AKSIOMA: Jurnal Program Studi Pendidikan Matematika
Volume 14, No. 3, 2025, 676–686

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

DEVELOPMENT OF PAMUSI ONLINE GAME MEDIA IN MATHEMATICS LEARNING FOR 4TH GRADE ELEMENTARY SCHOOL STUDENTS

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Received 06 August 2023; Received in revised form 16 November 2023; Accepted 22 July 2025

Abstract

The research started from the problem of online learning which requires learning media to motivate students to increase their interest in learning. Researchers developed mathematics learning media based on the online game PAMUSI on the material Lowest Common Multiple (LCM) and Greatest Common Factor (GCF). This research aims to find out the influence and feasibility of the PAMUSI online game media on GCF and LCM material in class IV at Tegalpanggung Elementary School. The research method uses Research and Development (RnD) with the ADDIE development model. The stages in this research include analysis, design, development, implementation and evaluation. The subjects of this research were fourth grade students at Tegalpanggung Elementary School. Data collection techniques use interviews, observation, and literature study. The analysis used is qualitative descriptive analysis. The results of the validator research showed that the PAMUSI online game learning media was suitable for use to increase interest in learning. The results of material validation obtained an average score of 4.3 in the "very good" category and media validation obtained an average score of 4.95 in the "very good" category. Limited field trials obtained an average score of 2.86 from student responses using the reference scale of three N-Gain formulas in the "high" category and an average score of 3.98 from teacher responses using four scale conversions in the "very" category. good category". This learning media motivates students to learn mathematics independently, especially HCF and LCM material because students are more challenged by playing PAMUSI online game-based learning media.

Keywords: ADDIE; mathematics learning; media development.

Abstrak

Penelitian berawal dari permasalahan pembelajaran daring yang memerlukan media pembelajaran untuk memotivasi siswa dalam meningkatkan minat belajar. Peneliti mengembangkan media pembelajaran matematika berbasis game online PAMUSI pada materi Kelipatan Persekutuan Terendah (KPK) dan Faktor Persekutuan Tertinggi (FPB). Penelitian ini bertujuan untuk untuk mengetahui bagaimana pengaruh dan kelayakan media game online PAMUSI pada materi FPB dan KPK di kelas IV SD Tegalpanggung. Metode penelitian menggunakan Research and Development (RnD) dengan model pengembangan ADDIE. Tahapan dalam penelitian ini meliputi analisis, desain, pengembangan, implementasi, dan evaluasi. Subyek penelitian ini adalah siswa kelas IV SD Tegalpanggung. Teknik pengumpulan data menggunakan wawancara, observasi, dan studi literatur. Analisis yang digunakan adalah analisis deskriptif kualitatif. Hasil penelitian validator diperoleh hasil bahwa media pembelajaran game online PAMUSI layak digunakan ntuk meningkatkan minat belajar. Hasil validasi materi memperoleh skor rata-rata 4,3 dengan kategori "sangat baik" dan validasi media memperoleh skor rata-rata 4,95 dengan kategori "sangat baik". Uji coba lapangan terbatas memperoleh skor rata-rata sebesar 2,86 dari respon siswa dengan menggunakan skala acuan tiga rumus N-Gain pada kategori "tinggi" dan skor rata-rata sebesar 3,98 dari respon guru dengan konversi empat skala pada kategori "sangat kategori baik". Media pembelajaran ini memotivasi siswa untuk belajar matematika secara mandiri khususnya materi FPB dan KPK dikarenakan siswa lebih tertantang memainkan media pembelajaran berbasis game online PAMUSI.

***Kata kunci**: ADDIE; pembelajaran matematika; pengembangan media.*

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

INTRODUCTION

The rapid advancement of information and communication technology has not only reshaped educational landscapes in general but also opened new possibilities for designing inclusive and engaging learning experiences in elementary education (Kamid, 2025). Today's students grow up in a digital era that allows them to access various learning resources through the internet, such as e-books, instructional videos, and online platforms like Google Classroom and Ruangguru. This phenomenon raises the need to adapt teaching strategies to the characteristics of 21st-century students who are familiar with digital devices (Liu, Sun, Sun, Wang, & Yu, 2025). At the elementary school level, students are in a stage of play and exploration (Zosh et al., 2018). Therefore, it is essential for teachers to deliver engaging and contextual learning experiences to maintain students' motivation and improve learning outcomes (Conesa, Onandia-Hinchado, Duñabeitia, & Moreno, 2022).

Various studies have been conducted to utilize digital media in mathematics learning to enhance students' achievement and interest. Purba et al. (2021) stated that Contextual and interactive digital learning media, particularly when combined with structured methods like drill and practice, can significantly enhance students' conceptual under-standing and foster deeper engagement with mathe-matical content. Research by Hilton et al., (2019), also showed that students tend to be more focused when learning involves engaging software-based media. Moreover, Panjaitan et al., (2022), developed interactive game-based learning media in the form of software that facilitates students' understanding of abstract mathematical concepts in a more concrete and enjoyable way.

Ayu et al., (2021) stated that although various learning media have been developed, there are still shortcomings in using media that specifically integrate game elements with basic mathematics topics such as Greatest Common Factor (GCF) and Least Common Multiple (LCM). Previous studies have mostly focused on the use of video media, Power Point presentations, and conventional task-based learning (Rambe, Musdi, Suherman, & Asmar, 2024). The limited development of interactive and contextual game-based media for GCF and LCM material remains a gap at the elementary school level. In fact, GCF and LCM are abstract concepts that require visual and kinesthetic approaches to be more easily understood by students (Makmur, Andayani, & Sufaidah, 2023).

Based on a preliminary study conducted in an elementary school, it was found that mathematics instruction on GCF and LCM is still carried out conventionally, even though it is supported by media such as videos and Google Classroom. Students were not actively involved in the learning process, showed little enthusiasm, and rarely asked questions. The interaction between teachers and students was not optimal, causing students to merely complete tasks without understanding the concepts being taught. This resulted in low learning outcomes, where 15 out of 20 students scored below the minimum passing grade of 62.3. Students perceived mathematics as difficult and boring, particularly due to challenges in understanding multiplication and division, which are fundamental to GCF and LCM material (Purwaningtyas, Sary, & Artharina, 2020).

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

Given these issues found in elementary schools, there is a need to develop learning media that can bridge the gap between students' abilities and learning needs. One proposed alternative is an interactive online game-based media called PAMUSI, designed to help students understand GCF and LCM concepts through an educational game-based approach. This media is web-based for easy access and features interactive components such as a number board, a choice between GCF or LCM topics, and visual displays that follow the multiples or factors of a number, making it easier for students to learn independently or collaboratively.

The researcher believes that the PAMUSI online game media can assist students in understanding the concepts of GCF and LCM. Research by Bu & Ding, (2024) stated that during mathematics learning, teachers used online educational games available on the internet. Students became more active and enthusiastic about the material being presented. Therefore, the objective of this study is to develop and produce a valid, practical, and effective PAMUSI media to improve learning outcomes on GCF and LCM material.

METHODS

Based on the established objectives, the research design used in this study is Research and Development (R&D). Research and development is a scientific method aimed at producing a specific product and testing the effectiveness of that product (Sasmito, Zahro' & Wahyuni, 2022). The R&D method is selected because as shown by Hamidah Ida (2024) it supports the systematic and iterative development of educational games like PAMUSI, allowing for ongoing refinement based on user feedback and expert validation to ensure the media is pedagogically effective, engaging, and aligned with students' mathematical literacy needs.

The product developed in this study is an online game-based learning media that can be accessed through web-based devices. The development model used refers to the ADDIE model developed by Branch, (2010) which consists of five main stages, namely:

1. Analysis Stage: In this stage, the learning needs, student characteristics, and subject matter that are considered difficult to understand—particularly the topics of Greatest Common Factor (GCF) and Least Common Multiple (LCM)—are identified.
2. Design Stage: At this stage, the initial design of the media is created, including content selection, interactive features, user interface design, and the preparation of research instruments such as validation questionnaires and observation sheets.
3. Development Stage: This stage involves the actual creation of the online game-based learning media PAMUSI based on the previous design, as well as the development of assessment and validation instruments.
4. Implementation Stage: The developed product is then tested through three stages: expert validation, initial field testing, and main field testing.
5. Evaluation Stage: Evaluation is carried out both formatively and summatively through the results of validation, teacher and student responses, and the improvement in student learning outcomes using the N-Gain test.

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

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The subjects of this study were 30 fourth-grade students from SD Negeri Tegalpanggung in Yogyakarta City. The initial field test involved 10 students, while the main field test involved 20 students.

The instruments used in this study were developed to ensure the validity and reliability of the data collected during the development and testing of the PAMUSI online game-based learning media. The primary instruments included validation questionnaires for media and material experts, observation sheets, and response questionnaires for teachers and students.

The validation instruments for experts were constructed using indicators aligned with standard evaluation criteria: for media experts, indicators assessed aspects such as technical quality, visual appeal, ease of navigation, and interactivity; for material experts, indicators covered content accuracy, relevance to the curriculum, clarity of concepts (particu-larly LCM and GCF), and pedagogical alignment. The assessment was conducted using a Likert scale with a score range of 1–5 (Taherdoost, 2019). These scores were then converted into qualitative data based on the categories in Table 1.

Table 1. Data Conversion

Quantitative Data	Mean Score	Qualitative Data
5	>4.2	Excellent
4	>3.4 – 4.2	Good
3	>2.6 – 3.4	Fair
2	>1.8 – 2.6	Poor
1	≤1.8	Very Poor

Teacher and student response questionnaires measured engagement, usability, and perceived usefulness of the media, with items rated on a Likert scale, four-point for teachers. Each set of indicators was designed to capture both qualitative and quantitative feedback, which was then converted into categorical interpretations (Excellent, Good, Fair, etc.) to determine the feasibility and effectiveness of the product. The results were converted into qualitative data based on the average score, as shown in Table 2.

Table 2. Data Conversion scale 1–4

Quantitative Data	Mean Score	Qualitative Data
4	$X \geq 3$	Excellent
3	$3 > X \geq 2.5$	Good
2	$2.5 > X \geq 2$	Poor
1	$X < 2$	Very Poor

To determine the effectiveness of the media in improving student learning outcomes, an N-Gain test was applied to the pretest and posttest scores of the fourth-grade students. The analysis was conducted descriptively using the following formula.

$$\text{N} - \text{Gain} = \frac{\text{postest score} - \text{pretest score}}{\text{score max} - \text{score min}} \quad (1)$$

The results of the N-Gain test were classified according to Table 3.

Table 3. N-Gain Classification

N-Gain Value (G)	Classification
N-Gain ≥ 0.7	High
0.3 ≤ N-Gain < 0.7	Medium
N-Gain < 0.3	Low

The PAMUSI learning media will be declared suitable for use if the validation results from media experts, material experts, teachers, and students fall within at least the "Excellent" category in all assessment aspects.

RESULTS AND DISCUSSION

The media developed in this study is the PAMUSI online game, which focuses on Greatest Common Factor (GCF) and Least Common Multiple

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

(LCM) material. The development followed the Research and Development (RnD) model, and this section presents the results of the development based on the instruments used.

The analysis results revealed that teachers encountered significant challenges during online learning, particularly in presenting abstract mathematical concepts such as GCF and LCM. Interviews and observations indicated that commonly used media lacked interactivity and failed to engage students meaningfully. This feedback informed the need for an online game that could visualize number relationships and support collaborative learning.

The design outcomes resulted in the creation of the PAMUSI online game using the React framework. The game interface was built with clear navigation and interactive elements. It includes an instructional section, interactive checkered icons displaying numbers for students to select, and pages guiding students through finding factors and multiples using numbers from 2–100. The system also generates automatic feedback, including visual conclusions and symbols to represent student understanding of GCF and LCM concepts.

In the development stage, the results included successful implementation of the game interface and content, followed by expert validation.

The validation process used an instrument adapted from the Ministry of National Education, evaluating three aspects: content feasibility, language, and presentation. The results indicated that the material met quality standards across all three categories. The content feasibility received high ratings for its alignment with the curriculum and conceptual clarity. The language was considered age-appropriate and communicative. The presentation was appreciated for its structured, interactive, and visually engaging design. A graphical representation of the expert validation results is shown in the Figure 1.

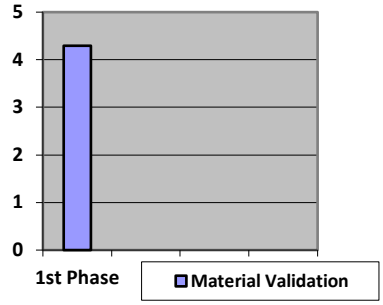

Figure 1. Material validation results

Based on the graph above, the validation results from material experts showed a total score of 65 with an average rating of 4.3. These results indicate that the PAMUSI Online Game media product falls into the "very good" category in terms of content validity and instructional quality.

Media expert validation was conducted using an instrument adapted from Arsyad, (2017), which evaluates media based on three main aspects: quality, effectiveness, and programming. The validation process was carried out in two phases to ensure consistency and improvements based on feedback. The results of the validation process, as shown in the subsequent graph (Figure 1), indicate that the media product meets the expected standards. The evaluators noted strengths in user interface design, functionality, and ease of use. The average score obtained places the media in the "very good" category, confirming that the PAMUSI Online Game is feasible for use in mathematics learning, especially for teaching GCF and LCM concepts interactively.

AKSIOMA: Jurnal Program Studi Pendidikan Matematika
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ISSN 2089-8703 (Print)
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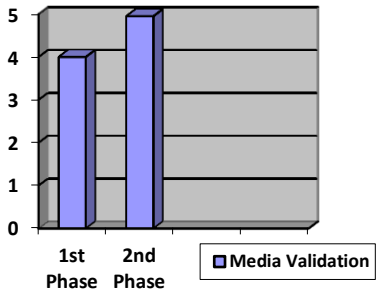

Figure 2. Media Validation Result

The first stage of media expert validation yielded a total score of 80 with an average rating of 4.0, placing the PAMUSI Online Game media product in the "very good" category. However, the media experts provided several suggestions for revision to enhance the quality and user experience of the media. The recommended improvements included:

1. Reconsideration of background color selection to improve visual comfort.
2. Clarification of game instructions to ensure better user understanding.
3. Review of illustrations or character images, particularly regarding clothing appropriateness.
4. Improved text alignment and tidiness for better readability.
5. Use of more varied text colors to distinguish different sections and enhance engagement.

After implementing the suggested revisions, the second stage of validation was conducted. This phase resulted in a total score of 99 with an average of 4.95, maintaining the media in the "very good" category. Based on the second validation outcome, it can be concluded that the PAMUSI Online Game media is valid and of high quality, and is ready for field testing without further revisions from media experts.

Figure 3. PAMUSI Online Game Homepage

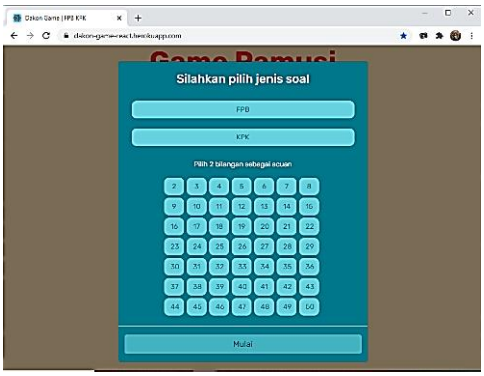

Figure 4. GCF and LCM Search Pages

Figure 5. Number Factor Page

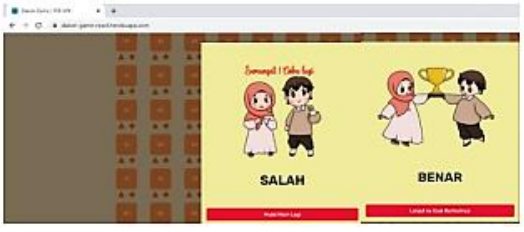

Figure 6. Awards Page

The fourth stage of the research was the implementation phase, where the researchers conducted a field test to

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

assess the performance of the PAMUSI online game media. The field test was conducted once through a limited trial involving 10 fourth-grade students from SD Negeri Tegalpanggung. The sample was purposefully selected to represent students with diverse academic abilities, including both high-achieving and slow learners.

At this stage, the researchers administered both feasibility and effectiveness tests. The feasibility test was carried out by both students and a teacher using different instruments. The students' feasibility test yielded a total score of 344 with an average score of 2.86 (on a scale of 3). When analyzed using the N-Gain criteria, this score falls into the "high" category, indicating that students found the media feasible and beneficial for learning.

The teacher's feasibility test, evaluated using the Mardapi conversion scale (1–4), produced a total score of 47.5 with an average of 3.95. Based on the conversion guidelines, this score falls into the "very good" category, signifying that the media is considered highly feasible and appropriate for classroom use.

To determine the effectiveness of the PAMUSI online game, the researchers also conducted pre-tests and post-tests with the students during the field implementation. The comparative results of these tests are illustrated in the following graph (Figure 7), demonstrating a measurable improvement in students' understanding of GCF and LCM concepts after using the developed media.

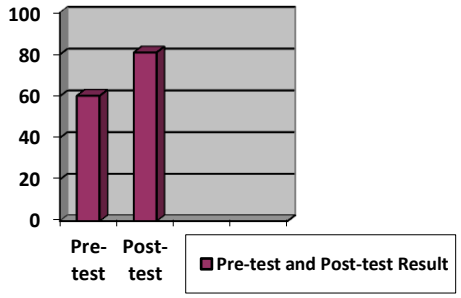

Figure 7. Pre-test and Post-test Result

Based on the results of the pre-test and post-test administered to students, the effectiveness of the PAMUSI online game media was measured using the N-Gain test. The analysis produced an N-Gain score of 0.69, which falls into the "medium" effectiveness category. These results indicate a significant improvement in students' understanding of GCF and LCM concepts after using the PAMUSI online game media compared to before its implementation.

The fifth stage of the research was the evaluation phase, involving inputs from material experts, media experts, students, and teachers. Experts evaluated the product to identify any deficiencies in both content and media aspects. Their feedback was used by the researchers to revise and enhance the media product. Meanwhile, students and teachers contributed feedback during field testing to determine the feasibility and acceptability of the media. Overall, their responses supported the continued use and development of the PAMUSI online game.

The results of this study indicate that the PAMUSI online game media has proven effective in enhancing students' understanding of Greatest Common Factor (GCF) and Least Common Multiple (LCM). This conclusion is supported by quantitative data from the N-Gain test, which shows a moderate category increase (0.69),

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

and qualitative data from student and teacher feasibility questionnaires, which rated the media in the "very good" category. The implication of this result suggests that PAMUSI can serve as an effective digital alternative for mathematics learning, especially during online or remote instruction.

A core finding of this research is that interactive, web-based visual media like PAMUSI can significantly increase student engagement and conceptual mastery in abstract mathematical topics such as GCF and LCM. This is largely because PAMUSI presents mathematical operations through visual interaction, symbolic feedback, and gamified tasks, which align with the cognitive needs of elementary school students.

Several factors contributed to the success of this media. First, the use of child-friendly visuals and interactive elements (e.g., clickable number icons, immediate feedback through character images) created a learning experience that was both meaningful and enjoyable. Second, the accessibility via web browser on smartphones or laptops allowed students to engage with the media anytime and anywhere. Third, the instructional design embedded in the media guided students through learning steps logically and consistently, reinforcing understanding through exploration and trial-error.

Despite these strengths, there are also limitations in this study. The field test was limited to only ten students. Additionally, the media was only tested on a single topic within mathematics, which limits its scope. Future research should expand both the sample size and content coverage to further validate the effectiveness of PAMUSI.

When compared with previous research, this study's results are in alignment with the findings of Nesri & Kristanto, (2020), who state that media can support student motivation, enhance conceptual understanding, and offer diverse learning methods. Similarly, Hidayat et al., (2019) emphasized that visual and modern media, when integrated effectively, can stimulate students' sensory processing and engagement. The positive validation scores in this study are also consistent with prior development studies that report high user satisfaction and learning impact when digital game-based learning tools are implemented (Wulandari & Oktaviani, 2021)

The contribution of this research lies in the design and validation of a contextual, curriculum-aligned, and web-based learning media that bridges the gap between digital tools and mathematics instruction in primary education. This study supports the broader pedagogical claim that gamified and visual media can be both instructionally sound and motivational for learners in the digital era.

From a practical standpoint, the PAMUSI online game provides an innovative approach to online learning, particularly in remote or hybrid learning conditions. It shows potential for scaling up in classroom settings with improved infrastructure and teacher training. Furthermore, this research contributes to the field of media development in mathematics education, offering a model that can be replicated or adapted for other topics or grade levels.

CONCLUSIONS AND SUGGESTIONS

PAMUSI media is concluded to be a feasible and effective media for improving student understanding of GCF and LCM. It is hoped that educators and developers integrate

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

PAMUSI online game media as a supplementary learning tool in both face-to-face and distance learning contexts to enrich students' learning experiences, especially in mathematics.

For future researchers, further development of the media is encouraged, especially by expanding the scope of materials beyond FPB (GCF) and KPK (LCM), such as fractions, geometry, or problem-solving strategies, to accommodate broader curriculum goals. From a technological standpoint, future research may explore mobile-optimized or offline-access versions of PAMUSI to support students in low-internet-access regions. In terms of evaluation, subsequent studies could employ experimental or quasi-experimental designs to more rigorously assess the impact of PAMUSI media on learning outcomes across different student populations and school contexts.

REFERENCES

Arsyad, A. (2017). *Media Pembelajaran* . Jakarta: PT Raja Grafindo Persada .

Ayu, S., Ardianti, S. D., & Wanabuliandari, S. (2021). Analisis Faktor Penyebab Kesulitan Belajar Matematika. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(3), 1611–1622. doi:10.24127/ajpm.v10i3.3824

Branch, R. M. (2010). *Instructional design: the ADDIE approach.* Springer US. Retrieved from https://doi.org/10.1007/978-0-387-09506-6

Bu, L., & Ding, B. (2024). A comparative study of online gaming between high-performing and low-performing students—A case from China. *Heliyon*, *10*(2). doi:10.1016/j.heliyon.2024.e24291

Conesa, P. J., Onandia-Hinchado, I., Duñabeitia, J. A., & Moreno, M. Á. (2022, August 1). Basic psychological needs in the classroom: A literature review in elementary and middle school students. *Learning and Motivation*. Academic Press Inc. doi:10.1016/j.lmot.2022.101819

Hamidah Ida, Z. P. R. I. I. P. S. A. (2024). View of Developing a Mathematical Literacy Learning Environment for Students through Educational Game Assistance. *Jurnal Pendidikan Matematika*, *19*(1), 141–162. doi:https://doi.org/10.22342/jpm.v19i1.pp141-162

Hidayat, M., Syahputra, E., & Napitupulu, E. E. (2019). The Development of Learning Media Based on Problem by Using Rubu' Al-Mujayyab Media. *Education Quarterly Reviews*, *2*(1). 198– 209. doi:10.31014/aior.1993.02.01.53

Hilton, J., Larsen, R., Wiley, D., & Fischer, L. (2019). Substituting open educational resources for commercial curriculum materials: effects on student mathematics achievement in elementary schools. *Research in Mathematics Education*, *21*(1), 60–76. doi:10.1080/14794802.2019.1573150

Kamid, A. K. (2025). View of Enhancing Learning Experiences and Outcomes Using Virtual

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

Media for Children with Autism Spectrum Disorders. *Jurnal Pendidikan Matematika*, *19*(2), 197–216. doi:https://doi.org/10.22342/mej.v19i2.pp197-216

Liu, J., Sun, D., Sun, J., Wang, J., & Yu, P. L. H. (2025). Designing a generative AI enabled learning environment for mathematics word problem solving in primary schools: Learning performance, attitudes and interaction. *Computers and Education: Artificial Intelligence*, *9*. doi:10.1016/j.caeai.2025.100438

Makmur, F., Andayani, S., & Sufaidah, V. A. A. (2023). The Development Gematika as a Website-Based Mathematics Learning Media on Comparison Materials. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 535–546. doi:10.24127/ajpm.v12i1.6233

Nesri, F. D. P., & Kristanto, Y. D. (2020). Pengembangan Modul Ajar Berbantuan Teknologi untuk Mengembangkan Kecakapan Abad 21 Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(3), 480–492. doi:10.24127/ajpm.v9i3.2925

Panjaitan, D. J., Ridwan, M., & Aprilia, R. (2022). Pengembangan Media Pembelajaran Berbasis Website Untuk Meningkatkan Motivasi Belajar Siswa Pada Masa Pandemi Covid-19. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(2), 1524–1536. doi:10.24127/ajpm.v11i2.4875

Purba, H. S., Sukmawati, A., Wiranda, N., Suryaningsih, Y., & Aprilian, R. (2022). View of Developing Wetland Contextual Interactive Learning Media on Numbers Using Drill and Practice Method. *Jurnal Pendidikan Matematika*, *16*(1), 45–56. https://doi.org/10.22342/jpm.16.1.14153.45-56

Purwaningtyas, B. A., Sary, R. M., & Artharina, F. P. (2021). Analysis of Misconceptions in FPB and KPK Material for Students. *International Journal of Elementary Education*, *4*(4), 596–604. https://doi.org/10.23887/ijee.v4i4.29277

Rambe, W. A., Musdi, E., Suherman, S., & Asmar, A. (2024). Pengembangan Video Interaktif Menggunakan Model Contextual Teaching And Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(2), 394–405. doi:10.24127/ajpm.v13i2.8538

Sasmito, A. P., Zahro', H. Z., & Wahyuni, F. S. (2022). Effectiveness of chain whispering learning method assisted by online chat messaging. *International Journal of Evaluation and Research in Education*, *11*(4), 1808–1817. doi:10.11591/ijere.v11i4.23202

Taherdoost, H. (2019). What Is the Best Response Scale for Survey and

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v14i3.8531

Questionnaire Design; Review of Different Lengths of Rating Scale / Attitude Scale / Likert Scale. *International Journal of Academic Research in Management (IJARM)*, *8*(1), 1-10. https://ssrn.com/abstract=3588604

Wulandari, I., & Oktaviani. N. M. (2021). Validitas Bahan Ajar Kurikulum Pembelajaran. *Jurnal Cakrawala Pendas*, *7*(1), 90-98. doi:http://dx.doi.org/10.31949/jcp.v6i1.2456

Zosh, J. M., Hirsh-Pasek, K., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., … Whitebread, D. Accessing the inaccessible: Redefining play as a spectrum. *Frontiers in Psychology*. Frontiers Media S.A. doi:10.3389/fpsyg.2018.01124