Development of Integrated TaRL Teaching Materials to Foster Deep Learning in Elementary School

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Abstract: This research and development (R&D) study aims to develop and evaluate the validity and practicality of integrated teaching materials based on the Teaching at the Right Level (TaRL) approach with deep learning principles to enhance the mathematical understanding of fourth-grade elementary school students. The study was conducted in response to the challenge of teachers' limited competence in designing teaching tools that are responsive to students' diverse needs and characteristics, a key requirement of Indonesia's Independent Curriculum. The ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) was employed as the systematic development framework. The subjects were students from SDN 131/IV, SDN 42/IV, and SDN 64/IV in Jambi City. Data were collected through validation sheets by experts and practicality questionnaires administered to teachers and students. The results demonstrated that the developed teaching materials achieved a very high validity level, with an average score of 97.36% across media, content, and language aspects. Furthermore, practicality tests showed consistently high scores from both teachers and students across all three schools, with averages above 89%, categorized as "Good Practicality." The findings indicate that the deep learning-based TaRL integrated teaching material is a valid, practical, and effective tool for facilitating personalized, engaging, and collaborative mathematics learning, ultimately supporting the goals of differentiated instruction within the Independent Curriculum.

Keywords: Deep learning; Integrated; TaRL; Teaching material

Introduction

Education is designed as a systematic effort to develop and enhance individual potential, including intelligence, character, and other positive capacities. Learning is defined as an interactional process between teachers and students, where the teacher's role is not only to provide guidance but also to create opportunities for students to engage in a learning environment aligned with established pedagogical goals. As facilitators, teachers are expected to design and implement active learning strategies that foster student interest and expand their knowledge (Faradila et al., 2023; Skrbinjek et al., 2024). Furthermore, policymakers emphasize the importance of supporting all students in developing their knowledge and skills at their own pace (Rock et al., 2008; Sanusi et al., 2024), while promoting equity and inclusivity in education. Therefore, educators must possess strong pedagogical competencies, including the ability to design creative and effective learning tools that cultivate an active and engaging learning atmosphere. A primary challenge faced by the Indonesian education system within the context of global complexity is teacher competency in designing and developing teaching materials, such as integrated materials, that are responsive to student needs and abilities (Fathimah et

al., 2024).

Many teachers still lack the skills to create and integrate learning approaches with innovative methods that encourage interactive learning, for example, through the development of integrated teaching materials using a TaRL (Teaching at the Right Level) approach based on deep learning principles (Rosnaeni, 2021; Putri & Muldash, 2024). The TaRL approach is specifically designed to be aligned with student achievement, ability, and needs. By implementing integrated teaching materials with a deep learning-based TaRL approach, educators can build an active learning environment that offers meaningful opportunities tailored to student learning needs. Teachers must realize that every student is unique, possesses different qualities from birth, and therefore that their educational needs must be addressed optimally. Furthermore, research highlights that challenges can positively stimulate the human brain, but only when presented at an optimal level of difficulty. If students are given tasks that are too easy, they may become quickly bored, which limits their cognitive growth. Conversely, if the tasks are too difficult, students may lose interest and motivation.

Therefore, effective learning tasks must be sufficiently challenging—slightly above the learner's current proficiency level. The Indonesian government, through the Ministry of Primary and Secondary Education, has introduced the Merdeka Curriculum. This curriculum provides flexibility for teachers to provide instruction based on their students' capacities, an approach widely known as Teaching at the Right Level (TaRL). Instead of emphasizing grade-level standards, TaRL encourages teachers to design learning experiences aligned with student readiness levels. The goal of this approach is to realize the student-centered educational philosophy of Ki Hadjar Dewantara [ki ˈhadʒar dɛwanˈtara], strengthen students' literacy and numeracy skills, and ensure that every learner achieves the intended learning objectives. TaRL is closely linked to student interest and learning outcomes. Its implementation requires teachers to conduct diagnostic assessments to identify student interests and current achievement levels (Subandiyah et al., 2025). The results of these assessments serve as the foundation for teachers to plan instruction that reflects their students' unique characteristics. By implementing TaRL, teachers can adapt their teaching to inspire, motivate, and enrich the learning process, thereby fostering greater student engagement and participation while enhancing interest and achievement (Susanti et al., 2023; Dahri et al., 2024).

In implementing the TaRL approach, teachers are required to adapt the learning process according to their students' characteristics. This approach emphasizes differentiated treatment, allowing student abilities and interests to develop according to their respective growth stages. Such adaptation may involve adjustments to various aspects, including the scope and content of instructional material, the learning process, expected learning outcomes, and the overall learning environment. Currently, teachers are also expected to design and deliver instruction aligned with the curriculum, one way being through the use of integrated teaching materials. These materials should be designed to facilitate student understanding according to their individual achievement levels and abilities. Integrated teaching materials are instructional materials designed to support students in the independent learning process. The integration of teaching materials aligns with the development of the 2013 Curriculum, which emphasizes a shift from teacher- centered teaching to student-centered learning activities. The use of integrated teaching materials allows students with faster learning paces to complete tasks more quickly than their peers (Daud et al., 2025).

Furthermore, integrated teaching materials have several key functions. First, as self-learning resources, they facilitate students' ability to learn autonomously without heavy reliance on educators. Second, they can act as a substitute for certain instructional functions of the teacher, as integrated teaching materials must be able to present learning content clearly, structurally, and understandably. Third, integrated teaching materials function as an evaluation tool, allowing students to assess their own understanding of the material. Finally, they serve as reference material, as they contain essential content that students must master (Pedroso et al., 2023; Nwachukwu et al., 2025). Recent studies highlight the crucial role of deep learning in transforming educational practices by fostering adaptive, student-centered learning environments oriented towards meaningful engagement. According to Kwangmuang et al. (2021) and Sudarmono et al. (2025), the integration of deep learning in the classroom supports not only knowledge acquisition but also the formation of reflective, critical, and active learning that encompasses cognitive, affective, and psychomotor dimensions.

In the context of instructional design, Ding et al. (2024) assert that integrated teaching materials developed with a deep learning orientation enable students to apply knowledge to new situations, engage collaboratively, and develop critical and creative thinking skills, making the learning process more relevant and impactful. Complementing this perspective, Oo et al. (2024) and Reiser et al. (2024) show that design-based learning strategies can significantly enhance student motivation, active participation, and higher-order thinking through the implementation of authentic, project-based activities. These insights reinforce the importance of developing integrated

teaching materials using a TaRL approach based on deep learning principles, as such materials are better positioned to accommodate varying student readiness levels, foster deeper understanding, and enrich the overall learning experience.

Based on the background described above, the research problem can be formulated as an investigation into the extent of teachers' ability to develop instructional devices in the form of integrated teaching materials that align with the characteristics, needs, and learning competency levels of students. This research also seeks to examine whether these materials support the achievement of learning outcomes and to assess the level of understanding and academic achievement of elementary school students through the implementation of integrated teaching materials using a deep learning-based TaRL approach.

Method

The research method applied in this study consists of observation and Research and Development (R&D).

The implementation model used is the ADDIE model, which stands for Analysis, Design, Development, Implementation, and Evaluation. The ADDIE framework provides a set of structured educational procedures, carried out systematically at each stage (Cahyadi, 2019). This research and development focuses on producing learning tools in the form of integrated teaching materials that utilize a deep learning-based TaRL approach with the aim of improving elementary school students' mathematical understanding. The ADDIE model was chosen for its systematic and sequential structure, where each phase is evaluated to ensure the developed product is valid, reliable, and aligned with learning needs. The subjects of this research were students from SDN 131/IV Jambi City, SDN 42/IV Jambi City, and SDN 64/IV Jambi City. The research was conducted to assess mathematical proficiency using integrated teaching materials with a deep learning-based TaRL approach, aiming to enhance students' mathematical competence at the elementary level.


Figure 1. Research scheme
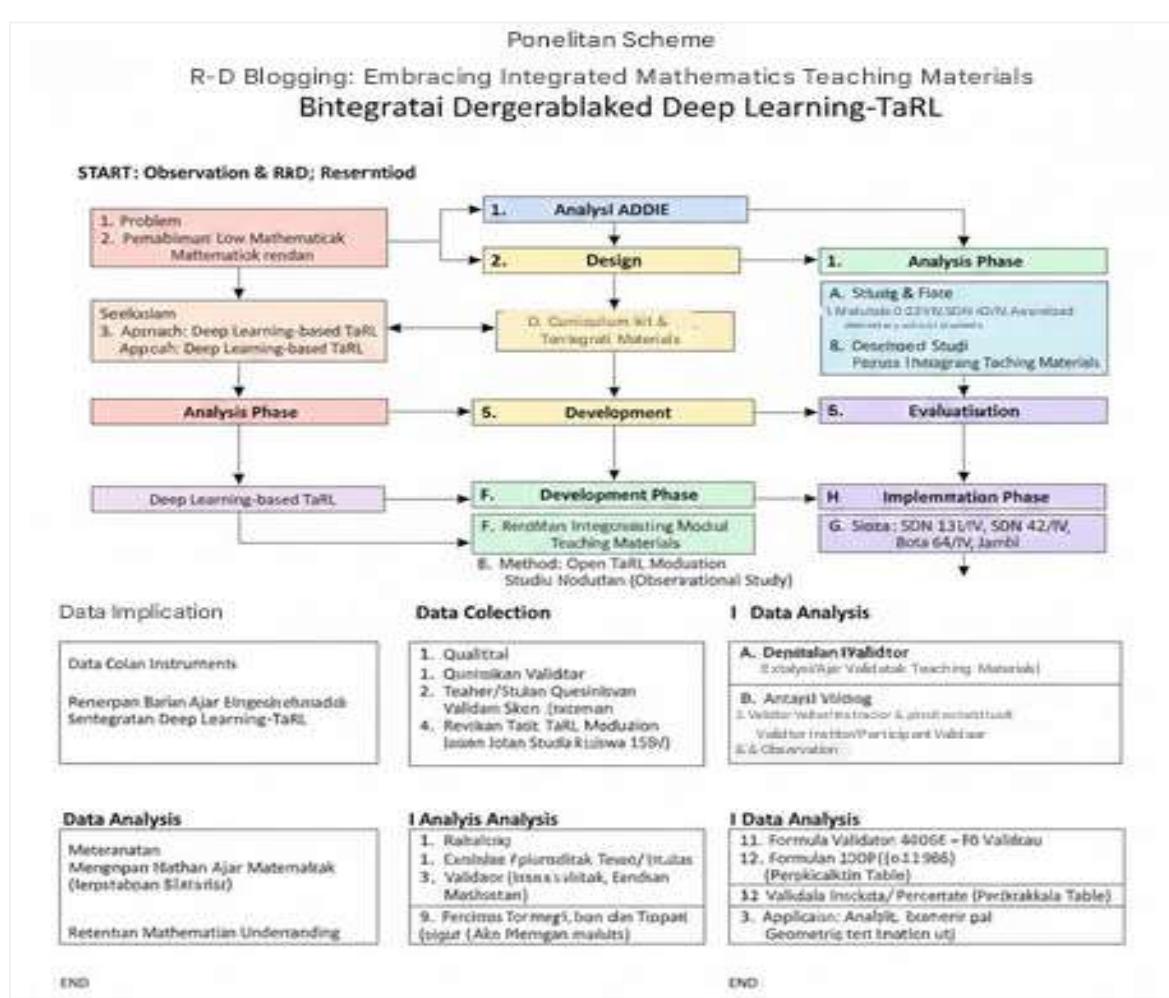
The deep learning-based approach is expected to increase student engagement and strengthen their problem- solving abilities. By following the structured guidance of the teaching materials, students are anticipated to apply the acquired knowledge more effectively. Data mining in this research used quantitative and qualitative approaches. Quantitative data consisted of validation results and responses from teachers and students regarding the implementation of the teaching materials, while qualitative data came from opinions and observations from validators, instructors, and research participants, serving as input for refining the materials. Research instruments included assessments from students, teachers, and validators. In this study, the researchers applied analytic geometry as a tool to test the integrated teaching materials with a deep learning-based TaRL approach through validation and practical implementation. Additional data collection was conducted through an observational study using open TaRL modulation. The analysis applied in this study combined qualitative and quantitative techniques.

Qualitative data analysis was derived from expert validator feedback, focusing on aspects such as media, content, and language. Quantitative data analysis was based on scores obtained from questionnaires given to respondents. The results of the validation stage were analyzed for their significance level, using a validation formula adapted from D'Agostino et al. (2025) and Koca et al. (2025). Furthermore, responses from validators were processed to calculate percentages, which were then used to determine the practicality criteria of the teaching materials, as presented in Table 1.

Table 1. Determine the Practicality Criteria of the Teaching Materials

Score (%)	Practicality Level
88 - 100	Good Practical (can be used without revision)
72.50 - 88	Practical sufficient (can be revised)
63 - 71.84	Less Practical (cannot be used)
0 - 62.46	Not too practical (total revision)

Results and Discussion

This research developed integrated learning materials applying the Teaching at the Right Level (TaRL) approach, based on deep learning for mathematics instruction in schools. Implementation adopted the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation. This classroom action research demonstrates that the TaRL (Teaching at the Right Level) approach, when combined with differentiated learning and dice game media, significantly enhanced student engagement in basic statistics. This is evidenced by the increase in the

active participation rate from 40% (pre-cycle) to 77% (cycle II) (Nirmala & Puspita, 2025). In the analysis stage, the focus was placed on identifying the need for integrated teaching materials utilizing the TaRL approach in fourth-grade elementary school classes. Observations showed that, in mathematics learning, teachers had not been able to design teaching materials that incorporated the TaRL framework, resulting in limited improvement in student learning outcomes. Existing teaching materials were primarily adapted from internet sources, highlighting the absence of contextualized instructional material. This condition underscored the need to develop integrated teaching materials based on the TaRL approach to enhance mathematical competence in elementary school. Furthermore, this need aligns with the requirements of the Merdeka Curriculum, which emphasizes the teacher's ability to design and adapt teaching materials according to diverse student learning needs. The competencies promoted through the TaRL approach are systematically embedded in the structure of the integrated teaching materials, ensuring their relevance to mathematics teaching and fostering a meaningful learning experience for students. An analysis of the characteristics of fourth-grade students at SDN 131/IV Jambi City, SDN 42/IV Jambi City, and SDN 64/IV Jambi City revealed that students tend to enjoy challenging and engaging learning activities. This finding highlights the difference between learning at the elementary level and instructional practices at higher education levels. For instance, activities such as group discussions and problem-solving in mathematics, intended to stimulate curiosity, are often hampered by limited resources and facilities, posing challenges for teachers. Furthermore, the learning process showed that students generally prefer collaborative (group-based) learning over individual learning. Their curiosity is reflected in their ability to ask questions and their willingness to actively participate in tasks according to instructions given by the teacher. Observations also indicated that students are accustomed to using technology, including computers and smartphones.

Based on this analysis of student characteristics, the researchers identified appropriate mathematics learning media to be incorporated into the teaching materials being developed. The design or planning stage was then carried out according to a previously developed storyboard. Product content was designed based on findings from the analysis stage, while the cover design and presentation of learning outcomes are illustrated in Figure 2.

The cover of the teaching materials was designed to visually represent the content within. It features the material title along with illustrations of students with diverse abilities and learning styles, symbolizing the

instructional process based on the TaRL approach. Consistent with the principles of the TaRL framework, the cover also integrates visual elements aimed at supporting children's language development and listening skills. The creative combination of images and text provides a distinctive and engaging learning medium. Inside the teaching materials, learning outcomes are outlined according to the current Merdeka Belajar Curriculum, which specifies the competencies students are expected to achieve during the learning process. The structure of each chapter, along with the overall layout of the teaching materials, is shown in Figure 3.
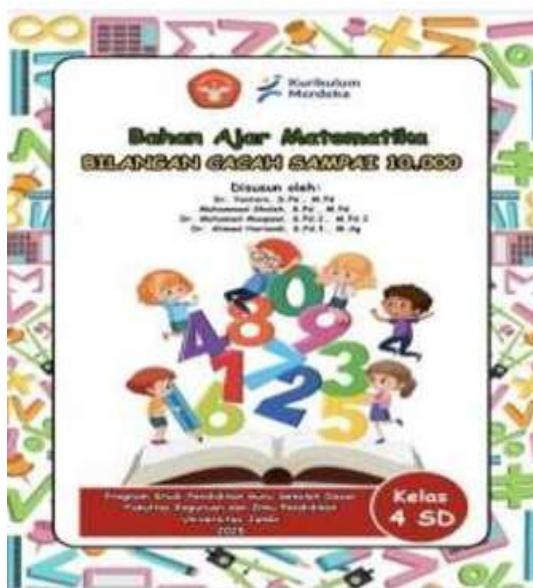
Figure 2. Cover

Figure 3. Layout

The overall structure of the teaching materials follows the guidelines outlined in the Merdeka Belajar Curriculum, starting with general information and ending with a bibliography that provides supporting references for the material. In the design stage, the product was first created as a prototype, which then underwent a validation process to ensure that the final version met established standards. Validation included the evaluation of media, content, and language aspects, with results from each reviewer summarized in Table 2.

Table 2. Level of Validation of TaRL Approach Integrated Teaching Material

Validation	Average Percentage Score (%)	Practicality Level
Media	97.14	High Validity
Material	96.61	High Validity
Language	98,34	High Validity
Validation Percentage	97.36	High Validity

Table 2 presents the validity level of the developed product, namely integrated teaching materials with the TaRL approach, designed to enhance elementary school students' mathematical abilities. Findings indicate that the average validity percentage was approximately 97.36%, which falls into the high validity category. These results show that the developed product is suitable for use in the instructional process, specifically in the fourth-grade elementary mathematics curriculum. Validation was conducted by experts with recognized competence in their respective fields to ensure evaluation reliability. For the media aspect, the average validity percentage reached 97.14%, confirming that the product meets the criteria for media use, specifically in implementing the TaRL approach for learning. In terms of material validation, the results showed 96.61%, while language validation reached 98.34%, both categorized as highly valid. This indicates that the language used in the teaching materials aligns with Indonesian spelling standards and is appropriate for elementary school students. Standardized spelling is used to support academic writing and research practices. Following the validation process, the implementation stage involved applying the product in real classroom settings through trials. After the teaching materials were deemed valid, small-group and large-group trials were conducted. The small-group trial aimed to assess the readability and clarity of the teaching materials, after which necessary revisions were made to prepare the product for wider implementation. In the large-group trial, the practicality of the teaching materials was evaluated by students and teachers using questionnaires administered at the end of the lesson. The results of this practicality assessment are presented in Tables 3, 4, and 5.

Table 3. Feasibility Level of TaRL Approach Integrated Teaching Material at SDN 131/IV Jambi City

Respondent	Average Percentage Score	Practicality Level
Teacher	92	Good Practicaly
Student	91.49	Good Practicaly
Averaging	92.57	Good Practicaly

Table 3 shows that the average percentage score for product suitability at SDN 131/IV Jambi City reached 92.57%, which falls into the "good practicality" category. Based on these results, both teacher and student responses support the practicality of the developed teaching materials. Student responses reached an average percentage of 91.49%, also categorized as good practicality, while teacher responses showed an average of 92% in the same category.

Table 4. Feasibility Level of TaRL Approach Integrated Teaching Material at SDN 42/IV Jambi City

Respondent	Average Percentage Score (%)	Practicality Level
Teacher	90.44	Good Practicaly
Student	89.30	Good Practicaly
Averaging	88.98	Good Practicaly

Table 4 shows that the average percentage of product suitability at SDN 42/IV Jambi City was 88.98%, categorized as good practicality. Based on these findings, both teacher and student responses support the practicality of the developed teaching materials. Student responses reached an average of 89.30% in the good practicality category, while teacher responses reached an average of 90.44% in the same category.

Table 5. Feasibility Level of TaRL Approach Integrated Teaching Material at SDN 64/IV Jambi City

Respondent	Average Percentage Score (%)	Practicality Level
Teacher	94.64	Good Practicaly
Student	93.39	Good Practicaly
Averaging	95.28	Good Practicaly

Table 5 shows that the average percentage of product suitability at SDN 64 Jambi City was 95.28%, categorized as good practicality. Based on these results, teacher and student responses further support the practicality of the developed teaching materials. Student responses scored an average of 93.39% in the good practicality category, while teacher responses reached an average of 94.64% in the same category. Integrated teaching materials, which integrate TaRL techniques, are designed to strengthen elementary students' mathematical abilities through structured instructional guidance. This strategy proved effective for classroom implementation, particularly in fourth-grade mathematics. The findings are supported by results obtained at each stage of the assessment process,

reflecting practical experience and validation thresholds that confirm the teaching materials' suitability for use in teaching and learning. The implementation of integrated teaching materials using a deep learning-based TaRL approach has proven effective in assessing students' basic abilities in arithmetic, reading, and writing, thus enabling personalized teaching according to different proficiency levels and fostering greater engagement, satisfaction, and collaboration, aligning with findings that deep learning approaches in elementary education strengthen critical thinking, contextual understanding, and motivation (Saputri et al., 2025). The analytical component of this research involved identifying the need for teaching materials in fourth-grade elementary school based on the TaRL approach.

Observations showed that in the mathematics learning process, teachers had not developed teaching materials that integrated the mathematics TaRL approach, thus limiting the improvement of students' mathematical abilities. Existing teaching materials were largely adapted from easily available internet sources (Rofi'i & Susilo, 2023; Sung et al., 2016). This problem underscores the importance of developing TaRL-based teaching materials grounded in deep learning principles to enhance elementary students' mathematical competence. Furthermore, the requirements of the Merdeka Curriculum, which mandates teachers to design and develop teaching materials aligned with student learning needs, further reinforce this need (Yuliandari et al., 2024). Competencies related to applying the TaRL approach through integrated teaching materials are expected to be embedded in mathematics subject content to support meaningful and effective learning. The TaRL approach has shown effectiveness in assessing students' foundational abilities in numeracy, reading, and writing, thus enabling instruction tailored to their low, medium, or high achievement levels.

Grouping students based on their abilities supports the implementation of more personalized and effective teaching strategies, which in turn enhances student engagement and cognitive development. Findings from this study indicate that students showed more enjoyment in the mathematics learning process when grouped according to their individual competencies, leading to higher levels of satisfaction and collaboration within groups. By emphasizing students' specific skill levels rather than grade level or age, the TaRL approach fosters enthusiasm for learning and reinforces active participation. These results suggest that the TaRL approach, when integrated with deep learning principles, provides a valuable framework for educators to enhance student motivation, engagement, and overall learning outcomes. In line with the developmental characteristics of fourth-grade students, they generally

prefer dynamic and challenging learning experiences, such as solving problems and participating in collaborative group discussions.

This indicates that the nature of learning in elementary school differs considerably from higher education levels, as students at this stage typically show greater curiosity and enthusiasm for cooperative activities—aspects that were limited during the COVID-19 pandemic (Riar et al., 2022; Yilmaz et al., 2024). Further classroom observations revealed that students are accustomed to using technology, such as laptops and smartphones, which can be integrated to support mathematics learning through digital-based teaching materials. The design of these materials was therefore adapted to these student characteristics and organized within a structured narrative framework. The validation process yielded highly satisfactory results. Media validation achieved an average score of 97.14%, confirming that the product successfully integrated appropriate instructional media. Content validation reached 96.61%, indicating that the material corresponds well with curriculum standards and the learning profiles of elementary school students (Agustini et al., 2019). Meanwhile, language validation obtained 98.34%, classified as highly valid, indicating that the teaching materials use correct Indonesian language conventions and are suitable for young learners.

Overall, these findings confirm that the teaching materials are viable and pedagogically appropriate, meeting curriculum requirements, addressing student needs, and adhering to principles of effective instruction based on deep learning. The implementation stage represented the use of the product in real classroom settings through trial activities. Both small-group and large-group trials were conducted after the product was validated. The small-group trial aimed to evaluate the readability of the developed teaching materials, and the findings were used to make improvements before proceeding to the large-group trial. In the large-group trial, the practicality of the product was assessed by students and teachers through questionnaires administered at the end of the learning session. Evaluation results at each stage indicated that the integrated teaching materials, applying the TaRL approach combined with deep learning principles, are feasible for use in mathematics teaching, particularly for fourth-grade elementary school students. This conclusion is supported by the obtained validity and practicality levels. Within the ADDIE development framework, the evaluation phase serves as a mechanism for refining the four previous stages (Shakeel et al., 2023; Spatioti et al., 2022).

In practice, changes in curriculum and educational policy can affect the implementation of the TaRL approach. Teachers may be required to adapt their strategies to align with new regulations or curriculum adjustments. Furthermore, challenges often arise from limited access to adequate technology and supporting software in many elementary schools, hindering effective implementation (Tomasouw et al., 2024; Mhlanga, 2024). Some teachers may also lack motivation to integrate technology into teaching or perceive little benefit in implementing the approach, resulting in slower adoption of innovative learning models. Additionally, inadequate training and limited digital literacy among teachers can lead to insecurity when integrating technology into classroom practice. For successful implementation, the use of technology must align with curriculum goals and not be treated as a foreign element (Abedi, 2024; Major et al., 2021). Gaps in students' access to technological devices at home also create inequalities in learning opportunities, with some students benefiting from better access than others. A significant challenge currently facing the Indonesian education sector amidst global complexity is the ability to design and implement integrated teaching materials that combine the TaRL approach with deep learning principles to foster collaborative and participatory learning practices (Sopacua, 2025; Mutambik, 2024). Through the use of technology, teachers can expand access to external resources, facilitate collaborative projects, and enhance communication and cooperation among students, thereby creating a richer and more meaningful learning experience.

The TaRL approach supports students in developing essential digital skills and literacy needed to adapt in an increasingly technological environment by integrating technology into classroom instruction. Technology enables teachers to provide timely and effective feedback, helping students identify areas requiring improvement. When used effectively, technology enhances student engagement and motivation, thereby increasing participation in learning. Furthermore, TaRL assists teachers in managing time and resources more efficiently, as technology can automate administrative tasks and provide access to a variety of online teaching materials (Zou et al., 2025; Haleem et al., 2022). The effectiveness of teaching materials plays a crucial role in the learning process for both teachers and students (Garay Abad & Hattie, 2025; Dursun & Aykan, 2025). Without well-structured teaching materials, teachers may face challenges in delivering effective instruction, potentially resulting in learning material that does not meet curriculum requirements. Therefore, teaching materials serve as a primary tool for ensuring learning quality and relevance. The development of TaRL-based teaching materials aims to enrich and strengthen instructional resources, offering reliable guidance for teachers during classroom practice. In line with the current Merdeka

Curriculum, teachers are given the flexibility to adapt existing government-provided teaching materials or design their own, tailored to the specific needs and characteristics of their students and schools.

Conclusion

This research successfully developed an integrated teaching at the Right Level (TaRL) teaching material based on deep learning principles to enhance elementary school students' mathematical understanding. The teaching materials were designed using the systematic ADDIE model, ensuring alignment with curriculum goals and student characteristics. Validation results showed high validity, with scores of 97.14% for media, 96.61% for material, and 98.34% for language, indicating that the teaching materials are pedagogically sound and suitable for the target learners. Furthermore, practicality assessments conducted in several schools revealed consistently high approval from teachers and students, with average scores exceeding 89%, confirming the usability and effectiveness of the teaching materials in real classroom settings. The integration of TaRL with deep learning facilitates a more personalized, engaging, and collaborative learning environment, allowing teachers to effectively address diverse student needs. The teaching materials not only support the emphasis of the Indonesian Merdeka Curriculum on differentiation and student- centered learning but also promote critical thinking, motivation, and academic achievement. However, successful implementation requires adequate teacher training, technological support, and continuous adaptation to policy changes. Future efforts should focus on scaling the application of the teaching materials, providing professional development for educators, and further exploring the synergies between TaRL and deep learning in various educational contexts.

Author Contributions
Conceptualization; methodology; validation; formal analysis; Y, M.S., M. M.; investigation; resources; data curation; A. H.; writing—original draft preparation; writing—review and editing; E. S.; visualization: S. M. All authors have read and approved the published version of the manuscript.

Conflicts of Interest
The authors declare no conflict of interest.

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