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# The Effectiveness of Mathematics Learning Media Developed with Artificial Intelligence (AI) Assistance in Training Basic Arithmetic Skills

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**Abstract**

Technological advancements in education have prompted the sector to respond by utilising digital learning innovations. However, the implementation of technology, particularly artificial intelligence (AI), remains limited at elementary school level. This has resulted in suboptimal student engagement and inadequate basic arithmetic skills. This study aims to examine the effectiveness of AI-based learning media in improving basic arithmetic skills. The study employs a quantitative approach with a one-group pretest-posttest design. The research subjects are second-grade students at MI Al Fithrah in Surabaya. Data collection techniques include validity checklists and achievement tests. The analysis was conducted using the Paired Samples T-Test The results from the validity check sheets showed that the first validator achieved a 90% validity rate and the second validator 92%, while the test instrument achieved an 85% validity rate, placing it in the "highly valid" category. The results of the hypothesis test showed a significant increase in the mean score. It increased from 71.20 to 92.80. The p-value was 0.000. This is less than 0.05. This indicates a substantial difference in the mean score. The effectiveness of mathematics learning media developed with artificial intelligence assistance in training basic arithmetic skills has been demonstrated, as has its potential to create interactive and engaging learning experiences.

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## INTRODUCTION

In the current era, marked by rapid advancements in technology, educational institutions are compelled to demonstrate a capacity for ongoing adaptation to the evolving dynamics of global change (Hakim & Yulia, 2024) . The rapid pace of digital transformation presents both challenges and potential opportunities to enhance learning quality (Parwatha et al., 2025). n this context, education is expected to strategically leverage technological resources so that the learning process becomes more effective, efficient, and relevant to students' needs in the digital age (Mundir, 2019). The integration of technology has been identified as a key factor in making learning more appealing and promoting active student engagement. The integration of technology has been identified as a significant factor in augmenting the appeal of learning and promoting active student engagement.

Media has been identified as a crucial element in supporting the success of the teaching and learning process (Rifai et al., 2025). However, the reality on the ground shows that the implementation of technology in education in Indonesia remains uneven; some educational institutions still adhere to conventional teaching methods and have not yet optimized the use of technology as a learning tool (Maufidhoh & Maghfirah, 2023). This situation indicates a gap between technological demands and advancements and actual teaching practices in the field.

A case study of Madrasah Ibtidaiyah (MI) Al Fithrah in Surabaya reveals that the integration of technology as an instructionak aid remains its infancy. Educators have not yet optimized the use of technology to support the learning process. An analysis of interview results indicates that students continue to demonstrate deficiencies in fundamental arithmetic skills, particularly in the domain of subtration. This situation underescores the necessity for instructional innovations that can effectively enhance students academic abilities, particularly in the domain of mathematics. Consecquently, there is an imperative for technological innovations that ar not merely supplementary but can become an integral part of the learning process (Sari, 2022).

One technology with great potential in the field of education is AI. This technology facilitates the development of adaptive and interactie learning systems (Subiyantoro, 2024). Enabling the customization of learning material to suit the diverse abilities and needs of each student. In addition, AI facilitates the provision of rapid feedback and enables educators to monitor student progress with greates precision. The application of AI not only serves as a tool but also as a strategic step in improving the quality and effectiveness of learning (R et al., 2023).

A multitude of earlier studies have indicated that the integration of AI in educational domains has a favorable impact. A study conducted by marta in mathematic demonstrated that the use of AI can improve student learning outcomes by 20.6% from 65.4% to 78.9% (Marta et al., 2025). Additionally, research by Mujib and Walid revealed that AI can improve the quality of learning through personalized content, the provision of instant feedback, and the use of AI as an interactive medium, which can foster a deeper understanding among students (Mujib & Walid, 2025). While these findings demonstrate the significant potential of AI in classroom learning, some studies have not directly tested the effectiveness of AI through experimental designs in real world learning contexts, particularly in training basic arithmatic skills.

Given these challenges, there is a need for an innovative learning approach that can meet students needs while keeping pace with tecnological advancements. This study proposes a novel approach by utilizing the collaborative use of generative AI specifically *ChatGPT* and *Canva AI* in the development of mathematics learning materials. The objective of this study is to examine the The effectiveness of mathematics learning media developed with artificial intelligence assistance in training basic arithmetic skills at MI Al Fithrah in Surabaya.

## RESEARCH METHOD

This study employs a quantitative approach aimed at objectively testing the relationships and influences among variables through data analysis (Priadana & Sunarsi, 2021). The quantitative approach was chosen because it provides a measruable assesment of the effectiveness of mathematics learning media developed with artificial intelligence assistance in training basic arithmetic skills. The research design employed is the One Group Pretest-Posttest Design. The experimental design involves a single group of research subjects who are given an intervention in the form of AI-based learning material. Before the administration of the treatment, students will first undergo a pretest to assess their initial proficiency, followed by a posttest after the learning process to measure the resulting changes in proficiency.

The objective of this study is to ascertain the extent to which mathematics learning media developed with artificial intelligence assistance in training (variable X) is effective in basic arithmetic skills (variable Y). The sampling technique employed in this study was purposive

sampling, which is a method of sample selection predicated on specific criteria and meticulously tailored to the overarching objectives of the research study (Sihotang, 2023). The data collection techniques employed in this study encompassed validity testing and the utilization of test instruments. Conducting validity testing necessitated the utilization of a validation sheet, which was employed to evaluate the suitability of artificial intelligence (AI)-based learning media before its implementation in the research procedure (Saputria et al., 2023).

The validation in this study was carried out by media experts to ensure that the learning media developed met the feasibility criteria in accordance with the learning objectives. In addition, a test instrument was used in this study to assess students basic numeracy skills. The evaluation instrument was administered in the form of a pretest and a posttest, each containing a number of questions in accordance with the established criteria(Putri et al., 2024). Before conducting the hypothesis test, the normality of the data distribution was examined. The analysis revealed that the Pretest-Posttest scores were not distributed . Consequently, the Wilcoxon Signed-Rank Test was utilizied as a non parametric alternative to evaluate the significance of differences between students' before and after the intervention. The use of this test was considered appropriate due to its suitability for paired samples with non normal data distributions (Hartanti et al., 2024).

Analysis of validation data entailed the calculation of the percentage of scores obtained from the experts evaluations (Widodo et al., 2023). This percentage was determined by comparing the total score obtained with the maximum possible score and subsequently multiplying by 100% The resulting percentage was then interpreted based on the following criteria table (Maulana, 2022):

**Table 1. Criteria Validity**

| Tabel Validasi | |
|---|---|
| Presentase | Kriteria Validasi |
| 21%-40% | Tidak Valid |
| 41%-60% | Kurang Valid |
| 61%-80% | Valid |
| 81%-100% | Sangat Valid |

Concurrently, the test data were subjected to analysis using a hypothesis test with the *Paired Sample T-Test* technique to ascertain the discrepancy between the pretest and posttest results, with the following hypotheses

1. $H_0$ : There is no significant difference in the use of AI as a learning tool for teaching students basic arithmetic skills.
2. $H_1$: There is a significant difference in the use of artificial intelligence (AI) as a learning tool for teaching students basic arithmetic skills.

The basis for decision making is as follows: if the significance value (Sig) is less than 0.05, then $H_0$ is rejected and $H_1$ is accepted. It is evident that a substantial discrepancy exists in the utilisation of AI as a pedagogical tool for basic numeracy instruction. In instances where the significance value (Sig) exceeds 0.05, the null hypothesis ($H_0$) is substantiated and the alternative hypothesis ($H_1$) is refuted. Consequently, it can be deduced that there is no substantial variance in the employment of AI as a medium for basic arithmetic skill development (Niruri et al., 2023).

## RESULT AND DISCUSSION

### Data Analysis The Effectiveness Of Artificial Intelligence (AI) Based Learning Media In Training Basic Arithmetic Skills

The AI-based mathematics learning media in this study utilizes a combination of generative AI technologies, namely ChatGPT and Canva AI. The validation of this material was conducted by PGMI lecturers at the Al Fithrah Institute (IAF) in Surabaya and teachers at the Al Fithrah Elementary Madrasah (MI). This process aimed to produce learning materials that are not only innovative but also meet the standards of suitability for use in the ongoing learning process (Tulak et al., 2024). The subsequent section presents a preview of the material.

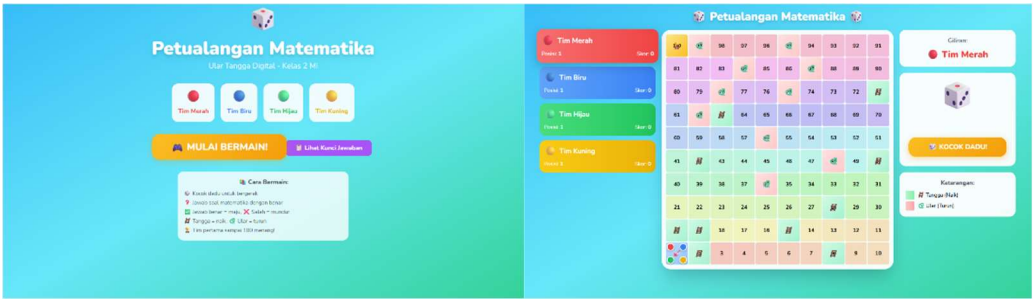


**Figure 1. AI-Based Learning Mathematics Materials**

### Validity Test

The evaluation of instructional media and test instruments in this study is based on criteria of validity. In this context, the term "validity" signifies the alignment between the content, presentation, and function of the media and instruments with the established learning objectives. The following table summarizes the validity results from media experts and test experts:

**Table 2. Summary of Media Expert Validity Results**

| | Hasil Lembar Validasi Ahli Media | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 | P13 | P14 | P15 | P16 | P17 | P18 | P19 | P20 | Skor | Maksimal | Total | Kriteria |
| Dosen PGMI IAF | 4 | 4 | 3 | 3 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 3 | 4 | 4 | 72 | 80 | 90% | Sangat Valid |
| Guru MI AL Fithrah Surabaya | 4 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 74 | 80 | 92% | Sangat Valid |

The results of the media validity assessment, conducted by experts-specifically a lecturer from the PGMI program at IAF and a mathematics teacher at MI Al Fithrah were as follows: The assessment evaluated 20 items (P1–P20) covering aspects of the suitability of AI-based learning media. Each item was rated on a scale of up to 4, resulting in a maximum total score of 80.

The evaluation results show that the first validator scored 72 out of a maximum of 80, representing a 90% accuracy rate. Meanwhile, the second validator scored 74 out of a maximum of 80, representing a 92% accuracy rate. The percentages were calculated by dividing the actual score by the maximum score and multiplying the result by 100%. According to the established validity assessment criteria, both results are classified as " Sangat Valid" due to their placement within the 81–100% range. This signifies that the AI-based learning media developed has met the criteria for suitability in terms of content, appearance, and functionality (Andita et al., 2025).

**Table 3. Summary of Expert Test Validity Results**

| | Hasil Validasi Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | P1 | P2 | P3 | P4 | P5 | Skor | Maksimal | Total | Kriteria |
| Dosen PGMI IAF | 3 | 3 | 3 | 4 | 4 | 17 | 20 | 85% | Sangat Valid |
| Guru MI Al Fithrah Surabaya | 4 | 3 | 3 | 3 | 4 | 17 | 20 | 85% | Sangat Valid |

This was followed by a presentation of the summary of the test validity results conducted by the two validators: a lecturer from the PGMI program at IAF and a mathematics teacher from MI Al Fithrah in Surabaya. The assessment focused on five items (P1–P5), which reflect the instrument's suitability for measuring students' basic numeracy skills. The evaluation of each item was performed on a scale of 1 to 4, resulting in a maximum possible total score of 20.

The assessment results show that both validators each scored 17 out of a maximum score of 20, representing a percentage of 85%. This percentage was calculated by comparing the score obtained to the maximum score and then multiplying by 100%. A percentage of 85% falls into the "Sangat Valid" category because it lies within the 81%–100% range, as based on the criteria for validity. This indicates that the test instrument used has met the validity criteria, both in terms of content, clarity of questions, and alignment with learning indicators (Anggraini, et al,. 2026).

## Hypotesis Test

Subsequent to the results of the validity test, which showed that the AI-based learning media and test instruments fell into the **"Sangat Valid"** category, the next step was to test the use of these media during the learning process. The objective of this study is to ascertain the effectiveness of the learning media in training basic arithmetic skills. The study was conducted using a pretest and posttest design on a single group of respondents. Before the learning process, students were first administered an initial test (pretest) to assess their baseline proficiency in basic arithmetic.The students then engaged in learning activities that utilized mathematics learning media with artificial intelligence assistance that had been developed. After the learning process was completed, the students were given a final test (*Posttest*) to measure changes in their basic arithmetic skills following the use of the media. The testing in this study was conducted on 25 second-grade students at MI Al Fithrah in Surabaya.

**Figure 2. Documentation Pretest-Posttest.**

The data obtained from the pretest and posttest results were then analyzed using SPSS Version 27 to determine differences in students basic arithmetic skills before and after the AI-based learning media. The following table presents the results of the Paired Samples T-Test analysis using IBM SPSS Statistics Version 27. Based on the validity test results, the AI-based learning media and the test instruments were found to be highly valid. The next step in this research was to evaluate the use of this media during the learning process. The objective of this study is to ascertain the effectiveness of the assisted learning media in training students basic arithmetic skills.

**Table 2. Summary Normality Test**

**Tests of Normality**

| | | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | Pre | Statistic | df | Sig. | Statistic | df | Sig. |
| Post | 60 | ,448 | 11 | <,001 | ,572 | 11 | <,001 |
| | 80 | ,534 | 14 | <,001 | ,297 | 14 | <,001 |

a. Lilliefors Significance Correction

Prior to hypotesis testing, a normality test was conducted to determine whether the Pretest-Posttest scores were normally distributed. The Results of the Kolmogorov-Smirnov and Shapiro-Wilks Tests revealed significance values of less than 0.0001 for both data. Since the significance values were lower than the 0.05 threshold, the data were considered not normally distributed. Consequently, a non-paramtric statistical test was employed for futher (Ivanka & Cahaya Nurani, 2025).

**Table 3**. Summary Wilcoxon Test.

**Test Statistics[a]**

| | Post - Pre |
|---|---|
| Z | -4,669[b] |
| Asymp. Sig. (2-tailed) | <,001 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

The Wilcoxon Signed-Rank Test was subsequently performed to examine the differences between students' Pretest and Posttest Scores. The analysis yielded a Z value of -4,669 with an Asymp. Sig. (2-Tailed) value of less than 0.001. Since the significance value was below 0.05, the null hypotesis ($H_0$) was rejected and the alternative hypothesis ($H_1$) was accepted. These findings indicate a statistically significant difference between student' Score before and after the implementation of the AI assisted learning media(Fadilatunnisyah et al., 2024).

**Table 4.** Summary Paired Samples Statitics.

**Paired Samples Statistics**

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Pre | 71,20 | 25 | 10,132 | 2,026 |
| | Post | 92,80 | 25 | 9,798 | 1,960 |

The results of the data analysis, conducted using IBM SPSS Statistics Version 27 via the *Paired Samples T-Test*, provided an overview of the differences in students' basic arithmetic skills before and after the use of AI-based learning media. The mean score for the *Pretest* was 71.20,

while the mean score for the *Posttest* was 92.80, indicating a significant increase in performance. This indicates an increase of 21.60 points following the implementation of AI-based learning media (Yeni et al., 2022).

**Table 5**. Summary Paired Samples Test

**Paired Samples Test**

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | Pre - Post | -21,600 | 8,000 | 1,600 | -24,902 | -18,298 | -13,500 | 24 | <,001 |

Furthermore, the results of the Paired Samples T-Test yielded a significance value (Sig. 2-tailed) of 0.000, which is less than 0.05. This finding suggests that there is a substantial discrepancy between the pretest and posttest results. Consequently, the alternative hypothesis ($H_1$) is accepted, and the null hypothesis ($H_0$) is rejected. This finding suggests that the implementation of AI-based learning media has yielded positive outcomes in enhancing the basic arithmetic skills of second-grade students at MI Al Fithrah Surabaya (Ramadhan et al., 2025). This perspective aligns with Haguchi's assertion that the effectiveness of learning is contingent upon its capacity to engender a substantial transformation in students' learning outcomes throughout the learning process (Haguchi et al., 2026).

## Discussion

The significant improvement observed between the Pretest-Posttest scores indicates. The mathematics learning media with artificial intelligence (AI) assistance contributed positively to the development of students' basic arithmetic skills. This outcome suggets that the learning experiences facilitated through the media supported students in strengthening their understanding of fundamental arithmetic operations. Given arithmetic proficiency constitutes a foundational component of elementary mathematics, the improvement achieved following implementation of media reflects its potential to support acquisition of esential numeracy competencies.

Media can contribute to the development of arithmetic skills by creating learning conditions that promote conceptual understanding and skill acquisition (Maharani et al., 2026). AI functioned as an enabling component within learning environment, supporting the presentation of content and learning activities in ways that promoted students' engagement with arithmetic concepts (Hidayat et al., 2025). Effectiviness of the media may be associated withs its abilitity to provide structured learning experiences that support gradual development of arithmetic understanding (Andina Putri et al., 2025). Such organization is particularly important in elementary mathematic education, where conceptual foundations influence subsequent mathematical learning.

The implementation of artificial intelligence within learning media facilitated the organization of learning material into progressive learning stages enabling students to develop arithemetic skils through a sequence of increasingly challenging tasks (D. N. Anggraini et al., 2025). This approach is consistent with the nature of arithmetic learning, which requires learners to establish a solid understanding of basic operations before proceeding to more complex calculations (Andayani et al., 2024). Providing structured learning expreinces and repeated opportunities for pratice, the media supported both conceptual understanding and procedural fluency.

The present findings are consistent with previous research reporting positive relationship between technology-supported learning environments and mathematic achievement (Handini, 2025). Studies in mathematic education have shown that instructional media can enchance learning outcomes when they provide opportunities for active engagement, systematic pratice, and

meaningful interaction with mathematical concepts. The results of this study further support the view appropriately designed learning media can contribute to the development of arithmetic skills by creating learning conditions that promote conceptual understanding and skill acquisition.

## CONCLUSION

The findings of the study indicate that the mathematics learning media with artificial intelligence (AI) assistance is satisfactory in terms of its feasibility and effectiveness. The results of the validity test demonstrate that the learning media and test instruments are classified as "highly valid," indicating their suitability for utilization in the learning process. The results of the hypothesis test indicate a significant improvement in students' basic arithmetic skills, marked by a mean score difference of 21.60 between the Pretest and Posttest. Furthermore, the outcomes of the Paired Samples T-Test demonstrate a significance level of less than 0.05, thereby substantiating the effectiveness of AI-based mathematics learning media in cultivating students' basic arithmetic skills.

Consequently, the integration of learning tools that capitalize on the synergy of generative AI specifically, *ChatGPT* and *Canva AI* can emerge as a pioneering alternative to facilitate the mathematics learning process, particularly in fostering the development of fundamental arithmetic competencies among students in a dynamic and engaging manner. It is recommended that AI-based learning tools be utilized as an innovation in instructional activities to enhance student engagement and learning outcomes.

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