

Students' Numeracy Literacy Using Artificial Intelligence (AI)-Based Worksheets

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ABSTRACT

Artificial Intelligence has significant potential to enhance the mathematics learning experience. To fully realize the benefits of AI integration, it is crucial to develop teaching materials that effectively incorporate AI into classroom instruction. This study focuses on developing AI-based student worksheets to improve numeracy literacy skills among junior high school students. These worksheets were created with the support of AI technology and include AI applications that can be used directly during the learning process. Conducted in state junior high schools (SMP) and Islamic junior high schools (MTs) in Palembang, the project followed a series of formative evaluation stages. These stages involved self-evaluation, expert reviews, one-on-one sessions, small group testing, and field testing, alongside product dissemination activities. Data on students' numeracy literacy skills were gathered through interviews and tests, while the analysis process consisted of three key stages: data reduction, data presentation, and drawing conclusions. The findings showed that some students had already grasped the steps to solve problems. Overall, the evaluation results for the numeracy literacy test were categorized as high performance. The AI-based worksheets proved effective in helping teachers deliver engaging teaching materials and enhancing students' learning experiences, particularly in improving their numeracy literacy.

Keywords : artificial intelligence, worksheet, numeracy literacy

ABSTRAK

Artificial Intelligence memiliki potensi besar untuk memperkaya pengalaman belajar matematika. Untuk mengoptimalkan dampak positif dari pemanfaatan AI, pengembangan bahan ajar yang mendukung integrasi AI dalam pembelajaran dianggap penting. Penelitian ini bertujuan untuk menghasilkan Lembar Kerja Peserta Didik (LKPD) berbasis AI guna memperkuat kemampuan literasi numerasi siswa SMP. LKPD ini dikembangkan dengan bantuan teknologi AI dan dilengkapi aplikasi AI yang dapat digunakan dalam proses pembelajaran. Penelitian ini dilakukan di SMP dan MTs negeri di Kota Palembang dengan menggunakan tahapan evaluasi formatif, ditambah kegiatan diseminasi produk. Tahapan evaluasi formatif yang diterapkan meliputi: self-evaluation, expert review, one-to-one, small group, dan field test. Data terkait kemampuan literasi numerasi dikumpulkan melalui teknik wawancara dan tes. Analisis data dilakukan dalam tiga tahapan, yaitu reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa sebagian peserta didik sudah memahami langkah-langkah dalam menyelesaikan soal. Secara umum, hasil evaluasi tes literasi numerasi berada dalam kategori tinggi. LKPD berbasis AI ini terbukti dapat memudahkan guru dalam menyediakan bahan ajar yang efektif dan

memperkaya pengalaman belajar siswa, khususnya dalam meningkatkan kemampuan literasi numerasi.

Kata kunci : *artificial intelligence*, LKPD, literasi numerasi

INTRODUCTION

In the modern era, where real-time information is readily accessible, individuals must be able to process information quickly to keep up with technological advancements (Alam, 2013; Mukhlis & Rahayu, 2020). Within this context, literacy encompasses reasoning skills that are crucial for solving problems (Irawan et al., 2021). More specifically, numeracy literacy refers to the ability to formulate, apply, and interpret mathematical concepts to solve real-world problems (Dinni, 2018; Setiawan et al., 2014).

Recognizing its importance as a key indicator of national progress, Indonesia has made numeracy literacy a flagship educational priority. To strengthen this competency, the government introduced the Merdeka Curriculum as part of its broader educational reforms (Feriyanto, 2022). Law Number 20 of 2023 emphasizes the development of thinking skills that are competent, creative, independent, and responsible. To achieve these goals, literacy and numeracy have been established as the minimum competency standards (AKM) that students must achieve to demonstrate learning success (Muliantara & Suarni, 2022; Widiyasari & Eminita, 2023).

Strengthening literacy and numeracy in schools is essential, and several initiatives have been undertaken to achieve this goal. These include fostering numeracy literacy activities, establishing school literacy teams (TLS), involving external stakeholders, encouraging real actions by practitioner groups, and implementing school programs that directly engage students (Muliantara & Suarni, 2022). To continuously improve the quality of learning, evaluation activities are carried out both during the learning process and at various school levels.

Students' numeracy literacy achievements can be measured through assessment results. One notable source of assessment data is the Programme for International Student Assessment (PISA). In the 2022 PISA assessment, Indonesian students showed an improvement in ranking by 5–6 positions. However, this progress was accompanied by a decline in numeracy literacy scores compared to previous results (Azhar et al., 2023; Dewi et al., 2023; OECD, 2023). This indicates that students' numeracy literacy skills remain low. Several factors contribute to this issue, including the lack of adequate learning infrastructure, limited availability of teaching materials, and insufficient innovation in mathematics learning technology (Feriyanto, 2022).

In the field of educational technology, instructional materials powered by artificial intelligence (AI) are currently being developed to address challenges in student learning (Zawacki-Richter et al., 2019). This innovation holds great promise as a solution to the low numeracy literacy skills observed among students. One example of AI-powered tools is the student worksheet, which can identify individual learning challenges and provide targeted support to address them (Hwang & Tu, 2021). A significant issue contributing to poor numeracy literacy is the tendency of students to rely heavily on internet sources rather than textbooks provided by teachers for problem-solving (Feriyanto, 2022). AI-based worksheets can help mitigate these challenges by offering innovative and accessible teaching materials that benefit both

teachers and students, particularly in areas with limited infrastructure. With AI assistance, teachers can efficiently create teaching resources that provide students with rich numeracy literacy experiences. Likewise, students gain easier access to diverse learning materials, ultimately enhancing their learning outcomes. Given these considerations, this study focuses on developing AI-based student worksheets to strengthen numeracy literacy among junior high school students. The research specifically explores students' numeracy literacy after the implementation of these AI-powered worksheets.

METHOD

This article is part of a developmental design utilizing formative evaluation, a structured approach ideal for educational product development (Tessmer, 2013). The evaluation process comprises four stages: self-evaluation, expert review combined with one-to-one evaluation, small group testing, and field testing. By emphasizing iterative feedback and refinement, this model ensures educational materials meet the needs of both students and educators (Cennamo & Kalk, 2019; Shahidayanti et al., 2024).

Following the formative evaluation, the study advanced to the dissemination stage, which involved systematically sharing the research product with target groups through well-structured activities to maximize its effectiveness. At this stage, the AI-assisted worksheets were implemented in a different classroom, providing additional feedback for refinement, enhancing their benefits, and offering insights into student learning outcomes. This study employed a qualitative research method, which is effective for generating detailed, interpretative reports and understanding specific contexts (Thanh & Thanh, 2015). Data were collected using tests, questionnaires, and semi-structured interviews. The analysis followed three stages: data reduction, data presentation, and conclusion drawing (Moeloeng, 2013).

RESULTS AND DISCUSSION

AI-assisted worksheet utilizes AI in two ways: (1) Creating worksheets using AI tools such as Kreado AI, Gemini AI, Bing AI, Comic AI, Canva, and Quizizz for generating learning videos, math comics, graphics, animations, and assessment questions; (2) Enhancing the learning process through AI tools like ChatGPT, Gemini AI, and Perplexity AI to improve students' learning experiences.

Students completed a final test after learning with AI-assisted worksheets. The test consisted of three essay questions aligned with numeracy literacy indicators. Five topics were tested in different classes based on the implemented worksheets: One-Variable Linear Inequalities, Algebraic Operations, Two-Variable Linear Equation Systems, Measures of Central Tendency, and Data Presentation. The results were analyzed and categorized using the numeracy literacy scale (0-4), as shown in Table 1.

Tabel 1. Example of the process for assigning student answer scales

The questions are based on numeracy literacy indicators						
	Question 1		Question 2		Question 3	
Student	Indicator 1	Indicator 2	Indicator 1	Indicator 2	Indicator 1	Indicator 3
1	4	4	4	4	4	4
2	4	4	4	4	4	4
3	4	4	4	4	4	4
4	4	4	4	4	4	4
5	4	4	4	4	4	4
6	4	4	4	4	4	4
7	4	4	4	4	4	4
8	4	4	4	3	4	2
9	4	4	4	3	4	2
10	4	4	4	3	4	2
11	4	4	4	3	4	2
12	4	4	4	3	4	2
13	4	4	4	3	4	2
14	4	4	4	2	4	3
15	4	4	4	2	4	3
16	4	4	3	3	2	0
17	4	4	3	3	2	0
18	4	4	3	2	4	0
19	4	4	2	2	2	0
20	4	2	1	0	1	0

Furthermore, the data on the numeracy literacy indicators for the five classes are presented more clearly by analyzing students' responses based on their achievement of these indicators. The results show that some students have understood the steps to solve problems. For instance, in the first indicator, writing numbers and symbols related to algebraic operations correctly and completely, students demonstrated their understanding as follows:

2) a.) dik $= p = (5x+3)$
 $l = (6x+9)$
 $k = 2(p+l)$
 $= 2(5x+3) + (6x+9)$
 $= 2(11x+12)$
 $= 22x + 24m$

b.) $l = p \times l$
 $p = (5x+13) \times (6x+9)$
 $= 30x^2 + 45x + 18x + 27$
 $= 30x^2 + 63x + 27$
 $l = 30x^2 + 63 + 27 m^2 //$

Figure 1. Student's answer of algebraic operations topic

Based on Figure 1 in the algebraic operation topic, the tested question was a descriptive type, representing one form of numeracy literacy. In their responses, AI students demonstrated the ability to answer correctly by following the numeracy literacy indicators. First, they wrote the relevant numbers and symbols for algebraic operations (first indicator). Next, they identified the given data from the presented table (second indicator). A total of 19 students successfully answered this question. These results indicate that some students already understand the steps required to solve the problem based on the numeracy literacy indicators.

<input checked="" type="checkbox"/>	a.	$2x + 5y = 13.000$		
<input type="checkbox"/>		$3x + 4y = 16.000$		
<input type="checkbox"/>	b.	$2x + 5y = 13.000$	$ \times 3$	$6x + 15y = 39.000$
<input type="checkbox"/>		$3x + 4y = 16.000$	$ \times 2$	$6x + 8y = 32.000$
<input type="checkbox"/>				$-$
<input type="checkbox"/>				$7y = 7.000$
<input type="checkbox"/>				$y = \frac{7.000}{7}$
<input type="checkbox"/>				$y = 1.000$
<input type="checkbox"/>				
<input type="checkbox"/>		$2x + 5y = 13.000$	$ \times 4$	$8x + 20y = 52.000$
<input type="checkbox"/>		$3x + 4y = 16.000$	$ \times 5$	$15x + 20y = 80.000$
<input type="checkbox"/>				$-7x = -28.000$
<input type="checkbox"/>				$x = \frac{-28.000}{-7}$
<input type="checkbox"/>				$x = 4.000$

Figure 2. Student's answer of two-variable linear equations system

The two-variable linear equation system topic (Figure 2) featured a descriptive question designed to assess students' numeracy literacy skills. This type of question required students to demonstrate their analytical and problem-solving abilities by

interpreting provided information and selecting an appropriate mathematical strategy. Students tackled the question systematically, starting with an analysis of the given data before applying the elimination method to reach a solution.

The results for question number 1 revealed that 13 students successfully arrived at the correct solution, indicating a solid understanding of the concepts and processes involved. Based on the numeracy literacy indicators, the majority of students displayed proficiency in identifying key information, formulating a mathematical model, and applying the appropriate steps to solve the problem. This outcome suggests that the instructional approach, including the integration of AI-assisted worksheets, effectively supported students in mastering the necessary skills for solving two-variable linear equation problems.

Furthermore, the students' performance highlights their ability to connect abstract mathematical concepts with structured problem-solving techniques. This aligns with the broader objectives of numeracy literacy, which emphasize not only computational accuracy but also the development of logical reasoning and critical thinking skills. The findings reinforce the potential of well-designed instructional materials to enhance student comprehension and application of mathematical concepts in real-world contexts.

1.) Model matematika

$$50 + 15x \leq 500$$
$$-50 + 50 + 15x \leq 500 - 50$$
$$15x \leq 450$$
$$15x : 15 \leq 450 : 15$$
$$x \leq 30$$

Jadi, Pertidaksamaan ini menunjukkan bahwa jumlah kotak (x) yang dapat dimuat Pak Adi dalam sekali pengangkutan harus tidak boleh lebih dari 30 kotak.

Mathematics Model

$$50 + 15x \leq 500$$
$$-50 + 50 + 15x \leq 500 - 50$$
$$15x \leq 450$$
$$15x : 15 \leq 450 : 15$$
$$x \leq 30$$

So, this inequality shows that the number of boxes (x) that Mr. Adi can load in one shipment is no more than 30 boxes.

Figure 3. Student's answer of linear inequalities of one variable

In the one-variable linear inequality topic, the tested question was descriptive, representing an aspect of numeracy literacy. As shown in Figure 3, students successfully answered the question by first analyzing the information presented in

contextual story form, which reflected real-life situations, and then formulating the appropriate mathematical model. A total of 25 students demonstrated success in solving this question.

The results, based on numeracy literacy indicators and the consistently high scores in the final evaluation, highlight the effectiveness of the developed worksheets. These findings suggest that the learning media has a positive impact on students' learning outcomes, as evidenced by the improvement in their numeracy literacy skills. During the field test stage, most students exhibited a clear understanding of the problem by accurately identifying the problem statement before proceeding with the solution.

Students have the opportunity to have a deeper understanding of the subject matter through the creation of instructional materials, in this case worksheets, and learning through artificial intelligence. AI-generated worksheets offer a greater variety of simulations and visualizations pertaining to the mathematical ideas that students have studied, allowing them to develop a deeper comprehension.

Additionally, the use of AI as a supplementary learning tool, particularly in expanding the area where students need to be numerate and literate in order to comprehend concepts and solve given issues. This is in line with research results that state that learning with AI-driven simulations and interactive learning activities, AI can greatly enhance the educational environment (Kotsis, 2024). Another intriguing finding of this study is the rise in students' critical thinking and curiosity as a result of the more possibilities they have to ask questions of teachers and, more specifically, AI apps.

Numeracy literacy skills are seen based on the results of interviews and the completion of student scores after working on evaluation questions at the field test stage. However, despite the potential of AI to revolutionize education, significant barriers may hinder its effective implementation. Many schools, particularly those involved in this study, face challenges such as insufficient technological resources, including high-speed internet, adequate devices (PCs or smartphones), and appropriate software for AI-based learning.

Furthermore, AI-based education may not always be effective in enhancing basic learning skills. As highlighted by Mittal et al. (Mittal et al., 2024), the successful integration of pedagogical insights and human-AI collaboration is essential for achieving meaningful outcomes. However, a lack of educators' knowledge and skills in implementing AI within the classroom remains a significant barrier. Without adequate training and support, teachers may be hesitant to adopt new technologies or unable to leverage them effectively to improve learning processes.

CONCLUSION

Worksheets assisted by Artificial Intelligence (AI) for topics such as Data Presentation, Statistics, Algebraic Arithmetic Operations, Two-Variable Linear Equation Systems, and One-Variable Linear Inequality Systems were developed based on numeracy literacy indicators. These worksheets have demonstrated a significant impact on improving students' numeracy literacy skills, as reflected in the final ability test results, where students achieved scores in the proficient category with an above-average performance.

Based on the observed potential effects of AI-assisted learning on numeracy literacy, researchers recommend that teachers integrate AI into learning activities in

two ways: (1) creating worksheets: Teachers can utilize AI applications to develop engaging learning materials, such as learning videos, mathematics comics, graphics, animations, and assessment questions. Examples of AI tools include Kreado, Gemini, Bing, ComicAI, Canva, and Quizizz, and (2) enhancing learning experiences: AI applications like ChatGPT, Gemini, and Perplexity can be used as interactive tools to enrich students' understanding and engagement during the learning process.

Furthermore, policymakers are encouraged to provide comprehensive training programs and facilitate access to AI tools for teachers in schools. Proper training will ensure that educators are equipped with the knowledge and skills to effectively integrate AI into teaching, ultimately improving learning outcomes.

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