Al-Bidayah : jurnal pendidikan dasar Islam
Volume 17 Number 1, June 2025
ISSN: 2549-3388 (online)
Available online at https://ejournal.uin-suka.ac.id/tarbiyah/albidayah
Submitted: May 25, 2025, Accepted: June 30, 2025

Development of *Extreme Addition Mathematics* Media to Improve Counting Skills of Madrasah Ibtidaiyah Students

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DOI: 10.14421/al-bidayah.v17i1.11124

Abstract

Low numeracy skills remain a persistent challenge in primary education, particularly in Madrasah Ibtidaiyah (MI), where students often struggle with basic arithmetic operations such as addition. This study aims to develop Extreme Addition Mathematics media to enhance the counting skills of fourth-grade Madrasah Ibtidaiyah (MI) students and evaluate its effectiveness. The research employed the Research and Development (R&D) method, guided by the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The media was validated by material, media, and learning experts using Aiken's V coefficient, with results of 0.87 (material), 0.91 (media), and 0.89 (learning), all exceeding the 0.75 threshold, confirming its validity. Implementation involved 57 students divided into an experimental group (n=29) using the media and a control group (n=28) with conventional methods. Pretest and posttest data were analysed using Shapiro-Wilk normality tests, Levene's homogeneity test, and independent t-tests. The experimental group showed a significant improvement, with posttest scores increasing from 40.72 to 86.90, compared to the control group's 49.40 to 72.79. The N-Gain score for the experimental group was 77.4%, categorised as "effective." Findings indicate that gamified, interactive media significantly enhance students' engagement and mastery of addition operations. The study concludes that Extreme Addition Mathematics is a practical and effective tool for improving numeracy skills, aligning with constructivist principles and addressing challenges in conventional teaching methods. Recommendations include expanding the media for other mathematical operations and adapting it to digital platforms for broader applicability.

Keywords: counting skills improvement; extreme addition mathematics media; madrasah ibtidaiyah; research and development

Introduction

Twenty-first-century education emphasises the importance of numeracy and literacy as essential skills for all students. Numeracy not only plays a critical role in understanding mathematical concepts but also supports decision-making, data analysis, and problem-solving in everyday life (Goos & O'Sullivan, 2023). A foundational component of numeracy literacy is counting ability, particularly addition operations, which underpin more advanced mathematical thinking (Hornburg et al., 2024; Putriana & Haqiqi, 2023). However, numerous studies have documented that many elementary students, especially those in Madrasah Ibtidaiyah (MI), continue to struggle with basic arithmetic, demonstrating inaccuracy and low computational fluency (Irwan & Masrul, 2023).

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To address these challenges, innovative and engaging teaching strategies are needed to reinforce foundational skills in a way that is effective and contextually relevant. Numeracy skills are not only key to understanding higher-level concepts such as algebra and geometry (Algebraic, 2023), but they also strengthen logic, critical thinking, and daily decision-making (Fauzi et al., 2024; S. A. Putri et al., 2024; Siti, 2023). The integration of interactive learning media, particularly those based on gamification and augmented reality (AR), has shown promising results in increasing student engagement and achievement. For instance, studies have found that the use of AR-based mathematics media significantly improves students' literacy and problem-solving performance, with average N-Gain scores reaching 0.67 to 0.85 (Ahmad & Khan, 2024; Sriyanti et al., 2024).

Complementing this line of inquiry, several studies have highlighted the value of experiential and contextual learning environments, such as outdoor classroom approaches, in enhancing student numeracy. Sievert et al. (2019) found that embedding mathematics instruction in outdoor settings fosters deeper understanding through real-world context and active engagement. Fatchurahman et al. (2022) further contributed by developing animation-based learning media inspired by outdoor learning principles, which improved motivation and conceptual clarity. Sumilat (2022) identified significant improvements in students' arithmetic skills through the use of online media designed around real-life contexts, reinforcing the role of interactive and meaningful instruction. Nevertheless, Laksana et al. (2024) cautioned that practical challenges such as limited infrastructure, teacher readiness, and rigid curricula often constrain the implementation of such innovative approaches.

Despite its potential, the dominant use of conventional teaching methods remains a barrier. Research by Mahmud & Pratiwi (2019) found that grade IV MI students often struggle with addition involving large numbers due to shallow conceptual understanding. Contributing factors include the absence of interactive visual aids and students' perception of mathematics as abstract and uninteresting(Mahmud & Pratiwi, 2019; Prabhu, 2022; Soewardini et al., 2020). Preliminary studies at MIS Ma'arif Asas Islam Kalibening in January 2025 confirm this, showing that only 40% of 28 fourth-grade students achieved the minimum competency standard (KKTP). Interviews with teachers revealed a reliance on lectures and worksheets, with minimal use of stimulating or concrete learning tools (Ulya, 2024).

To make learning more effective and meaningful, especially for students who find mathematics difficult, media that combines game mechanics and interactive visuals is very useful. The gamification and AR approaches not only increase student engagement but also help instil cognitive skills, such as students' numeracy skills. Through challenge-based activities, immediate feedback, and collaborative tasks, students can experience the value of persistence, teamwork, and integrity (Kovalenko & Skvortsova, 2022; Solekhah et al., 2023).

One such innovative approach is the development of “Extreme Addition Mathematics” media. This interactive tool integrates progressive challenge-based games with counting exercises involving tens to hundreds, supporting speed, accuracy, and deeper understanding. It includes immediate feedback mechanisms, facilitating students’ reflection on errors and reinforcing procedural fluency (Gumulya & Suhanto, 2023). In addition, the structured levels in this program gradually increase in difficulty, encouraging a high level of curiosity about the challenges of the next exercise.

This research applies the ADDIE (Analyse, Design, Development, Implementation, Evaluation) model combined with user-centred design principles Branch & Varank, 2009) to produce valid and effective instructional media. With the title "Development of Extreme Addition Mathematics Media to Improve Counting Skills of Madrasah Ibtidaiyah Students," the study aims to address the numeracy gap among MI students and provide practical solutions for teachers. The findings are expected to inform broader educational strategies for enhancing numeracy.

Research Methods

This study employed the Research and Development (R&D) method with the aim of developing and testing the effectiveness of the “Extreme Addition Mathematics” media. According to Sugiyono (2019), R&D is a systematic method for creating and validating educational products, including instructional strategies, software, and multimedia tools. The development followed the ADDIE instructional design model, which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Rusdi et al., 2022). The model was chosen for its structured approach in ensuring the final product meets user needs (Adeoye et al., 2024). The media was

designed using Canva, a platform that supports intuitive visual communication (Samosir et al., 2023).

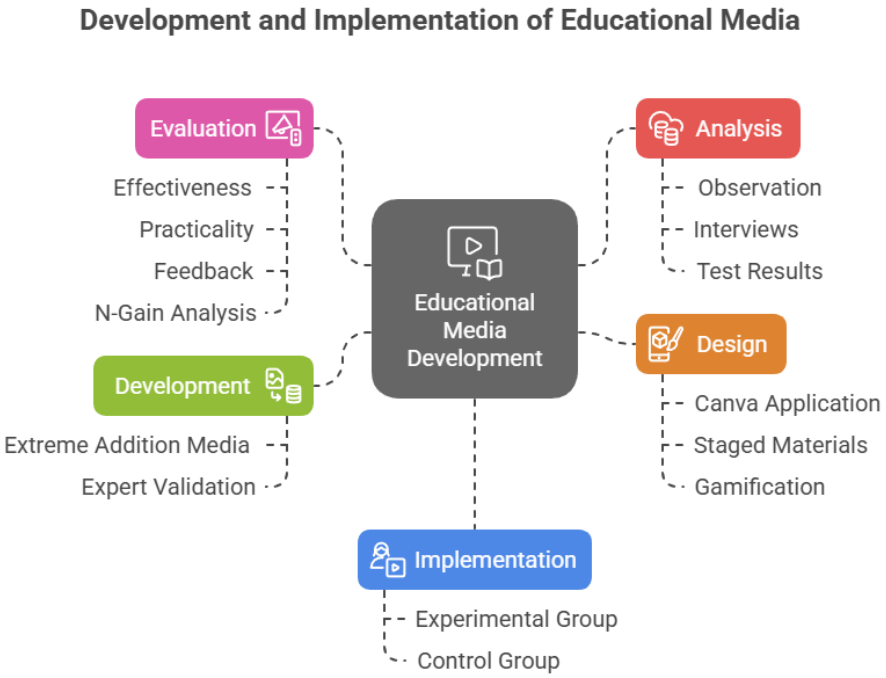


Figure 1
ADDIE Research Framework
Source: Personal Document

This study took place at MIS Ma'arif Asas Islam Kalibening in Salatiga City, focusing on fourth-grade students. A purposive sampling technique was applied to select 57 students from two parallel classes with similar characteristics in terms of low numeracy skills. Class 4A (n=28) served as the experimental group using the developed media, while Class 4C (n=29) acted as the control group receiving conventional instruction. The participants were aged 9–10 years and included a balanced mix of male and female students. All students were previously identified as having below-average performance in addition operations, based on prior academic assessments.

To ensure content validity, the media underwent validation by three categories of experts: material experts, media design experts, and learning process experts. Experts were selected based on the following criteria: (1) holding at least a master's degree in education or related fields, (2) having a minimum of five years of experience in curriculum design, instructional technology, or elementary education, and (3) having published academic work relevant to instructional media. Each expert was provided with

a structured validation instrument in the form of a questionnaire using a 4-point Likert scale. The evaluation criteria covered content relevance, visual clarity, instructional effectiveness, and user engagement. The data collected were analysed using Aiken's V formula to determine validity. Furthermore, the results of the validity and practicality data were analysed using the V-Aiken formula, namely:

$$\boldsymbol{V = \frac{\sum s}{n(c-1)}}$$

The results of the V-Aiken calculation for validity and practicality data will be classified into eligibility and practicality criteria as follows:

Table 1
Egilibity Criteria

Nilai Aiken's V	**Criteria**
$V \geq 0.75$	Worth
$0.60 \leq V < 0.75$	Decent Enough
$V < 0.60$	Not Feasible

Source: Personal Document

Table 2
Practicality Criteria

Nilai Aiken's V	**Criteria**
$V \geq 0.75$	Practical
$0.60 \leq V < 0.75$	Practical Enough
$V < 0.60$	Not Practical

Source: Personal Document

Data were collected through pretest and posttest assessments conducted for both experimental and control groups. The instruments used included: Numeracy Test: A 15-item addition test tailored to the curriculum, validated through expert review, with a reliability coefficient of 0.84 (Cronbach's Alpha). Observation Sheet used by observers to evaluate classroom engagement and use of media.

Data Analysis Techniques Data analysis included both descriptive and inferential statistics. Descriptive statistics were used to summarise mean scores and standard deviations. Shapiro-Wilk normality test (α=0.05) to verify normal data distribution. As for the testing criteria to determine normality, the following guidelines were used: (1) If the Sig value < 0.05, then the data is not normally distributed, (2) If the Sig value > 0.05, then the data is normally distributed.

Then test the homogeneity of variance through the Levene Test to ensure the equality of variance between groups. Furthermore, hypothesis testing was carried out with the t-test (independent sample t-test) to compare differences in results between groups. The criteria for hypothesis testing are as follows: (1) If t-count is negative: t-count < t-table, P-value < 0.05, then Ho is rejected and Ha is accepted, (2) If the t-count is positive (t-count > t-table), with a P-value > 0.05, then Ho is accepted, and Ha is rejected.

N-Gain test to measure the effectiveness of the treatment based on the increase in pretest and posttest scores using the Extreme Addition Mathematics media. Media effectiveness is calculated through N-gain (Hake, 1999) with the formula:

$$\boldsymbol{N - Gain = \frac{Skor\ PostTest - Skor\ PreTest}{Skor\ Ideal - Skor\ PreTest}}$$

Table 3
Effectiveness Criteria

Presentation (%)	Interpretation
> 76	Effective
56 – 75	Effective Enough
40 – 55	Less Effective
< 40	Ineffective

Source: Personal Document

Result

Analyze

The needs analysis stage was conducted to understand the problems faced by students in learning arithmetic and the urgency of developing Extreme Addition Mathematics media. Data was collected through observation of teaching and learning activities in the classroom, interviews with classroom teachers, and analysis of students' daily test results. Based on the observation in January 2025, the learning method applied in the classroom still focuses on lectures and practice problems from the textbook. The teacher explains the material verbally, then students are asked to work on problems on the blackboard or in an exercise book. However, in practice, only a small number of students actively asked or answered questions, while most others seemed less enthusiastic and experienced difficulties when working on large number addition problems.

Based on the results of preliminary observations at MIS Ma'arif Asas Islam Kalibening on January 21, 2025, serious problems were found related to the numeracy skills of grade IV students. Students find it difficult and are less motivated to solve addition problems, especially those involving larger numbers. Based on the results of preliminary observations at MIS Ma'arif Asas Islam Kalibening, it was found that most grade IV students still had difficulty with addition operations. Data from the daily math test results of class IV A showed that out of 28 students, only 40% reached the Criteria for Completion of Learning Objectives (KKTP) set by the school, which is 70.

Based on the results of interviews with fourth-grade teachers on January 21, 2025, it was revealed that many students still depend on the help of teachers or friends in completing addition operations. Students find it difficult and are less motivated to solve addition problems, especially those involving larger numbers. Some of the factors that cause these difficulties include a lack of understanding of basic concepts, low student interest in learning, and limited learning media that support visual and interactive understanding. Teachers also emphasise that students understand concepts more easily when given concrete tools, but so far, the limitations of the media have hindered the application of these methods in learning.

The results of the analysis of daily test scores also support the findings of observations and interviews. Data from the daily math test results of class IV A showed that out of 28 students, only 40% reached the school's Learning Objective Completeness Criteria (KKTP) of 70. Some students who scored above KKTP still needed quite a long time to solve addition problems compared to other simpler materials. These results show that there are still many students who need help in developing their numeracy skills.

A study by Qureshi et al. (2023) found that conventional methods are less effective in improving students' mathematical understanding because they do not involve active participation and visualisation of concepts. In addition, research from Chan & Chan (2023) stated that concrete or visual media can reduce math anxiety and accelerate understanding of basic concepts, which supports the need for the development of Extreme Addition Mathematics as a solution. Research by Fadda et al. (2022) also states that the use of game-based digital media increases students' mathematics learning completeness, so that the development of interactive and visual Extreme Addition Mathematics media

can be an effective strategy to overcome the problem of low achievement of KKTP and student learning motivation.

Design

Based on the results of the needs analysis, the Extreme Addition Mathematics media development was designed using Canva to produce a visual display that is attractive, intuitive, and in accordance with the needs of Madrasah Ibtidaiyah (MI) students. This media is developed with an interactive visual approach, where each design element is made to support the understanding of the concept of addition in a concrete manner (Shurr et al., 2021). The main display of this media displays the game title, instructions for use, and interactive navigation that makes it easy for students to access learning materials. The use of bright colours and educational icons aims to increase attractiveness and create a more enjoyable learning experience. According to Suhardiman, Prabandari, & Rahmah (2024), the use of Canva to design interactive mathematics media with an intuitive navigation structure and high-contrast colors improves MI students' conceptual understanding compared to static media.

In content design, Extreme Addition Mathematics Media has several stages of exercises that are organised based on the difficulty level of the questions. In the early stages, students are introduced to simple addition operations using small numbers, then gradually increase to more complex operations with large numbers. The slide design in Canva is made in the form of interactive problems, where students can write their calculation results directly in the media. To increase motivation, the media is also equipped with gamification elements, such as simple animations, as well as star awards for students who complete challenges well (Oliveira et al., 2022).

Development

The development stage carried out is the validation process by three types of experts, namely material experts, media experts, and learning experts, to ensure the quality and feasibility of the media developed. Material expert validation aims to assess the suitability of the content with curriculum standards and the level of difficulty of the questions given. Validation by media experts was conducted to assess the appearance, navigation, and quality of visual design in this learning media. Validation by learning experts was conducted to evaluate the effectiveness of the media in supporting the learning process of students in the classroom. Some of the adjustments made include

improving the addition of questions to be more in line with MI curriculum standards, increasing colour contrast and text readability to facilitate the use of media in classroom learning.

Table 4
Results of Material Expert Validation

No.	Assessed Aspects	Score				s(r-1)
		1	2	3	4	
1	Suitability of test questions with learning objectives				✓	3
2	Test questions reflect indicators of competency achievement.				✓	3
3	Problem instructions are clear and easy to understand			✓		2
4	The level of difficulty of the questions is in accordance with the students' abilities.				✓	3
5	Questions include a proportional variety of difficulty levels.			✓		2
6	The content of the questions is relevant to the counting material taught.				✓	3
7	Questions are able to measure students' numeracy skills accurately.				✓	3
8	The problem can be implemented easily without technical or conceptual constraints.			✓		2
	Σ_s					21
V-Aiken						**0.87**

Source: Personal Document

Based on the data in Table 4, the V-Aiken coefficient value is 0.87. The V-Aiken coefficient of 0.87 indicates a decent level of content validity (0.87> 0.75). Based on the validation results, the test instrument can be declared valid from the material aspect and is suitable for use in measuring students' numeracy skills in accordance with the predetermined learning objectives.

These findings are consistent with the results of a study by Putri et al. (2022), which showed that a V-Aiken value of 0.87 falls within the category of excellent content validity, as it is within the range of 0.770 to 0.920. The instrument in the study was proven effective in evaluating components of mathematical computational thinking, including

decomposition and algorithmic thinking, which are also closely related to numeracy skills. Support also comes from Astarina (2022), who states that test instruments with a validity coefficient above 0.75 meet the criteria for content validity and are deemed appropriate in terms of material. Thus, the V-Aiken value of 0.87 not only meets the minimum statistical standards but is also conceptually and empirically supported by current literature as a sufficient validity indicator for numeracy ability measurement instruments.

Table 5
Results of Media Expert Validation

No.	Assessed Aspects	Score				s(r-1)
		1	2	3	4	
1	The media has a clear and attractive visual appearance.				✓	3
2	The media has a clear and attractive visual appearance. The colours and design of the media are suitable for grade IV students and do not interfere with comfort.				✓	3
3	The layout of media elements supports ease of use.				✓	3
4	Media is easily understood by grade IV students.				✓	3
5	The media provides appropriate responses when students perform activities.			✓		2
6	The media provides a variety of interesting and challenging questions for students.				✓	3
7	The material in the media is in accordance with the basic competencies of grade IV counting.				✓	3
8	The level of difficulty of the questions on the media has been arranged in stages according to the ability of students.			✓		2
9	The math material presented in the media is correct and valid.				✓	3

No.	Assessed Aspects	Score				s(r-1)
		1	2	3	4	
10	Media helps improve students' understanding and numeracy skills.				✓	3
11	This media is effective in increasing students' motivation to learn math.			✓		2
12	Media can be used repeatedly without reducing student interest.				✓	3
	Σ_s					**33**
V-Aiken						**0.91**

Source: Personal Document

Based on Table 5, the V-Aiken coefficient is 0.91. The V-Aiken coefficient of 0.91 indicates a decent level of validity (0.91 > 0.75). This indicates that the validated learning media has very good quality from the perspective of media experts. Based on the validity results, the learning media is considered feasible to be implemented in the mathematics learning process for grade 4 students at MIS Ma'arif Asas Islam Kalibening.

This finding aligns with the theoretical framework proposed by Spoto et al. (2023), who emphasise the utility of the V-Aiken coefficient in formally evaluating the alignment between assessment items and the intended construct. According to their study, a coefficient exceeding the 0.75 threshold, such as 0.87, denotes a strong degree of content validity. Although the study does not focus specifically on learning media, it reinforces that a high V-Aiken value signals content appropriateness and coherence with learning objectives. Meanwhile, Farrell et al. (2022) provide supporting evidence through their use of content validity indices (CVI) in evaluating instructional tools, although they do not directly apply the V-Aiken method. Nonetheless, the principle remains consistent: a high validity index (e.g., CVI 0.81) reflects strong content alignment. Therefore, the obtained V-Aiken coefficient of 0.91 not only exceeds the commonly accepted benchmark but also affirms the suitability of the learning media as a valid instrument to support educational objectives in mathematics instruction.

Table 6
Results of Learning Expert Validation

No.	Assessed Aspects	Score				s(r-1)
		1	2	3	4	
1	Learning indicators are clearly formulated in accordance with CP and TP.				✓	3
2	Learning objectives are clearly formulated in accordance with the indicators.			✓		2
3	The material presented is in accordance with the latest mathematical developments.				✓	3
4	Definitions, formulas, and theorems are presented correctly and precisely.				✓	3
5	Mathematical notations, symbols, and icons are used appropriately.			✓		2
6	Examples and applications of math concepts are presented correctly.				✓	3
7	Presentation of material encourages students to actively learn.				✓	3
8	Examples and illustrations support students' understanding of concepts.				✓	3
9	The exercise questions presented are varied and cover a range of difficulty levels.			✓		2
10	The material is in accordance with the characteristics and developmental level of grade 4 SD / MI students.				✓	3
11	The material is interesting and motivates students to learn math.			✓		2
12	Materials develop students' logical, critical, and creative thinking skills.				✓	3
	$\boldsymbol{\Sigma_s}$					**32**
V-Aiken						**0.89**

Source: Personal Document

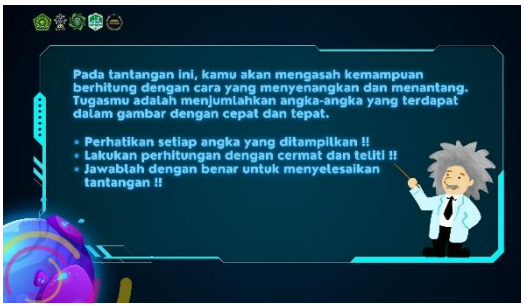
Based on the data in Table 6, the V-Aiken coefficient is 0.89. The V-Aiken coefficient value of 0.89 indicates a decent level of validity (0.89> 0.75). These results indicate that the validated mathematics learning materials have very good quality from the perspective of learning experts. With a high level of validity, the learning materials can be implemented in the mathematics learning process for grade 4 MI students.

While the study by Wafudu et al. (2022) does not directly utilise the V-Aiken method, it contributes relevant insight into the broader context of educational quality assurance. Their development and validation of the Quality Assurance for Teaching and Learning (QATL) questionnaire revealed strong internal consistency (Cronbach's alpha between 0.835 and 0.963) and significant explanatory power in the domains of input, process, and output quality. These findings reinforce the importance of validating educational instruments to ensure their reliability and alignment with intended learning outcomes. In this context, the V-Aiken coefficient of 0.89 functions as a robust indicator, analogous to the psychometric strengths observed in the QATL study. Both cases underscore that well-validated instruments, whether questionnaires or instructional materials, play a critical role in supporting effective teaching and learning processes by ensuring that content quality meets professional and pedagogical standards.

Table 7
Extreme Addition Mathematics Media Results Before and After Revision

No.	Validator Suggestion	
	Before Revision	**After Revision**
1		
	The background is less interesting, and foreign terms are not written correctly.	The background is more interesting and futuristic for students, as well as justifying the use of foreign terms.

No.	Validator Suggestion	
	Before Revision	**After Revision**
2		
	The background is more interesting and futuristic for students, as well as the justification for writing in foreign terms. The learning rules use more relaxed language and a bit of joking ("Yossh, during learning we focus!", "No focus = no rest", etc.). Backgrounds lack variety, using only star effects.	Language is made more formal and educational ("So that during learning we focus", "Sholih sholihah children study seriously"). The background is made more colourful with a galaxy effect to increase visual appeal.
3		
	The questions are numbered in a circle, with the same background colour. There are no additional elements to make the display more interactive.	Numbers are replaced with valuable coin symbols that are more appealing to students. Clearer instructions: "Add up all the numbers in the coin above!". More interactive with a game-like interface.
4		
	The number display is a blue hexagon with no colour variation. The commands are not clear to students.	Added different colours to the hexagons to differentiate the number groups. Problem instructions are clearer and more interesting.

No.	Validator Suggestion	
	Before Revision	After Revision
5		
	The discussion only shows the numbers circled in red, with no additional instructions. The text is quite long and uninteresting.	Addition of a scientist character who gives direct instructions to students. Clearer instructions: “In this challenge, you hone your math skills in a fun way”. Presentation of information is more interactive and easier to understand.

Source: Personal Document

Based on the results of the validation test that has been done by experts on Extreme Addition Mathematics, the media produces valid learning media. Media developed has passed the validation stage of 3 experts, namely material experts, media experts, and learning experts. Based on the results of the validation sheet from the material expert, a validity of 0.87 was obtained, which is a decent category with improvements according to expert input. The results of the Validity Test by media experts obtained a result of 0.91, which included a decent category with little improvement. In addition, the results of the validity test by learning experts obtained a value of 0.89, which also included a feasible category.

These results indicate high validity as stated by Azwar (2019), which states that instruments with a V-Aiken value above 0.75 are considered valid with high reliability. Aspects of improvement made after validation show the application of visual learning design principles in accordance with the theory Mayer (2002) on multimedia learning, in the part of adjusting visual elements (changing numbers to valuable coins, adding colors to number representations, and using scientist characters) that can facilitate students' cognitive processes in understanding abstract mathematical concepts. This reflects the importance of a multimedia approach in primary school mathematics learning, as

emphasized by Irshid, Khasawneh, & Al-Barakat (2023), that rich and contextual visual representations can strengthen conceptual understanding.

The revisions made to the Extreme Addition Mathematics media show the implementation of user experience design principles that are concerned with aesthetic aspects, ease of use, and contextual relevance (Norman, 2023). The transformation of the background into a more attractive galaxy effect, the use of more formal and educational language, and the presentation of questions in a more interactive format reflect the application of instructional motivation theory from Keller's ARCS Model (Attention, Relevance, Confidence, Satisfaction) theory which emphasizes the importance of attracting students' attention through attractive and contextual visual design (Taşkın & Sallabaş, 2024). The presentation of materials that encourage students to actively learn and develop logical and critical thinking skills is in line with constructivism theory in mathematics learning, where students not only understand calculation procedures but also develop deeper mathematical reasoning through interaction with learning media (Romdhon et al., 2024).

Implementation

At the implementation stage, this study compared two groups of students in the experimental group using Extreme Addition Mathematics media (29 students) and the control group using conventional learning (28 students). The following is a comparison of the test results of the two groups:

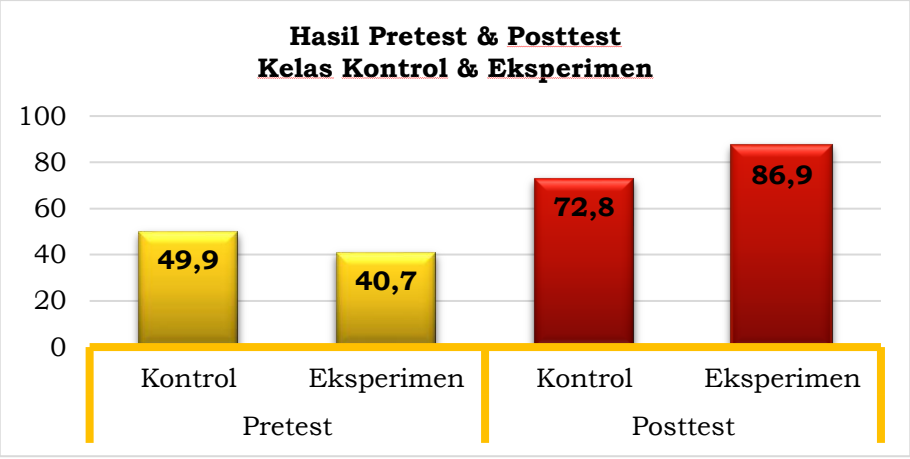


Figure 2
Graph of Student Test Results
Source: Personal Document

The data in Figure 1 shows that the experimental group experienced a greater increase in scores compared to the control group. Although the initial score (pretest) of the experimental group was lower than the control group (40.72 < 49.4), the final score (posttest) of the experimental group was much higher (86.90 > 72.79), which indicates the effectiveness of Extreme Addition Mathematics media.

To ensure that the data can be analysed with parametric statistics, a normality test was conducted using the Shapiro-Wilk method. The results of the normality test are as follows:

Table 8
Presentation of Normality Data

Tests of Normality

Kelas	Shapiro-Wilk		
	Statistic	df	Sig.
Pretest Control	.927	28	.051
Posttest Control	.937	28	.090
Pretest Eksperimen	.929	29	.051
Posttest Eksperimen	.930	29	.055

a. Lilliefors Significance Correction

Source: Personal Document

Based on the data in Table 8, the significance value > 0.05 is obtained, which indicates that the pretest and posttest data in both groups are normally distributed. Thus, the analysis can proceed with parametric statistical tests.

The homogeneity test is carried out to determine whether the data groups have homogeneous variances. The results of the homogeneity test are as follows:

Table 9
Presentation of Homogeneity Data

Test of Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.
Based on the Mean	082	1	55	.776

Source: Personal Document

Based on the data in Table 9, the results of the homogeneity test using the Levene statistic show a significance value of 0.776, which is much greater than 0.05 (0.776> 0.05). This means that the variance of the post-test data in both groups is homogeneous, which meets the assumptions of the t-test.

To analyse the significance of the difference between the two groups, an Independent Samples T-test was performed with the following results:

Table 10
Presentation of Paired Sample T-Test Data

Independent Samples Test					
	Levene's Test for Equality of Variances				
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.082	.776	-6.473	55	.000

Source: Personal Document

Based on Table 10, the t-test results show a significance value (2-tailed) of 0.000, which is less than 0.05 (0.000 <0.05). With a degree of freedom (df) of 55 and a significance level of 0.05, the t-count is -6.473, while the t-table is 1.673. Since t-count < t-table (-6.473 < 1.673), the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. The data shows that there is a significant difference between the learning outcomes of the experimental group and the control group.

To measure the effectiveness of the learning media, an N-gain calculation was performed, comparing the increase in scores between the pretest and posttest.

Table 11
Presentation of N-Gain Test Data

Descriptives						
	Kelas	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain_Persen	Kontrol	28	-42.42	88.33	41.6825	28.78801
	Eksperimen	29	49.06	100.00	77.3515	14.21393

Source: Personal Document

Based on the data in Table 11, the average value of N-gain in the experimental group is 77.3515% (> 76%), which is included in the "Effective" category according to the effectiveness criteria.

Based on the implementation results presented, it can be said that Extreme Addition Mathematics media has a great influence in improving the numeracy skills of grade 4 students of MIS Ma'arif Asas Islam Kalibening. This can be seen from the

difference in the mean of the pretest and posttest, which is much greater in the experimental group compared to the control group, with an N-gain of 77.4%, so it can be said to be “effective”. The statistical tests performed, namely the normality test (Shapiro-Wilk), the homogeneity test (Levene's test) and the independent samples t-test, showed that the data met the requirements of the parametric assumptions, and the significant differences found were scientifically acceptable.

This research is in line with Jean Piaget's theory of constructivism, which states that learning is much more effective when students are actively involved through interactive and exploratory media (Erawati & Adnyana, 2024). Extreme Addition Mathematics is a new learning medium that is in line with the principles of David Ausubel's theory of meaningful learning (Bryce & Blown, 2024). This media facilitates the anchoring of new knowledge into students' existing cognitive structures. This is also in accordance with the opinion of Liberna, Bhakti, and Astuti (2021), which states that interesting and interactive media have the potential to increase student motivation and learning outcomes.

In addition, the use of a quantitative approach to measure the effectiveness of educational media ensures that this study has followed traditional scientific criteria, particularly in terms of data verification (normality and homogeneity tests) and comparative analysis (through the use of t-tests). The t-test results, which showed high significance ($p < 0.05$), confirmed that the improvement in learning outcomes was not the result of random changes, but rather the effect of the learning media used. Therefore, this study is not only statistically robust but also practically significant in formulating mathematics teaching methods in madrasah ibtidaiyah and primary schools.

Evaluation

The evaluation stage in this study aims to assess the effectiveness and quality of Extreme Addition Mathematics media based on feedback from teachers and students. The evaluation was conducted through observation, interviews, and analysis of student learning outcomes after the use of the media. Based on the results of interviews with classroom teachers, this media is considered capable of increasing students' interest and motivation in learning mathematics, especially in addition operations. Pires et al. (2022) stated that interactive design and the use of interesting visual elements make students more focused on solving the problems given.

In terms of effectiveness, the results of the N-Gain analysis showed a significant increase in students' numeracy skills after using this media. In addition, students' responses also showed positive acceptance of the learning media. Students felt that the use of this media made the learning process more enjoyable and helped them understand the concept of addition more easily. In line with research, Lestari & Rasilah (2025) stated that counting media in learning mathematics in elementary schools has been proven effective in improving students' understanding of basic mathematical concepts.

This media provides a replicable model for integration in the classroom. Teachers can use it as a supplement to existing curricula, especially during mathematics learning units. The structure of this media also allows for adjustments for students with different skill levels. Some limitations include the relatively small sample size and focus on a single school, which may affect external validity. In addition, the intervention is limited to addition; other operations were not tested. Access to digital tools may limit scalability in areas with limited resources. Future studies should explore the long-term impact of game-based arithmetic media, expand the scope to operations such as subtraction and multiplication, and evaluate the integration of digital platforms.

Discussion

The findings of this study demonstrate that the development and implementation of Extreme Addition Mathematics media significantly improved the numeracy skills of Madrasah Ibtidaiyah (MI) students, particularly in mastering addition operations. The posttest results indicated a notable increase in performance for the experimental group, with an N-Gain score of 77.4%, categorised as “effective,” while the control group showed only moderate improvement. This reinforces the idea that interactive and gamified media are more effective than conventional teaching methods for developing computational fluency in young learners.

These results align with constructivist learning theory, particularly Piaget’s emphasis on active learning and Ausubel’s concept of meaningful learning, which stress the importance of engaging students in concrete and contextual activities (Erawati & Adnyana, 2024; Bryce & Blown, 2024). By integrating progressive challenges, interactive visuals, and immediate feedback, the Extreme Addition Mathematics media provided students with opportunities to construct new knowledge through experience,

reflection, and error correction. This aligns with Mayer's (2002) multimedia learning theory, which highlights the role of visual and interactive representations in enhancing conceptual understanding.

The validation results from material, media, and learning experts (all exceeding Aiken's V threshold of 0.75) confirm that the developed media is not only valid but also practical for classroom application. This is consistent with previous findings that emphasise the role of gamification in increasing motivation and learning outcomes in mathematics (Fadda et al., 2022; Oliveira et al., 2022). Students reported higher engagement and enjoyment during lessons, which is consistent with Solekhah et al. (2023), who found that gamified mathematics media fosters positive perceptions of learning and encourages persistence in problem-solving.

An important contribution of this research is its response to the long-standing challenge of low numeracy achievement among MI students. Previous studies (Mahmud & Pratiwi, 2019; Irwan & Masrul, 2023) have shown that abstract and conventional teaching methods hinder students' understanding of arithmetic. By offering interactive, visually appealing, and game-like elements, the Extreme Addition Mathematics media reduced the perceived difficulty of addition tasks and increased students' confidence. This supports Chan & Chan's (2023) conclusion that concrete and visual media alleviate mathematics anxiety and strengthen comprehension.

Despite its effectiveness, some limitations should be acknowledged. First, the study was conducted in a single school with a relatively small sample, which may affect the generalisability of the findings. Second, the intervention was limited to addition operations, leaving open the question of whether similar results would be achieved with subtraction, multiplication, or division. Third, while the use of Canva provided an accessible design solution, scalability may be limited in resource-constrained schools without adequate digital infrastructure. These constraints suggest the need for further research that extends the model to broader contexts, larger populations, and diverse mathematical operations.

Overall, this study highlights the practical and theoretical significance of integrating gamified, interactive media into mathematics instruction at the elementary level. The results not only provide empirical evidence for the effectiveness of game-based learning in improving numeracy but also contribute to the growing body of research on

digital pedagogy in Islamic elementary schools. By combining constructivist principles with multimedia learning design, Extreme Addition Mathematics offers a replicable and scalable model that can inform future curriculum development and teaching practices.

Conclusion

The development and implementation of the Extreme Addition Mathematics media have demonstrated significant contributions to enhancing the numeracy skills of Madrasah Ibtidaiyah (MI) students, particularly in mastering addition operations. The study confirmed the validity and effectiveness of this media through rigorous validation processes and empirical testing, with material, media, and learning expert validations all exceeding the acceptable threshold (Aiken's $V > 0.75$). Statistically, the experimental group achieved an average N-Gain of 77.4%, significantly higher than the control group, indicating that gamified and visually engaging media substantially improve students' arithmetic performance. These results underscore the importance of integrating constructivist principles and interactive elements into educational interventions, particularly for foundational mathematics. By facilitating conceptual understanding, procedural fluency, and student motivation, this media not only addresses current pedagogical challenges but also offers a scalable model for mathematics education in similar contexts. Future studies are encouraged to adapt and expand this media for other mathematical operations, such as subtraction and multiplication, and to explore its integration into digital platforms for broader reach and sustainability in diverse educational environments.

Acknowledgment

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Declaration of Conflicting Interests

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Funding

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References

Adeoye, M. A., Wirawan, K. A. S. I., Pradnyani, M. S. S., & Septiarini, N. I. (2024). Revolutionising education: Unleashing the power of the ADDIE model for effective teaching and learning. *JPI (Jurnal Pendidikan Indonesia)*, *13*(1), 202–209. https://doi.org/10.23887/jpiundiksha.v13i1.68624.

Ahmad, M., & Khan, R. W. (2024). Gamification in Education: Enhancing Students' Engagement and Learning Achievements through the Integration of Game-based Learning. *The Knowledge*, *3*(1), 23–37. https://doi.org/10.63062/tk/2k24a.31016.

Algebraic, B. A. O. I. (2023). The effectiveness of the GeoGebra-Assisted Inquiry-Discovery learning strategy on students' mastery and interest in algebraic expressions. *International Journal of information and Education Technology*, *13*(11). https://doi.org/10.18178/ijiet.2023.13.11.1977.

Astarina, M. (2022). Pengembangan Instrumen Tes untuk Mengukur Kemampuan Numerasi Siswa Kelas V Sekolah Dasar. *Jurnal Kualita Pendidikan*, *3*(3), 152–156. https://doi.org/10.51651/jkp.v3i3.334.

Azwar, S. (2019). *Reliabilitas dan validitas*.

Bryce, T. G. K., & Blown, E. J. (2024). Ausubel's meaningful learning revisited. *Current Psychology*, *43*(5), 4579–4598. https://doi.org/10.1007/s12144-023-04440-4.

Chan, J. W. Y., & Chan, W. W. L. (2023). Examining the learning effects of concrete and abstract materials among university students using a two-dimensional approach. *British Journal of Educational Psychology*, *93*(4), 1053–1071. https://doi.org/10.1111/bjep.12619.

Erawati, N. K., & Adnyana, P. B. (2024). Implementation of Jean Piaget's Theory of Constructivism in Learning: A Literature Review. *Indonesian Journal of Educational Development (IJED)*, *5*(3), 394–401. https://doi.org/10.59672/ijed.v5i3.4148.

Fadda, D., Pellegrini, M., Vivanet, G., & Zandonella Callegher, C. (2022). Effects of digital games on student motivation in mathematics: A meta-analysis in K-12. *Journal of Computer Assisted Learning*, *38*(1), 304–325. https://doi.org/10.1111/jcal.12618.

Farrell, R. M., Gilbert, G. E., Betance, L., Huck, J., Hunt, J. A., Dundas, J., & Pope, E. (2022). Evaluating validity evidence for two instruments developed to assess students' surgical skills in a simulated environment. *Veterinary Surgery*, *51*(5), 788–800. https://doi.org/10.1111/vsu.13791.

Fatchurahman, M., Adella, H., & Setiawan, M. A. (2022). Development of Animation Learning Media Based on Local Wisdom to Improve Student Learning Outcomes in Elementary Schools. *International Journal of Instruction*, *15*(1), 55–72.

Fauzi, A. L., Kusumah, Y. S., Nurlaelah, E., & Juandi, D. (2024). Computational Thinking in Mathematics Education: A Systematic Literature Review on Its Implementation and Impact on Students' Learning. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, *10*(2), 640–653. https://doi.org/10.33394/jk.v10i2.11140.

Goos, M., & O'Sullivan, K. (2023). The evolution and uptake of numeracy and mathematical literacy as drivers for curriculum reform. In *Mathematics curriculum reforms around the world: The 24th ICMI Study* (pp. 345–357). Springer International Publishing Cham. https://doi.org/10.1007/978-3-031-13548-4_21.

Gumulya, D., & Suhanto, Y. (2023). Applying Gamification Principles Through the Design Thinking Framework for Developing A Mixed Reality Educational Game in Numeracy Learning. *Idealog: Ide Dan Dialog Desain Indonesia*, *8*(2), 145–159. https://doi.org/10.25124/idealog.v8i2.5506.

Hornburg, C. B., King, Y. A., Westerberg, L., Schmitt, S. A., & Purpura, D. J. (2024). The roles of mathematical language and emergent literacy skills in the longitudinal prediction of specific early numeracy skills. *Journal of Experimental Child Psychology*, *244*, 105959. https://doi.org/10.1016/j.jecp.2024.105959.

Irshid, M. M. B., Khasawneh, A. A., & Al-Barakat, A. A. (2023). The effect of a conceptual understanding principles-based training program on the enhancement of pedagogical knowledge of mathematics teachers. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(6), em2277. https://doi.org/10.29333/ejmste/13215.

Irwan, I., & Masrul, M. (2023). Analisis Kemampuan Numerasi Siswa Pada Pembelajaran Matematika Di Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *8*(1), 4119–4128. https://doi.org/10.23969/jp.v8i1.7235.

Kovalenko, I. V, & Skvortsova, T. P. (2022). Game technologies and gamification techniques in teaching English: An analysis of pedagogical experience. *RUDN Journal of Psychology and Pedagogy*, *19*(2), 382–392. https://doi.org/10.22363/2313-1683-2022-19-2-382-392.

Laksana, S. D., Saputro, A. D., Ariyanto, A., & Lestari, D. A. (2024). Development of Learning Media Gamification Based on Gamimath Android in Mathematics Learning for Elementary School. *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, *16*(2), 329–348. https://doi.org/10.14421/al-bidayah.v16i2.9585.

Lestari, F. F., & Rasilah, R. (2025). Use of Counting Media to Improve Understanding of Elementary School Students. *Journal of General Education and Humanities*, *4*(1), 59–68. https://doi.org/10.58421/gehu.v4i1.324.

Liberna, H., Bhakti, Y. B., & Astuti, I. A. D. (2021). The innovation of learning mathematics through the introduction of numbers for pre-school students.

Formatif: Jurnal Ilmiah Pendidikan MIPA, *11*(1). https://doi.org/10.30998/formatif.v11i1.7623.

Mahmud, M. R., & Pratiwi, I. M. (2019). Literasi numerasi siswa dalam pemecahan masalah tidak terstruktur. *Kalamatika: Jurnal Pendidikan Matematika*, *4*(1), 69–88. https://doi.org/10.22236/KALAMATIKA.vol4no1.2019pp69-88.

Mayer, R. E. B. T.-P. of L. and M. (2002). *Multimedia learning* (Vol. 41, pp. 85–139). Academic Press. https://doi.org/https://doi.org/10.1016/S0079-7421(02)80005-6.

Norman, D. A. (2023). *Design for a better world: Meaningful, sustainable, humanity-centred*. MIT Press.

Oliveira, W., Hamari, J., Joaquim, S., Toda, A. M., Palomino, P. T., Vassileva, J., & Isotani, S. (2022). The effects of personalised gamification on students' flow experience, motivation, and enjoyment. *Smart Learning Environments*, *9*(1), 16. https://doi.org/10.1186/s40561-022-00194-x.

Pires, A. C., Bakala, E., González-Perilli, F., Sansone, G., Fleischer, B., Marichal, S., & Guerreiro, T. (2022). Learning maths with a tangible user interface: Lessons learned through participatory design with children with visual impairments and their educators. *International Journal of Child-Computer Interaction*, *32*, 100382. https://doi.org/10.1016/j.ijcci.2021.100382.

Prabhu, S. (2022). Changing students' perception of learning mathematics. *PRIMUS*, *32*(4), 503–516. https://doi.org/10.1080/10511970.2020.1844826.

Putri, S. A., Andhini, N. S., Putri, I. A., Yanthi, N., & Sukmawati, W. (2024). Critical and Creative Thinking Skills in Elementary School Minimum Competency Assessment: Literacy and Numeracy. *Jurnal Cakrawala Pendas*, *10*(2), 206–214. https://doi.org/10.31949/jcp.v10i2.8413.

Putri, Y. F., Kadir, K., & Dimyati, A. (2022). Analysis of content validity on mathematical computational thinking skill test for junior high school students using the Aiken method. *Jurnal Hipotenusa*, *4*(2). https://doi.org/10.18326/hipotenusa.v4i2.7465.

Putriana, C., & Haqiqi, A. K. (2023). *The Effectiveness of the SSCS (Search, Solve, Create, and Share) Learning Model for Increasing Mathematical Communication Skills and Numeracy Literacy*. https://doi.org/10.21043/jpmk.v6i2.22484.

Qureshi, M. A., Khaskheli, A., Qureshi, J. A., Raza, S. A., & Yousufi, S. Q. (2023). Factors affecting students' learning performance through collaborative learning and engagement. *Interactive Learning Environments*, *31*(4), 2371–2391. https://doi.org/10.1080/10494820.2021.1884886.

Romdhon, J., Masrifah, M., Shiyama, N. M., & Suharyati, H. (2024). Applying Constructivist Learning Theory to Enhance Student Learning Outcomes in Elementary Schools. *International Journal of Sustainable Development & Future Society*, *2*(2), 62–69. https://doi.org/10.62157/ijsdfs.v2i2.73.

Rusdi, M., Sirajuddin, H., & Alfah, R. (2022). Implementation of the Addie Model (Analysis, Design, Development, implementation, evaluation) in php-based E-

Learning in the era of pandemic. *Jurnal Teknologi Informasi Universitas Lambung Mangkurat (JTIULM)*, *7*(1), 49–56. https://doi.org/10.20527/jtiulm.v7i1.74.

Samosir, E. D. B., Agung, A. A. G., & Suartama, I. K. (2023). Interactive Learning Media Based on Character Education in Indonesian Subjects for Grade 1 Elementary Schools. *Indonesian Values and Character Education Journal*, *6*(1), 12–23. https://doi.org/10.23887/ivcej.v6i1.57720.

Shurr, J., Bouck, E. C., Bassette, L., & Park, J. (2021). Virtual versus concrete: A comparison of mathematics manipulatives for three elementary students with autism. *Focus on Autism and Other Developmental Disabilities*, *36*(2), 71–82. https://doi.org/10.1177/1088357620986944.

Sievert, H., van den Ham, A.-K., Niedermeyer, I., & Heinze, A. (2019). Effects of mathematics textbooks on the development of primary school children's adaptive expertise in arithmetic. *Learning and Individual Differences*, *74*, 101716. https://doi.org/10.1016/j.lindif.2019.02.006.

Siti, M. (2023). Analisis hubungan literasi numerasi dan hasil belajar siswa. *Jurnal Pendidikan Dasar Dan Keguruan, Doi*, *10*. https://doi.org/10.47435/jpdk.v8i1.1798.

Soewardini, H. M. D., Setiyawan, H., Juniati, D., Khabibah, S., & bin Bon, A. T. (2020). Fostering innovation of thinking for student-facing mathematics difficulty through commercial sport video games. *International Journal of Integrated Education, Engineering and Business*, *3*(1), 33–41. https://doi.org/10.29138/IJEEIT.V3I1.1081.

Solekhah, H., Kutni, I. D., & Pamungkas, A. B. (2023). Student's Engagement and Perception of Gamification in Mathematics. *International Journal of Theory and Application in Elementary and Secondary School Education*, *5*(2), 255–266. https://doi.org/10.33830/ijtaese.v5i2.1430.

Spoto, A., Nucci, M., Prunetti, E., & Vicovaro, M. (2023). Improving content validity evaluation of assessment instruments through formal content validity analysis. *Psychological Methods*. https://doi.org/10.1037/met0000545.supp.

Sriyanti, A., Natia, S. A., Yunus, M., & Aprilia, D. (2024). Development of Interactive Learning Video Media to Improve Mathematical Representation Ability on Data Presentation Material. *Mathematics Education Journal*, *8*(2), 194–205. https://doi.org/10.22219/mej.v8i2.34849.

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D* (kedua). ALFABETA.

Suhardiman, S., Prabandari, E. T., & Rahmah, L. (2024). Using Canva to improve drawing for elementary school. *Elementary School Teacher*, *7*(2), 91–103. https://doi.org/10.15294/v9gqvd37.

Sumilat, J. M. (2022). *The Utilization of Online Media in Calculating Operations in Mathematics Learning in Elementary School Students*. https://doi.org/10.36941/jesr-2022-0069.

Taşkın, Y., & Sallabaş, M. E. (2024). The Effect of the ARCS Motivation Model on

Secondary School Students' Motivation and Academic Achievement towards Turkish Lessons. *International Journal of Field Education*, *10*(3), 12–41. https://doi.org/10.32570/ijofe.1568239.

Ulya, H. (2024). The Meta-Analysis of Innovative Mathematics Learning Toward the Mathematics Ability in Various Countries. *AL-ISHLAH: Jurnal Pendidikan*, *16*(4), 4899–4914. https://doi.org/10.35445/alishlah.v16i4.5854.

Wafudu, S. J., Kamin, Y. Bin, & Marcel, D. (2022). Validity and reliability of a questionnaire developed to explore quality assurance components for teaching and learning in vocational and technical education. *Humanities and Social Sciences Communications*, *9*(1), 1–10. https://doi.org/10.1057/s41599-022-01306-1.

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