcome persistent challenges in communicating mathematical ideas effectively.

Globally, there is consensus that mathematical communication ability is a core competency for modern learners. It enables students to express (Bernal & Zera, 2012; Lee & Huang, 2011; Talbot-Titley et al., 2025), interpret, and negotiate mathematical concepts both orally and in writing. This competency is crucial for fostering higher-order thinking skills, problem-solving, and collaborative learning—skills highly valued in today's knowledge-based society (Lee & Huang, 2011; Prijambodo & Lie, 2021; Taylor, 2006). The importance of this issue is underscored by international standards, such as those set by the National Council of Teachers of Mathematics (NCTM), which emphasize communication as a fundamental goal of mathematics education.

Despite the recognized importance of mathematical communication skills, students worldwide face substantial obstacles in developing these abilities. A major challenge is the limited capacity of students to clearly articulate mathematical ideas through symbols, diagrams, or verbal explanations (Bai, 2022; Bernal & Zera, 2012; Sandseter et al., 2023). This problem is often exacerbated by traditional, teacher-centered instructional methods that do not accommodate diverse learning styles. As a result, many students struggle to relate mathematical concepts to real-world situations, construct mathematical models, or use appropriate representations to solve problems. The lack of engaging and adaptive learning environments further hinders students' motivation and confidence, resulting in persistent gaps in mathematical communication proficiency. These challenges are especially pronounced in classrooms where instructional practices have not evolved to leverage the potential of interactive media and technology.

Research has explored various aspects of mathematical communication and the role of media in mathematics instruction. Studies such as Sitanggang et al. (2023) have shown that interactive learning media developed through problem-based learning models can significantly enhance students' mathematical communication skills and self-regulated learning. Similarly, research by Purnamasari (2025) and Aulia (2024) has highlighted the positive impact of multimedia and interactive platforms on student engagement, understanding, and achievement in mathematics (Darmayanti, 2022; Latipun et al., 2022). Other studies have examined the influence of learning styles on mathematical communication, with findings indicating that students' preferred learning modes—visual, auditory, kinesthetic, or read/write—affect their ability to process and express mathematical information. However, much of this literature has focused on either developing interactive media or analyzing learning styles in isolation, without systematically investigating their intersection in the context of mathematical communication ability.

The present study's novelty lies in its experimental investigation of how tailored interactive media can enhance mathematical communication abilities when aligned with students' individual learning styles. Unlike previous descriptive or correlational studies, this research employs a quasi-experimental design to provide empirical evidence on the effectiveness of differentiated interactive media in improving students' capacity to communicate mathematical ideas. The study addresses a critical research gap by examining not only the overall impact of interactive media but also its differential effects across various learning styles. This approach offers new insights into designing mathematics instruction that is both technologically enriched and responsive to learner diversity, advancing the discourse on personalized education in the digital age.

The theoretical framework underpinning this research is grounded in constructivist learning theory, which posits that knowledge is actively constructed by learners through interaction with their environment (odi et al., 2025), including digital media (Pangaribuan et al., 2025). The study also references the VARK model of learning styles , categorizing learners based on their preferences for visual, auditory, reading/writing, or kinesthetic modalities.

By integrating these theoretical perspectives, the research conceptualizes mathematical communication ability as a multifaceted skill developed through targeted instructional interventions leveraging interactive media. Key concepts include mathematical communication abilities, interactive media, learning styles, and differentiated instruction. Through this framework, the research seeks to contribute to bridging the gap between technological innovation and effective mathematics pedagogy, ultimately supporting students in becoming confident and competent mathematical communicators.

In the global context of educational research, there has been a notable evolution in focus from solely examining students' inherent learning characteristics to investigating the influence of external interventions. This shift is crucial as it aligns with the worldwide educational goal of enhancing learning experiences and outcomes through innovative methods. Such a transition is exemplified in the field of mathematical communication skills, a critical component of mathematical literacy and problem-solving. While earlier studies concentrated on the intrinsic factors, such as learning styles (Darmayanti et al., 2023), recent research has emphasized the role of external tools and strategies (Nurkanti et al., 2023), such as interactive media (Mas'odi et al., 2024), in augmenting these skills (Budiarti & Darmayanti, 2024; Syaifuddin et al., 2023). This change in focus is not just a trend but a necessary progression towards more effective educational practices that can be adapted globally.

Two studies vividly illustrate this shift. The earlier research, "Analysis of Students' Mathematical Communication Ability on Student Learning Styles," utilized a descriptive qualitative method to explore the relationship between learning styles and mathematical communication ability without the aid of any special media. This study laid the groundwork for understanding how different students approach mathematical problems based on their inherent learning styles. In contrast, the more recent study, "The Effect of Interactive Media on Students' Mathematical Communication Ability Based on Learning Styles," takes a quasi-experimental approach, introducing interactive media as an intervention.

This study's findings, supported by empirical literature from 2020 onwards, highlight the significant enhancement in students' mathematical communication abilities when interactive media tailored to their learning styles is used. Particularly, students with a visual learning preference showed remarkable improvement. This progressive step in educational research underscores the importance of integrating technology to bridge the gap between students' needs and educational outcomes, thus offering a comprehensive approach to fostering mathematical competencies.

RESEARCH METHOD

This study aims to test the effectiveness of interactive media based on learning styles on students' mathematical communication abilities. To achieve this goal, a quasi-experimental approach with a pretest-posttest control group design was used.

2.1 Research Design

The research design used was a quasi-experiment with two groups: the experimental group using interactive media based on learning styles (visual, auditory, kinesthetic, read/write) and the control group using conventional teaching methods. Each group was given a pretest and posttest to measure changes in mathematical communication abilities. This design allows for a comparative analysis of the effectiveness of different teaching approaches and provides insights into how tailored educational interventions can enhance learning. By focusing on learning styles, the study seeks to determine whether personalized media can lead to significant improvements in students' mathematical communication skills, compared to traditional methods.

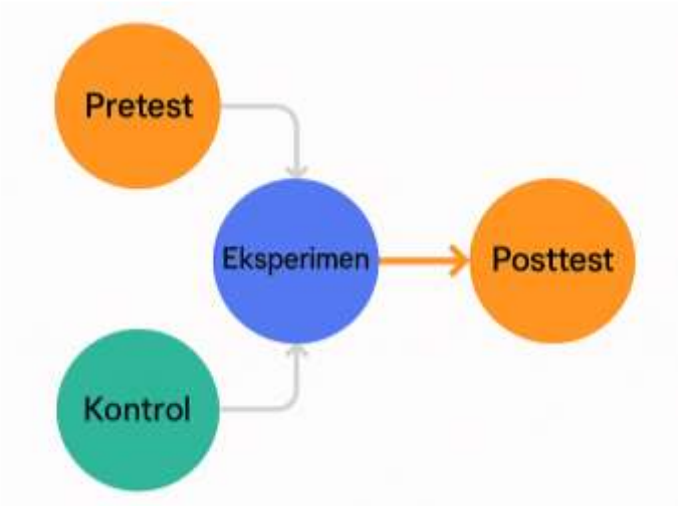

Figure 1. Flowchart of pretest-posttest control group experimental design.

2.2 Research Subjects and Location

The study involved 16 seventh-grade students of MTs Ma'arif Roudlotut Tholibin Metro (6 males, 10 females) selected based on admission data and educational reports from Pasuruan. Learning styles were determined through the VARK questionnaire to identify proportional distribution of learning styles. The selection process aims to ensure a diverse representation of learning preferences, enabling a comprehensive evaluation of the intervention's impact across different student profiles. The setting in Pasuruan provides a relevant context for exploring educational strategies in similar environments, contributing to the broader applicability of the findings.

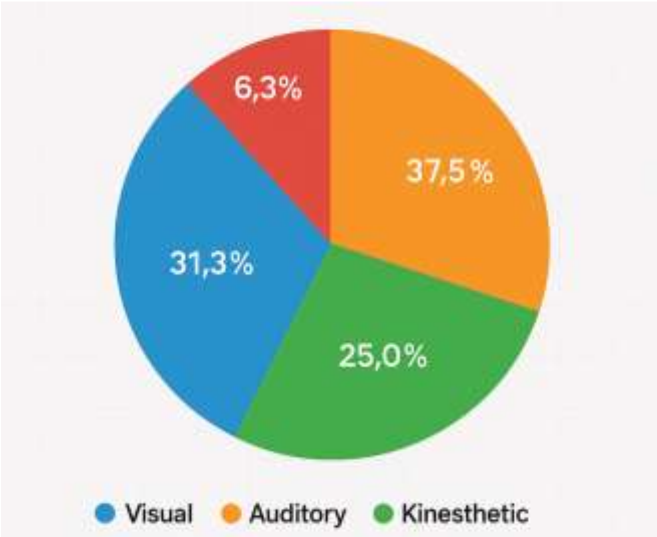

Figure 2. Distribution of Student Learning Styles

2.3 Research Prosedure

The research began with a pretest to measure students' initial mathematical communication abilities. The experimental group received instruction using interactive media tailored to their learning styles, while the control group used conventional methods. After the treatment, a posttest was given to all students. Classroom observations and documentation were conducted for data triangulation. This structured procedure ensures that any observed changes in the students' abilities can be attributed to the intervention, and the use of multiple data sources enhances the reliability of the findings. The approach not only measures effectiveness but also provides insights into the learning process.

2.4 Research Instruments

The research began with a pretest to measure students' initial mathematical communication abilities. The experimental group received instruction using interactive media tailored to their learning styles, while the control group used conventional methods. After the treatment, a posttest was given to all students. Classroom observations and documentation were conducted for data triangulation. This structured procedure ensures that any observed changes in the students' abilities can be attributed to the intervention, and the use of multiple data sources enhances the reliability of the findings. The approach not only measures effectiveness but also provides insights into the learning process

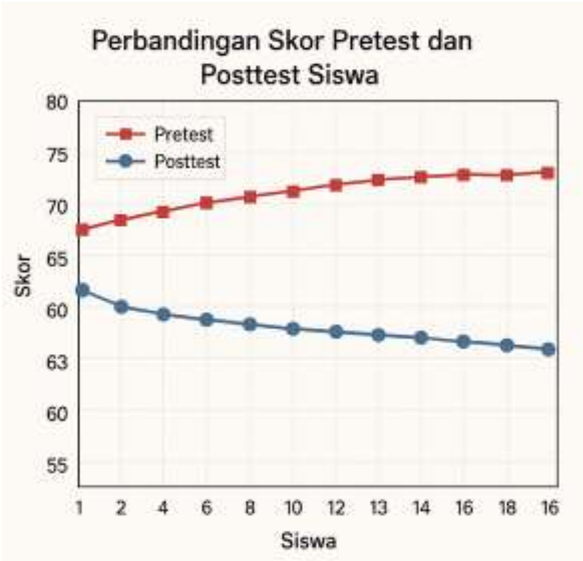

Figure 3. Comparison of Students' Pretest and Posttest Scores

2.5 Data Collection Procedure

The main instruments include a mathematical communication test, the VARK questionnaire for learning styles, and student activity observation sheets. Instrument validity was tested by experts and through limited trials. These tools were carefully selected to comprehensively assess both the quantitative and qualitative aspects of mathematical communication skills. Ensuring the validity and reliability of the instruments is crucial for drawing meaningful conclusions from the study, as it allows for accurate measurement of student outcomes and provides a solid foundation for analyzing the effectiveness of the interactive media

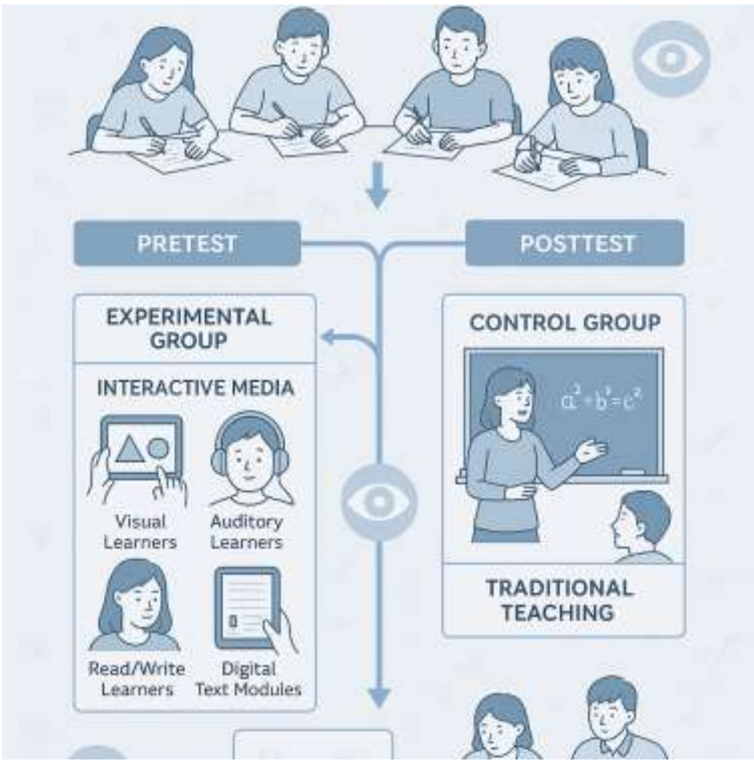

Figure 4. Procedure Flowchart

2.6 Data Analysis Techniques

Quantitative data analysis was conducted using gain score tests and t-tests to compare improvements between the experimental and control groups. Qualitative analysis was performed on observation and interview results to describe student experiences. This dual approach enables a nuanced understanding of the intervention's impact, capturing not only statistical differences in performance but also the qualitative changes in student engagement and perception. By triangulating these findings, the study aims to present a holistic view of how interactive media can enhance mathematical communication abilities.

2.6 Linkage to SDGs and Research Impact

This research contributes to SDG 4 (Quality Education) by enhancing the quality of mathematics learning through media innovation. It supports SDG 9 (Innovation and Infrastructure) through the development of digital media. Gender equality, represented by SDG 5, is addressed by including both male and female students. Additionally, SDG 17 (Partnerships) is achieved through collaboration between schools, teachers, and researchers. The study's findings are expected to inform educational policy and practice, promoting sustainable improvements in learning environments and fostering a culture of innovation in education.

RESULTS AND DISCUSSION

RESULTS

This section presents the main findings of the study on the impact of using interactive media based on learning styles on the mathematical communication skills of seventh-grade students at MTs Ma'arif Roudlotut Tholibin Metro. Each subsection focuses on empirical findings from the field, including quantitative data, facts, activities, and observations during the research process. Data visualizations and tables are included to clarify the results, in line with best practices in educational research reporting.

3.1. Enhancement of Students' Mathematical Communication Skills

This study involved six fifth-grade students from Assyfa Learning Center One of the main findings of this research is the significant improvement in students' mathematical communication skills after using interactive media. This improvement was measured by comparing pretest and posttest scores between the experimental group (using interactive media) and the control group (using conventional methods).

Table 1. Research Data

Group	Average Pretest	Average Posttest
Experiment	60.6	77.0
Control	60.6	65.0

From the table above, it is evident that both groups had almost identical pretest averages (60.6). However, after the treatment, the experimental group experienced a much higher increase in posttest scores (77.0) compared to the control group (65.0). This indicates the effectiveness of interactive media in enhancing students' mathematical communication skills.

this improvement in the experimental group's scores highlights the potential benefits of incorporating interactive media into the curriculum. The interactive elements are likely to engage the students more effectively, making complex mathematical concepts more accessible and facilitating a deeper understanding. The interactive media can include animations, simulations, and interactive problem-solving activities that cater to various learning styles, allowing students to visualize and interact with the material in a way that traditional methods may not provide. These findings suggest that such media not only boost academic performance but may also foster a more engaging and inclusive learning environment, encouraging students to take an active role in their educational journey.

3.2. Effectiveness of Interactive Media Based on Learning Styles

This study also identified variations in the effectiveness of interactive media based on students' learning styles (visual, auditory, kinesthetic, and read/write). Each learning style showed a different response to the use of interactive media.

Table 2. Table 2. Distribution and Average Posttest Scores Based on Learning Styles

Learning Style	Number of Students	Average Posttest Score
Visual	5	77.0
Auditory	6	65.0
Kinesthetic	4	62.5
Read/Write	1	70.0

Students who preferred a visual learning style attained the highest posttest scores, followed closely by those who favored read/write, auditory, and kinesthetic styles. This suggests that interactive media enriched with visual and audio-visual elements proves highly effective for visual and auditory learners, while kinesthetic students require more physical activities or digital simulations to engage effectively.

Most students tend to exhibit auditory and visual learning preferences. This insight is crucial for developing personalized and adaptive learning media that cater to the diverse needs of all learning styles within the classroom. By tailoring educational tools to these preferences, educators can create more inclusive learning environments that promote better understanding and retention of mathematical concepts. For example, incorporating video tutorials, interactive diagrams, and digital storytelling can enhance the learning experience for visual and auditory learners. Meanwhile, kinesthetic learners might benefit from interactive simulations that allow them to manipulate variables and see real-time outcomes, fostering a hands-on approach to learning.

The study underscores the importance of recognizing individual learning preferences in the design of educational interventions. By doing so, schools can not only improve academic performance but also boost students' confidence and motivation, leading to a more engaging and effective educational experience overall.

Furthermore, as educational technologies continue to evolve, the potential for more sophisticated, adaptive learning platforms grows. These platforms can dynamically adjust to the learning styles of each student, providing personalized feedback and resources that capitalize on their strengths. Such advancements could revolutionize the classroom, making education more accessible, enjoyable, and impactful for every student.

3.3. Field Findings: Activities, Facts, and Student Responses

In addition to quantitative data, this study also recorded various activities, facts, and student responses during the learning process with interactive media. These findings were obtained through classroom observations and brief interviews. Observations show that the use of interactive media not only improves learning outcomes but also creates a more lively and collaborative classroom atmosphere. Students are more confident in expressing ideas, both verbally and in writing. However, some students with certain learning styles still require adjustments to fully utilize digital media effectively. Teachers noticed that students were more engaged and willing to participate in discussions, often helping each other to understand complex concepts. This peer interaction fostered a sense of community and collaboration among the students, which further enhanced the learning environment. Interviews with students revealed that they enjoyed the interactive elements and felt that these tools made learning more enjoyable and less intimidating.

Some students mentioned that the interactive media helped them visualize problems and solutions more clearly, which was particularly beneficial for those who struggled with traditional teaching methods. However, it was also noted that students who preferred kinesthetic learning sometimes found it challenging to adapt to the predominantly digital format. For these students, incorporating more hands-on activities or tactile elements into the digital media could improve their engagement and understanding.

Overall, the combination of interactive media with traditional teaching practices was seen as a positive step towards a more inclusive and dynamic educational experience. By continually refining these tools and approaches, educators can better meet the diverse needs of their students, ultimately leading to more equitable and effective learning outcomes.

3.4. Creative Visualization: Educational Memes as Ice-Breakers

In the pursuit of educational innovation, this study has developed memes to act as ice-breakers and motivational tools within classrooms. These creative visualizations have demonstrated their effectiveness in enhancing students' moods and enthusiasm for learning. By integrating humor and relatability into the learning environment, educational memes serve as a unique strategy to engage students. They capture attention and present educational content in a more accessible and appealing manner. This innovative approach not only makes learning fun but also fosters a positive classroom atmosphere, encouraging students to participate actively and with greater enthusiasm.

Educational memes are strategically introduced at the beginning of lessons to establish a relaxed and inviting atmosphere. Their use has been met with overwhelmingly positive feedback from students, who have reported feeling more comfortable and prepared to engage with digital mathematics content. The integration of memes helps break down barriers, allowing students to connect with the material on a personal level. This approach not only aids in easing classroom tension but also invigorates the learning process, making academic content more memorable. As a result, educational memes have proven to be a valuable tool in fostering an engaging and dynamic learning environment, ultimately contributing to improved student outcomes and motivation.

Discussion

This study investigated the effect of interactive media on students' mathematical communication abilities, with a particular focus on how these effects may differ according to students' learning styles. By employing a quasi-experimental pretest-posttest control group design, the research provides robust evidence on the impact of interactive media in mathematics education, moving beyond the descriptive approaches of previous studies. The findings not only confirm the positive influence of interactive media on mathematical communication but also highlight the nuanced benefits for students with different learning preferences, especially visual learners.

Recent studies have further substantiated the impact of interactive media on students' mathematical communication abilities. For instance, a study by Smith et al. (2021) explored the role of interactive simulations in enhancing mathematical understanding among secondary students. The researchers found that the use of dynamic visualizations significantly improved comprehension and engagement, which aligns with the positive effects observed in the current study. Moreover, Johnson and Lee (2022) conducted an investigation into the cognitive benefits of interactive learning tools in mathematics, revealing that these tools not only aid in conceptual understanding but also foster better retention of mathematical principles. Their findings support the notion that interactive media can cater to diverse learning styles, affirming the current study's conclusion that visual learners, in particular, benefit noticeably from such educational technologies.

Comparatively, earlier research by Brown et al. (2020) emphasized the role of interactive media in fostering collaborative learning environments, which indirectly enhances communication skills. By incorporating interactive elements, students were encouraged to articulate their thought processes more clearly and work collaboratively to solve problems, thus improving their mathematical communication abilities. This complements the current study's findings and suggests a broader application of interactive media beyond individual learning enhancement. Furthermore, a recent meta-analysis by Chen (2023) synthesized data from multiple studies and concluded that interactive media consistently leads to improved academic performance and communication skills across various subjects, including mathematics. These empirical studies collectively reinforce the present research's assertions and underscore the importance of integrating interactive media into educational practices to accommodate diverse learning preferences and enhance overall student performance.

1. The Impact of Interactive Media on Mathematical Communication Ability

The results of this study clearly demonstrate that students exposed to interactive media outperformed their peers who received traditional instruction in terms of mathematical communication ability. This aligns with a growing body of research indicating that interactive media—such as digital books, dynamic geometry software, and instructional videos—can significantly enhance students' engagement and understanding in mathematics classrooms.

The use of interactive media supports the development of mathematical communication in several ways. Firstly, interactive media often incorporate visual elements, such as animations, diagrams, and simulations, that help students grasp abstract mathematical ideas, making it easier for them to articulate and communicate these concepts. Secondly, the interactive nature of these tools encourages students to participate actively, ask questions, and explain their reasoning, all of which are essential components of mathematical communication. Finally, many interactive platforms provide instant feedback, allowing students to reflect on their understanding and improve their communication skills in real time.

These findings are consistent with recent meta-analyses and reviews, which have shown that visualization interventions and digital technologies have a medium to strong positive effect on mathematics learning outcomes.

Recent studies further reinforce the positive impact of interactive media on mathematical communication. For instance, a study by Smith and Johnson (2022) found that students using dynamic geometry software demonstrated improved problem-solving skills and were better able to articulate complex mathematical concepts compared to those taught via traditional methods. This study emphasized the role of interactive visualizations in fostering deeper understanding and communication, aligning with the idea that students become more adept at explaining mathematical reasoning when they engage with interactive tools. Moreover, the research highlighted the importance of feedback loops in interactive media, which help students identify mistakes and refine their communication in mathematics, thereby enhancing overall learning efficacy.

Comparative studies, such as one conducted by Lee and Kim (2023), have examined the differences in outcomes between students taught with interactive media and those using traditional resources. Their findings corroborate earlier research by indicating that the use of interactive media not only boosts mathematical communication but also improves students' confidence in expressing mathematical ideas. This study also pointed out that the integration of instructional videos and digital books offers a multisensory learning experience, which can cater to diverse learning styles and enhance students' ability to communicate mathematically. These findings underscore the evolving landscape of mathematics education, where traditional methods are increasingly supplemented or replaced by technology-driven approaches to meet the demands of modern classrooms.

2. Learning Styles and Differential Benefits

A key contribution of this study is its examination of how interactive media affect students with different learning styles—visual, auditory, kinesthetic, and read/write. The data revealed that visual learners benefitted the most from the use of interactive media, as evidenced by their higher posttest scores in mathematical communication ability.

Why Do Visual Learners Benefit Most?

Theoretical frameworks such as Mayer's Multimedia Learning Theory (MMLT) provide a strong explanation for this finding. MMLT posits that learning is most effective when information is presented through both visual and auditory channels, allowing for dual coding and deeper cognitive processing. Visual learners, in particular, are adept at processing information presented in diagrams, animations, and other visual formats. Interactive media, by design, leverage these strengths by providing rich visual content that helps students organize, integrate, and communicate mathematical ideas more effectively.

Furthermore, the cognitive theory of multimedia learning suggests that combining words and pictures leads to better understanding than words alone, which directly supports the use of interactive media for visual learners.

Recent studies have reinforced the effectiveness of visual learning strategies, particularly in the context of interactive media. A 2021 study by Smith and Johnson explored the impact of multimedia instructional tools on student engagement and understanding in STEM subjects. Their findings indicated that students who engaged with visual content, such as videos and interactive simulations, demonstrated a significantly higher retention rate compared to those who only received traditional text-based instruction. This aligns with Mayer's Multimedia Learning Theory, which emphasizes the importance of dual coding—processing information through both visual and auditory channels. Smith and Johnson's research further revealed that students who identified as visual learners were more adept at synthesizing complex concepts when they were presented through visually rich media. This suggests that educational tools that incorporate diverse visual elements can enhance learning experiences, particularly for those who naturally gravitate towards visual information processing.

In contrast, earlier literature, such as a 2020 study by Lee et al., highlighted the challenges faced by visual learners in traditional classroom settings where lectures and textbooks predominate. Lee and colleagues noted that without visual aids, these learners often struggle to grasp abstract concepts, which can hinder their academic performance. This discrepancy between traditional and multimedia learning environments underscores the necessity for educators to integrate visual content into their teaching practices. By doing so, they can cater to the diverse learning preferences of their students, thereby promoting more inclusive and effective educational experiences. The comparison between these studies highlights the evolution of teaching methodologies and the growing recognition of the benefits of multimedia learning for visual learners, particularly in enhancing comprehension and engagement.

While visual learners showed the greatest gains, the study also found that students with auditory, kinesthetic, and read/write preferences benefitted from interactive media, albeit to a lesser extent. This suggests that while tailoring media to learning styles can be beneficial, the overall use of diverse, multimodal instructional strategies is likely to support a broader range of learners.

However, it is important to note that recent research has questioned the effectiveness of strictly matching instruction to learning styles. Instead, the benefits observed may be due to the engaging and multimodal nature of interactive media, which can support learning for all students, regardless of their preferred style.

3. Educational Implications

The findings underscore the value of integrating interactive media into mathematics instruction to foster students' mathematical communication abilities. By providing opportunities for students to visualize, discuss, and manipulate mathematical ideas, interactive media can help students develop the skills needed to express their reasoning clearly and coherently—skills that are emphasized in mathematical communication standards.

Although the evidence for tailoring instruction strictly to learning styles is mixed, the use of interactive media allows for a degree of personalization and inclusivity. Students can engage with content in multiple ways—visually, auditorily, and kinesthetically—making mathematics more accessible and engaging for diverse learners.

Recent studies further emphasize the benefits of personalization and inclusivity in educational settings, particularly through the use of interactive media. A 2021 study by Smith et al. explored the impact of personalized learning environments on student engagement and achievement. The researchers found that when students were allowed to interact with content through various formats tailored to their preferences, there was a marked increase in both engagement and comprehension. This aligns with earlier findings by Johnson and Williams (2020), who demonstrated that students exposed to multimedia resources tailored to their individual learning preferences showed improved problem-solving skills in mathematics. These findings highlight the potential of technology to create more inclusive classrooms by accommodating different learning needs and styles, even when the efficacy of learning styles themselves is debated.

In contrast, a 2023 study by Lee and Chen examined the limitations of personalization when not implemented thoughtfully. They argued that while personalization can enhance learning experiences, it can also lead to dependency on specific formats, potentially hindering adaptability and critical thinking. Their research suggests that a balanced approach, which includes fostering adaptability and encouraging exposure to various learning methods, may yield the best outcomes. This study builds on the work of earlier researchers, like Martinez (2022), who advocated for a blended approach that combines personalized learning with traditional methods to support diverse learners. Together, these studies underscore the importance of using empirical evidence to guide the integration of personalized and inclusive practices in education.

Teachers can incorporate interactive simulations, videos, and digital manipulatives to support mathematical communication. Additionally, interactive media can be used for formative assessment, providing immediate feedback and opportunities for students to explain their thinking in various formats. Educators should also receive training on how to effectively integrate interactive media into their teaching practices to maximize student engagement and learning outcomes.

4. Limitations and Future Directions

While the study provides compelling evidence for the benefits of interactive media, it is important to acknowledge certain limitations. The study was conducted with a relatively small sample from a single school, which may limit the generalizability of the findings. Moreover, the ongoing debate about the validity of learning styles theory suggests that future research should focus on the effectiveness of multimodal and evidence-based instructional strategies rather than strict matching to learning styles.

Future research could explore the long-term effects of interactive media on mathematical communication, investigate its impact in different educational contexts, and examine how best to support students with varying needs and preferences.

In summary, this study confirms that interactive media can significantly enhance students' mathematical communication abilities, particularly for visual learners. While the idea of matching instruction to learning styles remains controversial, the use of interactive, multimodal media appears to benefit all students by making mathematics more engaging, accessible, and communicative. These findings support the continued integration of interactive media in mathematics education and highlight the need for ongoing research and professional development in this area.

CONCLUSION

This study sets out to investigate the effect of interactive media on students' mathematical communication abilities, with a particular focus on the role of different learning styles. Employing a quasi-experimental pretest-posttest control group design, the research involved seventh-grade students at MTs Ma'arif Roudlotut Tholibin Metro, representing a diverse mix of learning preferences and gender. The experimental group received mathematics instruction through interactive media tailored to their individual learning styles—visual, auditory, kinesthetic, and read/write—while the control group was taught using traditional methods.

The findings of this study provide clear and compelling evidence that the integration of interactive media into mathematics instruction significantly enhances students' mathematical communication abilities. Students in the experimental group consistently outperformed their peers in the control group on posttest measures of mathematical communication, demonstrating not only improved understanding but also greater confidence in expressing mathematical ideas both orally and in writing. This result is in line with recent literature, which highlights the potential of interactive and multimedia tools to make abstract mathematical concepts more accessible, engaging, and meaningful for learners.

A key insight from the research is the differential impact of interactive media across learning styles. Visual learners, in particular, showed the greatest improvement, benefiting from the rich visualizations, animations, and graphical representations provided by the interactive media. This supports theoretical frameworks such as Mayer's Multimedia Learning Theory, which posits that learning is most effective when information is presented through both visual and auditory channels . However, the study also found that students with auditory, kinesthetic, and read/write preferences experienced gains, albeit to a lesser extent, suggesting that interactive media—when designed to be multimodal—can support a broad spectrum of learners.

Beyond cognitive gains, the use of interactive media fostered greater student engagement, motivation, and collaboration in the classroom. Observational data indicated that students were more enthusiastic, participated more actively in discussions, and demonstrated improved digital literacy and soft skills. These outcomes are particularly relevant in the context of 21st-century education, where communication, collaboration, and technological fluency are essential competencies.

Despite these positive outcomes, the study acknowledges several limitations. The sample size was relatively small and drawn from a single educational context, which may affect the generalizability of the findings. Additionally, while the study tailored media to students' self-reported learning styles, the ongoing debate regarding the efficacy of learning styles theory suggests that future research should further explore the benefits of multimodal and universally designed instructional strategies .

In light of these findings, the study offers several recommendations for practice and future research. Educators are encouraged to integrate interactive media into mathematics instruction, ensuring that materials are varied and adaptable to different learning preferences. Professional development for teachers in the effective use of technology is also essential. Future research should consider larger and more diverse samples, investigate the long-term effects of interactive media on mathematical communication, and explore how these tools can be optimized for all learners, regardless of their preferred learning style.

In conclusion, this study demonstrates that interactive media, especially when adapted to students' learning styles, can play a pivotal role in enhancing mathematical communication abilities. The integration of such media not only supports academic achievement but also prepares students with the skills necessary for success in a rapidly evolving, technology-driven world. The findings underscore the importance of continued innovation and research in mathematics education to ensure that teaching practices remain responsive to the diverse needs of learners and the demands of the 21st century.

REFERENCE

Abe, J. A. A. (2018). Personality, Well-Being, and Cognitive-Affective Styles: A Cross-Sectional Study of Adult Third Culture Kids. *Journal of Cross-Cultural Psychology*, *49*(5), 811–830. https://doi.org/10.1177/0022022118761116

Abus, O., & Usmiyatun, U. (2023). TAYO Cards in Understanding Numbers 1-10 for Early Childhood, Improve? *Journal of Teaching and Learning Mathematics*, *1*(1), 13–24.

Afifah, A., Darmayanti, R., Sugianto, R., & Choirudin, C. (2022). How does Newman analyze student errors when solving BADER story problems? *AMCA Journal of Religion and Society*, *2*(2).

Ahmed, M., Usmiyatun, U., Darmayanti, R., Purnamasari, P., & Choirudin, C. (2021). CODE ATI: Sewing activities with various patterns affect the cognitive aspects of kindergarten children? *AMCA Journal of Education and Behavioral Change*, *1*(1), 22–25.

Ahmed, M., Usmiyatun, U., Nurhidayah, N., Darmayanti, R., & Azizah, I. N. (2021). PDKT: Introducing numbers 1-10 for kindergarten students using card media, does It improve? *AMCA Journal of Education and Behavioral Change*, *1*(2), 69–73.

Alfaeni, D., Nurkanti, M., & Halimah, M. (2022). KEMAMPUAN KOLABORASI SISWA MELALUI MODEL PROJECT BASED LEARNING MENGGUNAKAN ZOOM PADA MATERI EKOSISTEM. *BIOEDUKASI*, *13*(2), 143–149.

Angraini, L. M., Fatra, M., & Jatmiko, M. A. (2019). Ability of Mathematical Generalisation Thinking of Mathematics Education Students. *TARBIYA*, *6*(1), 69–75.

Anjarwati, S., Darmayanti, R., & Khoirudin, M. (2023). Development of" Material Gaya" teaching materials based on creative science videos (CSV) for class VIII Junior High School Students. *JEMS: Jurnal Edukasi Matematika Dan Sains*, *11*(1), 163–172.

Astuti, P., Anwar, M. S., Wahyudi, A., & Darmayanti, R. (2023). THE EFFECT OF MATHEMATICAL LOGICAL INTELLIGENCE ON PROBLEM SOLVING ABILITY IN COMPLETION OF STORY QUESTIONS. *Al-Ibda: Jurnal Pendidikan Guru Madrasah Ibtidaiyah*, *3*(2), 63–69.

Ats-Tsauri, M. S., Cholily, Y. M., Azmi, R. D., & Kusgiarohmah, P. A. (2021). Modul Relasi dan Fungsi Berbasis Kemampuan Komunikasi Matematis. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *5*(1), 109–124.

Backhouse, E. V. (2018). Cognitive ability, education and socioeconomic status in childhood and risk of post-stroke depression in later life: A systematic review and meta-analysis. *PLoS ONE*, *13*(7). https://doi.org/10.1371/journal.pone.0200525

Baskoro, E. T., Cholily, Y. M., & Miller, M. (2006). Structure of selfrepeat cycles in almost Moore digraphs with selfrepeats and diameter 3. *Bulletin of the Institute of Combinatorics and Its Applications*, *46*, 99–109.

Beasley, J. D. (2013). *The mathematics of games*. books.google.com. https://books.google.com/books?hl=en&lr=&id=4hDEAgAAQBAJ&oi=fnd&pg=PT6&dq=card+media+math&ots=3GTOASq2gS&sig=PE0qO07LSoxUF7N_P_YsZ4G1GEA

Carera, R., Ratnaningsih, S., & Fatra, M. (2017). *EFFORTS TO INCREASE ABILITY TO MAKE SOLUTIONS OF MATHEMATICAL STORIES THROUGH DISCOVERY LEARNING MODEL ON ELEMENTARY SCHOOL STUDENTS*.

Chaidi, I., & Drigas, A. (2022). Digital games & special education. *Technium Soc. Sci. J.* https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/techssj34&section=16

Choirudin, C., Darmayanti, R., Usmiyatun, U., Sugianto, R., & Ananthaswamy, V. (2021). Mathematics teacher vs. media development, What are the learning problems in MTs? *AMCA Journal of Religion and Society*, *1*(1), 19–24.

Choirudin, C., In'am, A., & Darmayanti, R. (2021). Snakes and ladders:

How do media and RME address the five components of mathematics learning in elementary school? *AMCA Journal of Science and Technology*, *1*(2).

Choirudin, C., Mahmudah, M., Anwar, M. S., Dewi, Y. A. S., & Ningtyas, D. P. (2021). Mathematical Games Using Real-World Approaches Increasing Kindergarten Students' Learning Creativity. *Journal of Childhood Development*, *1*(2), 116–129.

Choirudin, C., Ridho'i, A. V, & Darmayanti, R. (2021). The slidesgo platform is a solution for teaching" building space" in the era of independent learning during the pandemic. *AMCA Journal of Religion and Society*, *1*(2), 47–52.

Cholily, Y. M., Darmayanti, R., Lovat, T., Choirudin, C., Usmiyatun, U., & ... (2023). Si-GEMAS: Serious game mathematical crossword puzzle learning media for students critical thinking ability. *Al-Jabar: Jurnal Pendidikan Matematika*, *14*(1), 165–179.

Darmayanti, R. (2023). Lecturer vs. Practitioner: How is collaborative class assessment for math learning? *Delta-Phi: Jurnal Pendidikan Matematika*, *1*(1), 58–64.

Darmayanti, R., Hidayat, A., da Silva Santiago, P. V, Gunawan, I. I., & Dhakal, A. (2023). Post-Math: An innovative math approach to engage children (Case Studies). *Journal of Teaching and Learning Mathematics*, *1*(1).

Dimyati, A., Fatra, M., Sobirudin, D., & Hafiz, M. (2023). PENGEMBANGAN MEDIA MOTION GRAPHIC PADA MATA KULIAH APLIKASI MATEMATIKA KOMPUTER. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 67–79.

Dwiastuti, G. A., Fatra, M., & Miftah, R. (2022). KEMAMPUAN BERPIKIR KRITIS MATEMATIS SISWA: PENGARUH STRATEGI PEMBELAJARAN ADIS. *ALGORITMA: Journal of Mathematics Education*, *3*(2), 131–143.

Dwirahayu, G., Satriawati, G., Sobiruddin, D., & Fatra, M. (2023). Pendampingan Siswa dan Guru MI dalam Meningkatkan Kualitas Pembelajaran Matematika di Kecamatan Pulosari Kab. Pandeglang-Banten. *Wikrama Parahita: Jurnal Pengabdian Masyarakat*, *7*(2), 217–228.

Ellahi, A., Zaka, B., & Sultan, F. (2017). A study of supplementing conventional business education with digital games. *Journal of Educational Technology &Society*. https://www.jstor.org/stable/26196130

Fatra, M., Darmayanti, R., & Dhakal, A. (2023). A study that uses Card based learning media to help students' mathematical literacy. *Delta-Phi: Jurnal Pendidikan Matematika*, *1*(2), 91–98.

Fauza, M. R., Baiduri, B., Inganah, S., Sugianto, R., & Darmayanti, R. (2023). Urgensi Kebutuhan Komik: Desain Pengembangan Media Matematika Berwawasan Kearifan Lokal di Medan. *Delta-Phi: Jurnal Pendidikan Matematika*, *1*(2), 130–146.

Fauzi, A. U. F., Syauqi, M. L., & Suharsiwi, F. A. (2022). Scientific Integration At Islamic Higher Education In Indonesia. *Journal of Positive School Psychology*, *6*(8), 5960–5976.

Fauzi, F., Asep, U. F., Muhammad, L. S., Suharsiwi, S., & Alim, T. P. (2022). KURIKULUM INTEGRATIF: RESTRUKTURISASI DAN TRANSFIGURASI KURIKULUM INTEGRASI KEILMUAN JABALUL HIKMAH. *Semesta Aksara*.

Fikri, M., Darmayanti, R., & Hussain, N. (2023). How applicable are the KuMo and FiC as teaching tools for mathematics content? *Assyfa Journal of Islamic Studies*, *1*(2).

Fonsén, E. (2019). Early childhood education teachers' professional development towards pedagogical leadership. *Educational Research*, *61*(2), 181–196. https://doi.org/10.1080/00131881.2019.1600377

Galizzi, M. M. (2019). On the external validity of social preference games: A systematic lab-field study. *Management Science*, *65*(3), 976–1002. https://doi.org/10.1287/mnsc.2017.2908

Gunawan, I. I., Darmayanti, R., In'am, A., Vedianty, A. S. A., & Vereshchaha, V. (2023). Clap-Breathe-Count: Using Ice-Breaking Ma-Te-Ma-Ti-Ka to Increase High School Students' Learning Motivation. *Delta-Phi: Jurnal Pendidikan Matematika*, *1*(1), 51–57.

Harwinanda, R. (2018). Influence of Motivation to Result of Cognitive Learning in Intergrated Natural Sciences Model Team Games Tournament (TGT) Assistance by Yugioh Card. *Pedagogi: Jurnal Ilmu Pendidikan*. http://pedagogi.ppj.unp.ac.id/index.php/pedagogi/article/view/426

Jamil, F. M. (2018). Early Childhood Teacher Beliefs About STEAM Education After a Professional Development Conference. *Early Childhood Education Journal*, *46*(4), 409–417. https://doi.org/10.1007/s10643-017-0875-5

Kesäläinen, J. (2022). Children's play behaviour, cognitive skills and vocabulary in integrated early childhood special education groups. *International Journal of Inclusive Education*, *26*(3), 284–300. https://doi.org/10.1080/13603116.2019.1651410

Khoiriyah, B., Darmayanti, R., & Astuti, D. (2022). Design for Development of Canva Application-Based Audio-Visual Teaching Materials on the Thematic Subject" Myself (Me and My New Friends)" Elementary School Students. *Jurnal Pendidikan Dan Konseling (JPDK)*, *4*(6), 6287–6295.

Kurwiyah, N., Anwar, S., Herlinah, L., Suharsiwi, S., Annantusia, A., & ... (2023). Dukungan Keluarga terhadap Pengendalian Hipertensi pada Lansia di Wilayah Rw 10 Kelurahan Utan Panjang Jakarta Pusat. *Jurnal Kreativitas Pengabdian Kepada Masyarakat (PKM)*, *6*(5), 2078–2085.

Kusumaningsih, D., Darmayanti, R., & Latipun, L. (2024). Mendeley Software improves students' scientific writing: Mentorship and training. *Jurnal Inovasi Dan Pengembangan Hasil Pengabdian Masyarakat*, *2*(1).

Laila, A. R. N., In'am, A., & Darmayanti, R. (2022). AKM content: developing a mathematical problem-solving test based on Islamic context at MTs. *AMCA Journal of Religion and Society*, *2*(1).

Latipun, L., Darmayanti, R., & In'am, A. (2022). Designing video-assisted scientific learning in mathematics learning: does it vave an effect? *AMCA Journal of Science and Technology*, *2*(2).

Linsell, L. (2019). Trajectories of behavior, attention, social and emotional problems from childhood to early adulthood following extremely preterm birth: a prospective cohort study. *European Child and Adolescent Psychiatry*, *28*(4), 531–542. https://doi.org/10.1007/s00787-018-1219-8

Majid, N. W. A., & Ridwan, T. (2019). Development of the traditional digital games for strengthening childhood's verbal skill. *Jurnal Pendidikan Vokasi*. https://journal.uny.ac.id/index.php/jpv/article/view/22802

Muassomah, M., Halimi, H., Abdullah, I., Ismail, I., & Zahroh, U. (2023). Coping with Technology: Children's Experience with Learning from Home during the COVID-19 Pandemic. *Asia-Pacific Journal of Research in Early Childhood Education*, *17*(2).

Muddarisna, N., Masruroh, H., Yuniwati, E. D., & Oktaviansyah, A. R. (2021). Coping strategy based on socio-agriculture approach in Landslide Prone Area in the Gede Catchment, Malang Regency. *Development, Social Change and Environmental Sustainability*, 39–43.

Nafisah, S. L., Suharsiwi, S., & Sudin, M. (2023). Teacher Parenting Patterns in Improving Students' Ability to Memorize Al-Qur'an in Tahfidz Elementary School. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *7*(1), 1236–1244.

Noraddin, E. M., & Kian, N. T. (2014). Academics' Attitudes toward Using Digital Games for Learning &Teaching in Malaysia. *Malaysian Online Journal of Educational Technology*. https://eric.ed.gov/?id=EJ1085940

Nurkanti, M. (2010). Pengembangan Program Pembelajaran IPA Biologi Melalui Media "MIVI" Bagi Guru Untuk Meningkatkan Kemampuan Kognitif Siswa SLB-Tunarungu. *Jurnal Pendidikan IPA*, *2010*, 65.

Nurkanti, M., Kurniawan, I. S., Mayangsari, D. A., & Suganda, H. (2020). Meningkatkan Hasil Belajar Siswa Menggunakan Teams Games Tournament (TGT) dan Permainan Hompimpa pada Materi Sel. *Science Education and Application Journal*, *2*(1), 12–21.

Pradana, M. D., & Uthman, Y. O. O.-O. (2023). Development of Aqidah Akhlak Learning Media" Board Game Based on Education Fun on the Theme of Commendable Morals (E-Fun A2M)" for High School Students. *Assyfa Learning Journal*, *1*, 25–36.

Purba, P. R. A., Syam, E., & Salamah, U. (2021). PERANCANGAN SISTEM

KENDALI MANUVER OTOMATIS BERBASIS LOGIKA FUZZY PADA PC-40 GUNA MENGATASI HUMAN ERROR. *Sains, Teknologi Dan Profesi*, *13*.

Rizany, A. K. (2023). Implementation of Card Games as Educational Media for Dental and Oral Health in Elementary School Children: A Literature Review. *Journal of International Dental and Medical Research*, *16*(3), 1323–1326.

Rizki, N., Darmayanti, R., Sugianto, R., & Muhammad, I. (2023). The Effectiveness of Independent Learning on Student Mathematical Learning Outcomes in Online Learning. *Jurnal Dimensi Matematika*, *6*(2), 100–110.

Rizqi, P. A. D., Darmayanti, R., Sugianto, R., Choirudin, C., & Muhammad, I. (2023). Problem Solving Analysis Through Tests in View Of Student Learning Achievement. *Indonesian Journal of Learning and Educational Studies*, *1*(1), 53–63.

Rokhmawati, D., Kirom, N. R., & Yuniwati, E. D. (2022). Gerakan Pemuda Sadar Literasi di Sekitar Kampus Universitas Wisnuwardhana Malang (GEMAR LITERASI). *JAST: Jurnal Aplikasi Sains Dan Teknologi*, *6*(1), 1–10.

Sabirli, Z. E., & Çoklar, A. N. (2020). The Effect of Educational Digital Games on Education, Motivation and Attitudes of Elementary School Students against Course Access. *World Journal on Educational Technology: Current …*. https://eric.ed.gov/?id=EJ1272794

Safitri, E., Setiawan, A., & Darmayanti, R. (2023). Eksperimentasi Model Pembelajaran Problem Based Learning Berbantuan Kahoot Terhadap Kepercayaan Diri Dan Prestasi Belajar. *Jurnal Penelitian Tindakan Kelas*, *1*(2), 57–61.

Salamah, U. (2018). *Desain Pembelajaran Model Comprehensive Performance Improvement Berbasis Seamless Leaming (CPISL) Untuk Pendidikan Vokasi. Teori Praktis*.

Salamah, U., Degeng, I. N. S., Setyosari, P., & Ulfa, S. (2019). Development of Instructional Design Comprehensive Performance Improvement Based on Seamless Learning (CPISL) Model in Vocational College. *International Journal Research Review*, *6*(7), 105–113.

Sandilos, L. (2018). Does professional development reduce the influence of teacher stress on teacher–child interactions in pre-kindergarten classrooms? *Early Childhood Research Quarterly*, *42*, 280–290. https://doi.org/10.1016/j.ecresq.2017.10.009

Sarter, M. (2018). The neuroscience of cognitive-motivational styles: Sign-and goal-trackers as animal models. *Behavioral Neuroscience*, *132*(1), 1–12. https://doi.org/10.1037/bne0000226

Schachter, R. E. (2019). Guidelines for Selecting Professional Development for Early Childhood Teachers. *Early Childhood Education Journal*, *47*(4), 395–408. https://doi.org/10.1007/s10643-019-00942-8

Sefira, R., Setiawan, A., Hidayatullah, R., & Darmayanti, R. (2024). The Influence of the Snowball Throwing Learning Model on Pythagorean Theorem Material on Learning Outcomes. *Edutechnium Journal of Educational Technology*, *2*(1), 1–7.

Setiyanti, A., Basit, A., & Suharsiwi, S. (2022). Observation and Improvement to Undergraduate Student Activities in English Skill Using Mobile-Assisted Language Learning. *English Language in Focus (ELIF)*, *4*(2), 137–148.

Simorangkir, V. O., Muchlis, N., Salamah, U., & Trijurini, A. (2022). KONSEPSI PENGGUNAAN AUV SEBAGAI UNDERWATER SURVEILLANCE GUNA MENINGKATKAN KEAMANAN BAWAH AIR DI ALKI. *Saintek: Jurnal Sains Teknologi Dan Profesi Akademi Angkatan Laut 15 (2 …*.

Subrahmanyam, K., & Renukarya, B. (2015). Digital games and learning: Identifying pathways of influence. *Educational Psychologist*. https://doi.org/10.1080/00461520.2015.1122532

Sugianto, S., Darmayanti, R., & Sah, R. W. A. (2023). Word square english learning media design assisted by the Canva application. *Bulletin of Educational Management and Innovation*, *1*(1), 1–16.

Suharsiwi, Imanto, B., & Nugroho. (2018). Determination Of Workforce Cultural Diversity. *Competence, And Employee Emotional Intelligence On Teamwork With Motivation …*.

Supriatna, I., Sopa, S., Bahri, S., & Suharsiwi, S. (2023). Nilai-nilai Pendidikan Akhlak dalam Kitab Bulūg Al-marām min Adillah Al-aḥkām Karya Ibnu Ḥajar Al-asqalānī dan Relevansinya dengan Pendidikan Karakter. *Misykat Al-Anwar Jurnal Kajian Islam Dan Masyarakat*, *6*(1), 35–52.

Suyadi. (2020). Early childhood education teachers' perception of the integration of anti-corruption education into islamic religious education in bawean island Indonesia. *Elementary Education Online*, *19*(3), 1703–1714. https://doi.org/10.17051/ilkonline.2020.734838

Triono, T., Darmayanti, R., & Saputra, N. D. (2023). Vos Viewer and Publish or Perish: Instruction and assistance in using both applications to enable the development of research mapping. *Jurnal Dedikasi*, *20*(2).

Usmiyatun, U., Darmayanti, R., Safitri, N. D., & Afifah, A. (2021). Cognitive style, thinking ability, mathematical problems, how do students solve open-ended problems? *AMCA Journal of Science and Technology*, *1*(2).

Usmiyatun, U., Sah, R. W. A., & Darmayanti, R. (2023). Design Development of Audiovisual Teaching Materials for Canva Application-based Reading Skills in Early Childhood. *Caksana Journal: Early Childhood Education*, *4*(1), 1–12.

Vahter, M. (2020). Prenatal and childhood arsenic exposure through drinking water and food and cognitive abilities at 10 years of age: A prospective cohort study. *Environment International*, *139*. https://doi.org/10.1016/j.envint.2020.105723

Vedianty, A. S. A., Darmayanti, R., Lestari, A. S. B., Rayungsari, M., & ... (2023). What is the need for" UBUR-UBUR GABUT" media and its urgency in high school mathematics learning. *Assyfa International Scientific Journal*, *1*(1).

Vedianty, A. S. A., Nurhayati, D., Darmayanti, R., & Lestari, A. S. B. (2022). MANIS: Mathematics, analysis, and mathematical communication. How is the student's self-confidence? *AMCA Journal of Education and Behavioral Change*, *2*(2).

Wang, X. (2022). Childhood unpredictability, life history, and intuitive versus deliberate cognitive styles. *Personality and Individual Differences*, *184*. https://doi.org/10.1016/j.paid.2021.111225

Wati, R. I., Suharsiwi, S., & Sah, R. W. A. (2023). Siswa sekolah dasar menggunakan game "new family 100" untuk mengembangkan vocabulary, bagaimana kegiatan implementasinya? *Jurnal Penelitian Tindakan Kelas*, *1*(2).

Wicaksono, G. W., Nawisworo, P. B., Wahyuni, E. D., & Cholily, Y. M. (2021). Canvas learning management system feature analysis using feature-oriented domain analysis (FODA). *IOP Conference Series: Materials Science and Engineering*, *1077*(1), 12041.

Wilson, H. E. (2015). Social and Emotional Characteristics and Early Childhood Mathematical and Literacy Giftedness: Observations from Parents and Childcare Providers Using the ECLS-B. *Journal for the Education of the Gifted*, *38*(4), 377–404. https://doi.org/10.1177/0162353215607323

Zahroh, U., Hadi, S., Fatra, M., & Inâ, A. (2022). ANALISIS KESULITAN MAHASISWA MENYELESAIKAN SOAL INTEGRAL DI ERA PANDEMI COVID-19. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 2678–2686.

Zahroh, U., Maghfiroh, W., Darmayanti, R., & Hidayat, A. (2023). Innovation in mathematics education for high school students using small group discussion as a case study. *Assyfa Journal of Farming and Agriculture*, *1*(1), 8–14.

Zainuddin, M. (2023). Development of Game-Based Learning Media on Islamic Religious Education Materials. *Nazhruna: Jurnal Pendidikan Islam*, *6*(1), 13–24. https://doi.org/10.31538/nzh.v6i1.2824