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DEVELOPMENT OF A TEACHING AT THE RIGHT LEVEL (TARL)-BASED E-LKPD ON SOCIAL ARITHMETIC TO IMPROVE STUDENTS' CRITICAL REASONING SKILLS

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ABSTRACT
This study aims to develop an E-LKPD based on Teaching at the Right Level (TaRL) and to analyze the improvement of students' critical reasoning skills. The study was conducted with 29 seventh-grade students of class VII B at MTs Ar-Rahmah, Tasikmalaya City, using a Research and Development (R&D) method with the ADDIE model, which includes the stages of analyze, design, development, implementation, and evaluation. Data were collected through observation, interviews, critical reasoning tests, and questionnaires, with instruments consisting of expert validation sheets, response questionnaires, and test items. The results showed that in the analyze stage, learning was still procedural and had not implemented differentiation. The design stage produced a differentiated E-LKPD consisting of three ability levels: need guidance, proficient, and advanced. In the development stage, the product was categorized as highly feasible, with material validity of 88%, media validity of 93%, and test instrument validity of 85%. The product was also considered highly practical based on teacher responses (84%) and student responses (80.86%). During the implementation stage, learning was conducted in three meetings. In the evaluation stage, there was a significant improvement in students' critical reasoning skills, indicated by an increase in the mean score from 21.72 to 76.59, an N-Gain score of 0.70 (high category), and the paired sample t-test result showing p = 0.000 (<0.05). Therefore, the TaRL-based E-LKPD is effective in improving students' critical reasoning skills.
Keywords: critical reasoning skills ; E-LKPD; social arithmetic; teaching at the right level.

ABSTRAK
Penelitian ini bertujuan untuk mengembangkan E-LKPD berbasis Teaching at the Right Level (TaRL) serta menganalisis peningkatan kemampuan bernalar kritis peserta didik. Penelitian dilaksanakan pada 29 peserta didik kelas VII B MTs Ar-Rahmah Kota Tasikmalaya dengan menggunakan metode Research and Development (R&D) model ADDIE yang meliputi tahap analyze, design, development, implementation, dan evaluation. Teknik pengumpulan data meliputi observasi, wawancara, tes kemampuan bernalar kritis, dan angket, dengan instrumen berupa lembar validasi ahli, angket respon, dan soal tes. Hasil penelitian menunjukkan bahwa pada tahap analyze, pembelajaran masih bersifat prosedural dan belum menerapkan diferensiasi. Tahap design menghasilkan E-LKPD terdiferensiasi dalam tiga level kemampuan, yaitu perlu bimbingan, cakap, dan mahir. Pada tahap development, produk dinyatakan sangat layak dengan persentase kelayakan materi 88%, media 93%, dan instrumen tes 85%. Produk juga tergolong sangat praktis berdasarkan respon guru sebesar 84% dan peserta didik sebesar 80,86%. Pada tahap implementation, pembelajaran dilaksanakan dalam tiga pertemuan. Tahap evaluation menunjukkan adanya peningkatan signifikan kemampuan bernalar kritis, ditandai dengan peningkatan rata-rata nilai dari 21,72 menjadi 76,59, nilai N-Gain sebesar 0,70 (kategori tinggi), serta hasil uji paired sample t-test menunjukkan p = 0,000 (<0,05). Dengan demikian, E-LKPD berbasis TaRL efektif dalam meningkatkan kemampuan bernalar kritis peserta didik.
***Kata kunci**: aritmetika sosial; E-LKPD; kemampuan bernalar kritis; teaching at the right level.*

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Introduction

The rapid development of science and technology in the era of globalization and the Industrial Revolution 4.0 toward Society 5.0 requires the education system to develop human resources equipped with 21st-century skills, such as critical thinking, creativity, communication, and collaboration (Miller et al., 2023). In the context of education in Indonesia, the strengthening of these competencies is reflected in the Graduate Profile, one of which is critical reasoning skills (Ramandani, 2025). Critical thinking skills are very important to have, because critical thinking can be used to solve problems and as a consideration in making the right decisions (Kusniawati et al., 2020). Critical reasoning skills play an essential role in mathematics learning, as they support students in understanding concepts, analyzing problems, and making logical decisions (Facione, 2015; Mufidah & Siswono, 2024). However, the results of a preliminary study conducted at MTs Ar-Rahmah in Tasikmalaya City indicate that students' critical reasoning skills are still low, with 62% of students categorized at a low level. This condition is influenced by learning practices that are still procedural, have not yet implemented differentiated instruction, and rely on conventional teaching materials that do not adequately support the development of higher-order thinking skills.

In line with the Merdeka Curriculum, which emphasizes differentiated and contextual learning (Indartiningsih et al., 2023), the Teaching at the Right Level (TaRL) approach is considered a relevant alternative. TaRL emphasizes instruction based on students' actual ability levels through diagnostic assessment, making learning more adaptive and capable of accommodating diverse learning needs (Ananda & Adi, 2024). Conceptually, this approach aligns with the development of Higher Order Thinking Skills (HOTS), particularly critical reasoning skills, as it encourages students to learn within their zone of development and engage in meaningful problem-solving activities.

In addition to instructional approaches, the selection of teaching materials is also a crucial factor. The use of E-LKPD as a digital teaching material offers advantages in terms of interactivity, flexibility, and ease of integrating formative assessments to monitor students' learning progress (Zein & Musyarofah, 2024). By integrating TaRL principles, E-LKPD can be designed in a differentiated manner to accommodate diverse student needs while supporting the development of critical reasoning skills.

Previous studies have shown that TaRL is effective in improving learning outcomes, particularly in basic literacy and numeracy at the elementary school level (Rostikawati et al., 2025). However, studies that integrate TaRL with the development of digital teaching materials to enhance higher-order thinking skills, especially critical reasoning skills at the junior secondary (SMP/MTs) level, are still limited. Furthermore, previous studies generally focus on overall learning outcomes and do not specifically examine the development of TaRL-based E-LKPD in the context of mathematics learning. Based on this research gap, there is a need to develop adaptive, differentiated digital teaching materials that are oriented toward

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higher-order thinking skills. Therefore, the research questions of this study are: (1) How is the process of developing a TaRL-based E-LKPD on social arithmetic at the junior secondary level? (2) How does the use of the E-LKPD improve students' critical reasoning skills?

This study offers a novel contribution through the development of a TaRL-based E-LKPD for social arithmetic at the junior secondary level, specifically aimed at improving students' critical reasoning skills. Unlike previous studies that focus on basic literacy, this research integrates the TaRL approach, digital teaching materials, and HOTS development within a single instructional design. Thus, this study is expected to provide both theoretical contributions to the development of differentiated mathematics learning and practical contributions in the form of adaptive digital teaching materials that are relevant to the needs of 21st-century learning.

Research Methods

This study employed a quantitative approach using the Research and Development (R&D) method to develop and examine the improvement of students' critical reasoning skills through a TaRL-based E-LKPD on social arithmetic. The development model used was ADDIE, which consists of five stages: Analyze, Design, Development, Implementation, and Evaluation (Cahyadi, 2019). The study was conducted at MTs Ar-Rahmah in Tasikmalaya City with seventh-grade students. The research subjects consisted of 10 students from class VII A in the small-scale trial stage and 29 students from class VII B in the implementation stage. The sampling technique used was purposive sampling, considering the suitability of class characteristics with the research objectives. The research design at the implementation stage employed a one-group pretest–posttest design, in which students' critical reasoning skills were measured before and after learning using the E-LKPD.

Data collection techniques included observation, interviews, questionnaires, and critical reasoning tests. The research instruments consisted of expert validation sheets, response questionnaires, and critical reasoning test items. Instrument validation was conducted by two subject-matter experts and two test instrument validators with expertise in mathematics, as well as two media experts with competencies in instructional media and graphic design. In addition, questionnaire validation was carried out by one validator for the teacher questionnaire and one validator for the student questionnaire. Instrument validity was determined based on content, construct, and language appropriateness, while the reliability of the test instrument was analyzed using internal consistency testing, such as the Cronbach's Alpha coefficient. The questionnaires were developed using a Likert scale ranging from 1 to 5.

The analyze stage was conducted over one week through classroom observations, interviews with teachers, and analysis of the curriculum and student characteristics to identify learning needs. The design stage was carried out over three weeks by developing the structure of the E-LKPD, designing TaRL-based learning activities, and preparing critical reasoning test instruments. The development stage lasted six weeks and involved the creation of the E-LKPD product and validation by experts. The implementation stage was conducted over two weeks

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through the application of the E-LKPD in classroom learning. Prior to instruction, students were given a diagnostic test to determine ability grouping within the TaRL approach. Grouping was based on the mean and standard deviation, classifying students into three categories: needs guidance, competent, and proficient (Azwar in Suhardi, 2022), as presented in the following Table 1.

Table 1 Students' Ability Categories

Category	Score Range
Needs Guidance	Score ≤ Mean − Standard Deviation
Competent	Mean − SD < Score ≤ Mean + SD
Proficient	Score > Mean + Standard Deviation

Based on Table 1 after grouping, students were given a pretest to measure their initial critical reasoning skills, followed by a posttest after the learning process to determine the improvement. The evaluation stage was conducted over one week through data analysis of the research results.

Data analysis was carried out using percentage analysis to assess the feasibility and practicality of the product, as well as the N-Gain calculation using the following formula:

$$\frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}}$$

In addition, hypothesis testing was conducted using a paired sample t-test with a significance level of 0.05. Prior to hypothesis testing, prerequisite tests were conducted, including tests of normality and homogeneity. To ensure the consistency of the research results, controlled variables included the uniformity of the social arithmetic material presented in the E-LKPD, the duration of the learning process, the use of the same teacher, and the implementation of the TaRL-based E-LKPD as the primary instructional material throughout the learning process.

Results and Discussion

Result

The implementation of the TaRL-based E-LKPD on social arithmetic showed a significant improvement in students' critical reasoning skills. Figure 1 presents the comparison of the average pretest and posttest scores, while Figure 2 illustrates the percentage of achievement for each indicator of critical reasoning skills in Figure 1.

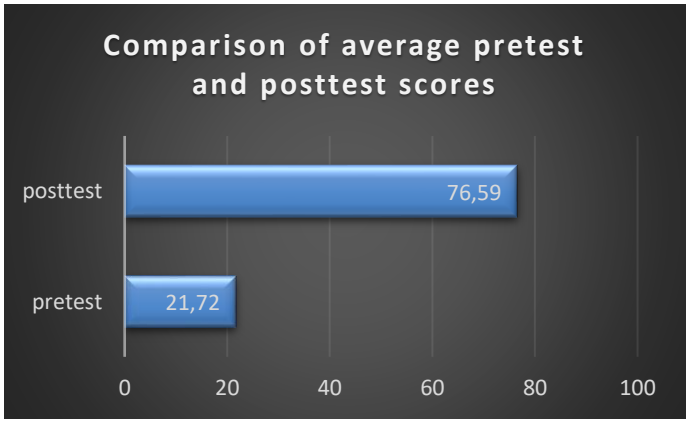

Figure 1 Comparison Of Average Pretest and Posttest Scores

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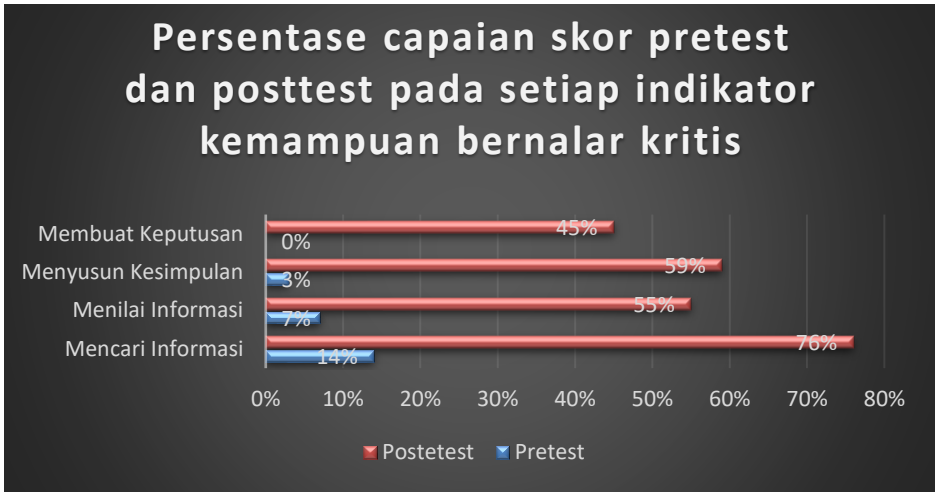

Figure 2 Percentage Of Pretest And Posttest Score Achievement For Each Critical Reasoning Ability Indicator

The average pretest score was 21.72, while the average posttest score increased to 76.59. The minimum and maximum scores in the pretest were 11 and 33, respectively, while in the posttest they increased to 65 and 94. These findings indicate an overall improvement in learning outcomes after the intervention using the TaRL-based E-LKPD.

When analyzed based on the indicators of critical reasoning skills, the improvements were as follows: identifying information increased from 14% to 76%, evaluating information from 7% to 55%, drawing conclusions from 3% to 59%, and making decisions from 0% to 45%. The highest improvement occurred in the identifying information indicator, while the lowest improvement was found in the decision-making indicator.

These results indicate that TaRL-based learning facilitates students according to their ability levels, thereby promoting the development of higher-order thinking skills. This finding is consistent with previous research stating that HOTS-based learning can improve students' critical thinking and problem-solving skills (Herman et al., 2022). Furthermore, the N-Gain calculation using SPSS is presented in Table 2.

Table 2. N-Gain Analysis Results

	N	Minimum	Maximum	Mean	Std. Deviation
NGain_Score	29	.60	.92	.7045	.07830
NGain_Persen	29	60.23	92.21	70.4482	7.83015
Valid N (listwise)	29				

Based on the analysis results, the average N-Gain score was 0.70 with a standard deviation of 0.07. This value falls into the high category ($0.70 \leq g \leq 1.00$) according to Hake (1999, in Lutfiyanti et al., 2025). This indicates that the improvement in students' critical reasoning skills was at an optimal level.

Furthermore, a normality test using the Shapiro–Wilk test showed that the significance values for the pretest and posttest were 0.420 ($p > 0.05$) and 0.125 ($p > 0.05$), respectively, indicating that both datasets were normally distributed. The homogeneity test also showed that the data had homogeneous variance ($p > 0.05$).

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Since the assumptions of normality and homogeneity were met, the analysis was continued using a paired sample t-test to determine the difference between the pretest and posttest results in Table 3.

Table 32. T-test results

		95% Confidence Interval of The Difference							
		Mean	**Std. Deviation**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**df**	**Sig. (2-tailed)**
Pair 1	Pretest-Posttest	-54.86207	4.91153	.91205	-56.73032	-52.99382	-60.153	28	.000

The results of the paired sample t-test in Table 2 show a t-value of -60.153 with a significance value (p-value) of 0.000 ($p < 0.05$). This indicates a significant difference between the pretest and posttest results. Therefore, it can be concluded that the use of the TaRL-based E-LKPD on social arithmetic has a significant effect on improving students' critical reasoning skills in Figure 3.

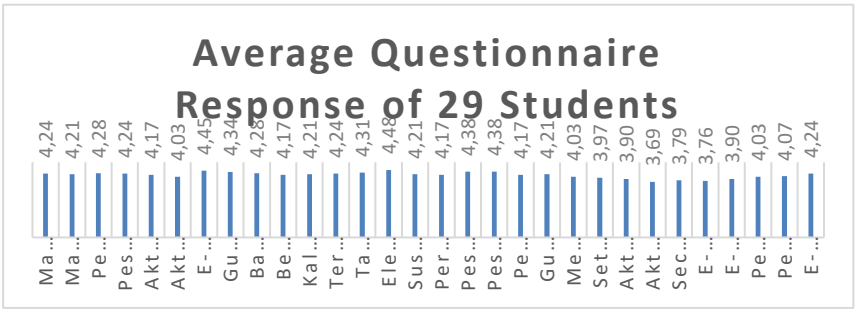

Figure 3. Average score of student response questionnaire (large group)

Figure 3 shows the average student responses to the use of the E-LKPD. Based on data from 29 students, the average score was 4.15, which falls into the very good category. This indicates that the E-LKPD is not only effective in improving cognitive abilities but also receives positive responses from students during the learning process.

The following is an excerpt of the developed TaRL-based E-LKPD on social arithmetic in Figure 4.

Figure 4. Sample of the TaRL-based E-LKPD on social arithmetic

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Discussion

The improvement in students' critical reasoning skills after the implementation of the TaRL-based E-LKPD on social arithmetic indicates that learning tailored to students' ability levels has a significant impact on the development of higher-order thinking skills. This finding is consistent with studies by Faturrosi et al. (2026) and Kasella et al. (2025), which state that TaRL-based worksheets are effective in improving learning outcomes because the material is adjusted to students' abilities. In addition, Ismail (2024) emphasizes that student-centered and adaptive learning is more effective in developing higher-order thinking skills. Furthermore, Mursidah et al. (2024) also demonstrate that the implementation of the TaRL approach significantly improves students' critical thinking. Thus, the characteristics of TaRL, which adapt both learning materials and instructional strategies, encourage students to actively engage in thinking processes such as analyzing, evaluating, and making decisions. This study provides a more specific contribution by showing that the improvement occurs not only in general learning outcomes but also in students' critical reasoning skills as part of higher-order thinking skills.

A deeper analysis shows that the improvement in each indicator reflects a gradual cognitive development process. In the indicator of identifying information, the highest improvement indicates that students are increasingly able to recognize essential information and understand contextual problems. This suggests that TaRL is effective at the initial stage of critical reasoning, namely understanding the problem. In the indicator of evaluating information, students begin to assess the validity and relevance of information; however, the improvement is lower because this process requires more complex analytical abilities. In the indicator of drawing conclusions, students demonstrate the ability to integrate information and formulate logical conclusions, reflecting progress toward higher-order thinking. Meanwhile, in the indicator of making decisions, the lowest improvement indicates that this skill represents the highest level of critical reasoning, as it involves synthesis, evaluation, and consideration of various solution alternatives. Therefore, differences in improvement across indicators are influenced by the complexity of the cognitive processes involved.

The improvement in students' critical reasoning skills in this study can be explained by several key factors. First, the implementation of the TaRL approach allows students to learn according to their ability levels, thereby reducing learning gaps and increasing instructional effectiveness. Second, the use of activity-based and problem-solving-oriented E-LKPD promotes active student engagement in analysis, evaluation, and problem-solving processes, as supported by Munika et al. (2021). Third, interactive elements in the E-LKPD, such as videos, images, and exercises, enhance students' motivation and participation (Rahmadoni & Aini, 2025). In addition, diagnostic assessment within the TaRL approach helps teachers design more targeted instruction. Therefore, the observed improvement is the result of the integration of adaptive pedagogical approaches and interactive learning media, rather than a single contributing factor.

These findings are further supported by statistical test results indicating a significant improvement. This is in line with Andriyani et al. (2025), who found that LKPD-based and differentiated learning improves learning outcomes significantly.

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Moreover, Putri et al. (2024) reported that the TaRL approach enhances learning effectiveness, while 'Ulya et al. (2024) showed that E-LKPD increases students' learning engagement. Furthermore, Rosyid et al. (2025) and Azizah and Safrina (2025) confirmed that TaRL contributes to the improvement of students' mathematical reasoning abilities. These findings are also consistent with Aliyah et al. (2025), who reported that TaRL is effective in improving mathematical problem-solving skills, particularly because instruction is aligned with students' actual ability levels. The use of media can improve critical thinking skills (Vahlia et al., 2020).

When compared with international studies, the results of this study are consistent with global findings. A study by the Abdul Latif Jameel Poverty Action Lab (J-PAL) using a randomized controlled trial (RCT) design concluded that "Teaching at the right level substantially improves learning outcomes" (Banerjee et al., 2016). In addition, the implementation of TaRL in several African countries has shown significant improvements in literacy and numeracy skills. Rostikawati et al. (2025) also demonstrated that TaRL remains relevant in modern technology-based learning contexts. These findings are further supported by Miller et al. (as cited in Astiantih & Akfan, 2023), who stated that critical thinking is an essential 21st-century competency, and by Abrami et al. (2015), who found that systematic instructional strategies can significantly improve critical thinking skills. In the context of digital learning, Kong (2021) emphasized that technology-based instruction enhances higher-order thinking skills through interactivity. Thus, the main distinction of this study lies in the integration of TaRL and E-LKPD, which provides additional reinforcement through interactive learning.

From a theoretical perspective, the findings of this study support constructivist theory, which emphasizes that students construct knowledge based on their experiences and prior knowledge. In addition, the findings align with differentiation theory, which highlights the importance of adapting instruction to individual student needs. In the context of 21st-century skills, improvements in the indicators of evaluating information, drawing conclusions, and making decisions indicate that TaRL-based learning facilitates the gradual development of higher-order thinking skills. This suggests that the improvement in each indicator reflects a progression from lower-order thinking to higher-order thinking skills (HOTS).

However, this study has several limitations. The limited sample size restricts the generalizability of the findings. In addition, the relatively short duration of the study does not fully capture the long-term impact of the TaRL-based E-LKPD. The study also focuses only on social arithmetic material, so its effectiveness in other mathematical topics remains to be explored. Therefore, future research is recommended to examine this approach over a longer period, across various subject matters, and in more diverse educational contexts.

Conclusion and Suggestion

The development of the TaRL-based E-LKPD on social arithmetic resulted in a learning medium that is valid, practical, and effective for use in mathematics learning. The developed E-LKPD is capable of accommodating students' diverse abilities through differentiated instruction.

Furthermore, the use of the TaRL-based E-LKPD has been proven effective in improving students' critical reasoning skills, as indicated by a significant increase in

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learning outcomes, a high N-Gain score, and statistical test results showing a significant difference between pretest and posttest scores. This improvement occurred across all indicators of critical reasoning skills, including identifying information, evaluating information, drawing conclusions, and making decisions.

However, the findings of this study are limited by the sample size, duration of the study, and scope of the material, indicating the need for further investigation in broader contexts. Based on the findings, it is recommended that teachers integrate TaRL-based E-LKPD into classroom instruction as part of a differentiated learning strategy, beginning with diagnostic assessment. Schools and policymakers should support the implementation of TaRL-based learning within the Merdeka Curriculum framework through teacher training and the provision of digital learning facilities. Future research is recommended to examine the effectiveness of TaRL-based E-LKPD across various subject areas, educational levels, and longer implementation periods, as well as to integrate it with other approaches such as Culturally Responsive Teaching (CRT) or storytelling.

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