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Developing Local Wisdom-Based Fraction Teaching Materials Through a Deep Learning Approach

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Abstract
Fraction learning in elementary schools is often presented procedurally and lacks meaningful connections to students' daily experiences, resulting in limited conceptual understanding. This study aimed to develop and evaluate local wisdom-based teaching materials using a deep learning approach to enhance fourth-grade students' understanding of fraction concepts. The research employed a Research and Development (R&D) design following the ADDIE model: analysis, design, development, implementation, and evaluation. The teaching materials integrated local cultural contexts, particularly traditional regional foods and everyday activities, to provide authentic and meaningful learning experiences. Validation by media and content experts indicated that the materials were highly feasible for classroom use. The effectiveness of the product was tested using a one-group pretest–posttest design involving 50 students. The results showed a significant improvement in students' learning outcomes, with the mean score increasing from 54.04 to 77.12 and an average N-gain of 0.545, categorized as medium improvement. These findings suggest that integrating local wisdom with a structured deep learning approach effectively strengthens students' conceptual understanding of fractions while promoting contextual and engaging mathematics learning.
Keywords: Local Wisdom; Deep Learning; Fraction Concepts; Teaching Materials; Elementary Education

Abstrak
Pembelajaran pecahan di sekolah dasar sering kali disajikan secara prosedural dan belum dikaitkan secara bermakna dengan pengalaman sehari-hari siswa, sehingga pemahaman konsep yang dimiliki siswa masih terbatas. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi bahan ajar berbasis kearifan lokal dengan pendekatan deep learning untuk meningkatkan pemahaman konsep pecahan pada siswa kelas IV sekolah dasar. Penelitian ini menggunakan metode Research and Development (R&D) dengan model ADDIE yang meliputi tahap analysis, design, development, implementation, dan evaluation. Bahan ajar yang dikembangkan mengintegrasikan konteks budaya lokal, khususnya makanan tradisional daerah dan aktivitas sehari-hari, guna memberikan pengalaman belajar yang autentik dan bermakna bagi siswa. Hasil validasi oleh ahli media dan ahli materi menunjukkan bahwa bahan ajar berada pada kategori sangat layak digunakan dalam pembelajaran. Efektivitas produk diuji menggunakan desain one-group pretest–posttest yang melibatkan 50 siswa. Hasil penelitian menunjukkan adanya peningkatan signifikan pada hasil belajar siswa, dengan rata-rata nilai meningkat dari 54,04 menjadi 77,12 serta rata-rata N-gain sebesar 0,545 yang termasuk dalam kategori peningkatan sedang. Temuan ini menunjukkan bahwa integrasi kearifan lokal dengan pendekatan deep learning yang terstruktur efektif dalam memperkuat pemahaman konsep pecahan siswa sekaligus menciptakan pembelajaran matematika yang kontekstual dan menarik.
Kata kunci: *Kearifan Lokal; Deep Learning; Konsep Pecahan; Bahan Ajar; Pendidikan Sekolah Dasar*

INTRODUCTION

In the 21st century, education is no longer solely focused on mastering concepts, but also on students' ability to solve contextual problems, think critically, collaborate, and adapt to technological advancements and socio-cultural changes. In line with this, the Merdeka Curriculum emphasizes strengthening 21st-century competencies through the development of Critical Thinking, Communication, Creative Thinking, and Collaboration (4C) skills, as well as the formation of the Pancasila Student Profile (Cahya & Meliyani, 2025). To achieve this goal, the learning process is expected to be meaningful, contextual, and encourage active student engagement through the use of relevant and innovative teaching materials. Educators, as learning facilitators, are expected to develop lesson plans, monitor learning progress, and provide assessments that offer effective feedback while actively engaging students (Ani, 2025).

Mathematics is one of the core disciplines in elementary school that is crucial in developing logical, analytical, and systematic thinking skills (Dores et al., 2020). However, the mathematical learning abilities of elementary school students in Indonesia are still relatively low. The results of the 2019 Trends in International Mathematics and Science Study (TIMSS) show that the mathematical abilities of Indonesian students are below the international average. The TIMSS 2019 assessment showed that Indonesian students scored below the international mathematics average of 500 at multiple education levels. Additionally, the learning context data collected through teacher and student questionnaires reveals a connection between teaching practices and student outcomes (Mullis et al., 2020).

Mathematics learning in elementary schools is still widely viewed by students as difficult and abstract. This is due to the presentation of material that lacks connection between mathematical concepts and students' daily lives (Nurhikmayati, 2017 : Wiryana & Alim, 2023). Learning that places too much emphasis on calculation procedures without understanding the underlying concepts causes students to struggle in applying mathematical knowledge to solve real-world problems (Putri et al., 2025). This situation indicates a gap between the ideal demands of contextual and meaningful learning and the practical learning in the field, which remains procedural, abstract, and minimizes the use of innovative teaching materials.

Students tend to be able to memorize definitions or perform simple calculations, but they are not yet able to explain mathematical reasoning, use various representations, or understand fractions in real-life situations. This finding is reinforced by interviews with fourth-grade teachers at the schools, which show that learning still relies on textbooks and worksheets, and has not yet integrated the material with local wisdom contexts relevant to the students' environment. In fact, local wisdom, which is closely tied to students' daily lives, has the potential to serve as an authentic context that can help students build a deeper understanding of concepts.

The significance of this study is supported by the demands of the Merdeka Curriculum, which requires students to possess Critical Thinking, Communication, Creative Thinking, and Collaboration (4C Skills) (Cahya & Meliyani, 2025). The integration of local wisdom into learning not only serves as a learning context but also as a means to foster a love for local culture and shape students' character (Habsyi et al., 2025). Meanwhile, a deep learning approach enables students to build a gradual understanding of concepts through active involvement, visual exploration, reflective discussions, and the application of concepts in real-world situations (Wibowo & Ardiansyah, 2023).

Moreover, the deep learning approach significantly enhances students' understanding of mathematical concepts (Norsafitri et al., 2025). This approach offers a structured and meaningful learning pattern, allowing students to build understanding progressively through active involvement, visual exploration, and the application of

concepts in contexts relevant to daily life (Hendrianty et al., 2024). In line with this, Rahayu et al., (2025) emphasize that meaningful, attentive, and enjoyable deep learning is an effective strategy for improving students' understanding, engagement, and overall learning outcomes. Therefore, the development of teaching materials designed with a deep learning approach has become an urgent need in efforts to enhance the quality of mathematics education in elementary schools.

This study offers a new contribution through the development of mathematics teaching materials that integrate local wisdom in the form of traditional regional foods by applying a deep learning strategy to enhance students' comprehension of fraction material at the fourth-grade elementary school level. The developed teaching materials are expected to enhance students' conceptual understanding of mathematics while also providing meaningful and real-life-based learning experiences, as well as supporting the preservation of local wisdom as part of the nation's cultural identity. Furthermore, the development of teaching materials that integrate local wisdom with a deep learning approach, specifically to strengthen the understanding of mathematical concepts, particularly fractions in elementary schools, is still very limited. Therefore, this research offers a new contribution to contextual and meaningful mathematics education.

Considering the issues described above, this research seeks to develop local wisdom-based teaching materials using a deep learning approach to improve students' conceptual understanding of mathematics, particularly fractions, among fourth-grade elementary school students in Nguntoronadi District. The novelty of this research lies in the integration of local wisdom, in the form of traditional regional foods, into mathematics material with a deep learning approach, which is expected to increase student engagement and provide contextual and meaningful learning. The focus of this research is on how the development of local wisdom-based teaching materials with a deep learning approach can enhance students' understanding of mathematical concepts, particularly fractions, among fourth-grade elementary school students, as well as the feasibility, practicality, and effectiveness of the developed teaching materials in the learning context.

METHOD

This research uses a Research and Development (R&D) approach aimed at developing local wisdom-based teaching materials with a deep learning approach. This study aims to develop a printed teaching module integrating local cultural heritage, especially regional foods, into mathematics learning on fractions to strengthen the conceptual understanding of fourth-grade elementary school students. In addition, this study emphasizes the suitability and effectiveness of the developed teaching materials within the classroom learning context (Ulfah et al., 2025).

The research procedure follows the ADDIE model, which consists of five stages: (1) Introduction, which includes preliminary research to identify issues in mathematics learning, particularly in the topic of fractions, and to conduct a needs analysis required for developing the teaching materials; (2) Design, where the researcher develops the initial product of culturally based instructional materials adapted to the curriculum and learning objectives; (3) Development, which includes creating a prototype product, validation by content and media experts, and revisions based on expert feedback; (4) Implementation, which involves field testing of the teaching materials to measure their practicality; and (5) Evaluation, which includes testing the effectiveness of the product through pretest and posttest to assess the improvement in students' understanding of mathematical concepts (Ulfah et al., 2025).

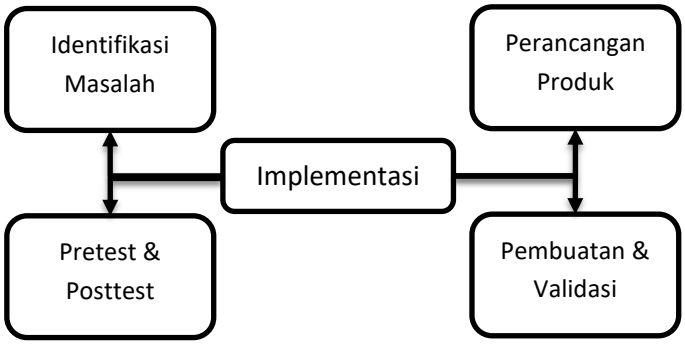

Figure 1. Stages of the ADDIE model research

The effectiveness test of the product uses the pre-experimental design of One-Group Pretest–Posttest, where one group of students is given a pretest prior to the implementation of the teaching materials and a posttest after the learning process. This design is employed to identify improvements in student learning outcomes before and after the treatment without the involvement of a control group (Abraham & Supriyati, 2022).

The needs analysis stage is conducted through a student needs questionnaire, supported by interviews and observations to identify learning difficulties in the topic of fractions. Based on the results of this analysis, the teaching materials are designed to be more contextual by integrating local wisdom, presenting relevant visuals, providing gradual exercises, and including learning activities that encourage engagement and deep conceptual understanding (Abraham & Supriyati, 2022).

The research instruments include: (1) a student needs questionnaire for the analysis stage; (2) media and content expert validation instruments to assess the feasibility of the product; and (3) Descriptive statistics consisting of minimum value, maximum value, average score, and standard deviation were used to analyze the pretest and posttest data. The improvement in learning outcomes is explained using the gain (posttest–pretest) and N-gain, with classification based on the N-gain criteria: low (<0.30), medium (0.30–0.69), and high (≥0.70) (Abraham & Supritati, 2022).

RESULT AND DISCUSSION

Findings

This study was conducted with fourth-grade elementary school students in Nguntoronadi District, Wonogiri Regency. The development activity aimed to develop local wisdom-integrated teaching materials using a deep learning approach in mathematics learning, particularly on fractions. The study's findings and discussion are described based on the ADDIE development framework. The research on the development of local wisdom-based teaching materials was conducted up to the fourth stage, which is product testing. The first stage of this development was the needs analysis stage, followed by the data collection stage. To determine students' needs for learning resources, a questionnaire was used. The results of the student needs questionnaire for learning resources are presented in the following table:

Table 1. Summary of Student Questionnaire Results per Statement

No	Statement	Remarks				Ket
		TS	KS	S	SS	
1	I understand fractions better if there are real-life examples	1	2	17	30	Strongly Needed
2	I like it when fraction examples use local food/culture	1	3	17	29	Strongly Needed
3	I need images/visuals to understand fractions	2	7	18	23	Needed

4	I need exercises from easy to difficult	0	7	14	29	Strongly Needed
5	I need story problems that relate to my activities	2	6	17	25	Needed
6	I enjoy having simple activities/games while learning fractions	2	7	16	25	Needed
7	I need step-by-step learning (try–discuss–reflect)	0	5	19	26	Strongly Needed
8	The language in the teaching materials should be simple and cleas	0	4	21	25	Strongly Needed
9	I need summaries/concept maps for each section	2	6	16	26	Needed
10	I need quick feedback from the teacher after exercises	0	2	16	32	Strongly Needed

Based on the questionnaire data, it is evident that students' needs for learning fractions are generally high to very high. This is reflected in the dominance of 'Agree' (S) and 'Strongly Agree' (SS) responses to almost all statements. The 'Strongly Needed' indicators appear strongly in statements 1, 2, 4, 7, 8, and 10, indicating that students feel greatly assisted when fraction learning is made more contextual, structured, and communicative.

From the context and learning approach perspective, students feel most supported when fractions are related to real-life examples (No. 1) and local culture/food (No. 2). This suggests that local wisdom-integrated teaching materials are relevant for enhancing students' understanding of fraction concepts. Additionally, students also require story problems that relate to their daily activities (No. 5) and the inclusion of simple activities/games (No. 6), ensuring that the learning experience is not only explanatory but also enjoyable and meaningful.

From the perspective of teaching material design and learning strategies, students highly need step-by-step learning (No. 4 and 7), simple and clear language (No. 8), and quick feedback from the teacher (No. 10). Another strong need is the inclusion of visuals/images (No. 3) and summaries/concept maps for each section (No. 9). This means that the fraction learning module should be designed with a 'from easy to difficult' progression, a learning sequence of try–discuss–reflect, complemented by visuals and summaries, and providing room for exercises with prompt feedback to help students better understand and feel more confident.

In the second stage (design stage), the local wisdom-based teaching materials integrating deep learning principles have been developed in the form of a printed module/textbook.

Figure 2. Cover of local wisdom-based teaching material

The design of this module is structured to encourage students to move beyond rote memorization toward conceptual understanding of fractions through learning experiences closely related to their daily lives. Therefore, elements of local wisdom (such as regional foods, traditions, market activities, or local household activities) are integrated into examples, images, and story problems, making it easier for students to connect fractions to real-life situations.

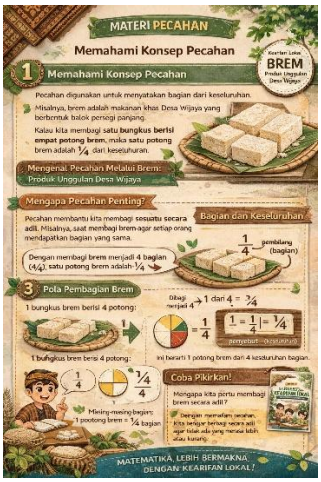

Figure 3. Sample page of fraction material based on local wisdom

Structurally, the teaching materials include the following core competencies: (1) usage instructions, so that both the teacher and students know how to use the module; (2) learning objectives, which serve as the goals to be achieved; (3) material explanations presented step by step using simple language; (4) practice exercises at the end of each explanation, so that students can immediately practice after understanding each sub-topic; and (5) comprehensive practice exercises at the end to assess overall mastery of the material. This pattern supports deep learning because students follow the flow of 'understand the concept → try exercises → reinforce through reflection/check answers → proceed to the next section.

Figure 4. Example of learning activities in the teaching material

With this design, the module becomes more effective as it meets students' needs: there are everyday examples and local culture, exercises from easy to difficult, visuals/summaries, and room for quick feedback through exercises in each section. Thus, this design stage produces a teaching material plan that is ready to be

tested/implemented in the next stage, with the main goal of reinforcing the meaningful and contextual understanding of fractions, not just solving problems.

The third stage is the product development stage. The development of local wisdom-based teaching materials applying a deep learning approach involves the process of collecting information regarding the validity and effectiveness of the developed teaching materials in improving students' understanding of fraction concepts. This stage begins with validation by two experts: one media expert and one content expert. After the teaching materials are verified by the experts, a limited trial is conducted to assess the feasibility of the local wisdom-based teaching materials with a deep learning approach for fourth-grade students.

Table 2. Media Expert Validation Results

Assessment Aspect	Media Expert
Introduction	5
Appearance/Design of Teaching Material	4
Content/Objectives	5
Utilization	5
Instructional Design	4
Total Score	23
Score	92
Category	Excellent

Based on the media expert validation results table, the local wisdom-based teaching materials with a deep learning approach received very high ratings on almost all aspects. The Introduction aspect received a score of 5, indicating that the usage instructions and the introductory section of the teaching materials are clear and support user understanding. The Appearance/Design of the Teaching Material aspect received a score of 4, meaning that the design is good and attractive, although there is still some room for improvement (such as layout neatness or visual consistency). Both the Content/Objectives and Utilization aspects received scores of 5, indicating that the objectives have been achieved with the material, and the ease of use of the teaching materials is excellent and effective for facilitating learning. The Instructional Design aspect received a score of 4, showing that the learning flow is structured and supports deep learning, but there is still room for refinement in certain areas. Overall, the accumulated score was 23, with a final result of 92, placing the teaching material in the "Excellent" category and indicating that it is feasible for use in learning activities.

Table 3. Content Expert Validation Results

Assessment Aspect	Content Expert
Introduction	4
Learning	5
Content	4
Summary	5
Assignments/Assessment	5
Total Score	23
Score	92
Category	Excellent

Based on the content expert validation results table, the local wisdom-based teaching materials with a deep learning approach received excellent ratings in all the assessed aspects. The Introduction aspect received a score of 4, indicating that the introductory section of the teaching materials is clear in providing direction, though it could still be improved in certain details. The Learning aspect received a score of 5,

which indicates that the learning steps are very appropriate, structured, and support the learning process of students. The Content aspect received a score of 4, meaning that the material is accurate and appropriate, but there is still room for improvement (e.g., in the completeness of examples, depth of explanation, or wording precision). The Summary and Assignments/ Assessment aspects each received a score of 5, indicating that the summary effectively reinforces the concepts and the exercises/assessments provided are highly relevant and support mastery of the material. Overall, the total score was 23, with a final score of 92, placing the teaching material in the "Excellent" category, making it deemed suitable for use in learning.

In the fourth stage (implementation/product testing), the local wisdom-based teaching materials with a deep learning approach, which had been deemed feasible by media and content experts, were then tested in a limited trial with fourth-grade students to evaluate their effectiveness in improving students' conceptual understanding of fractions. This trial was carried out using a pretest–posttest design, where students took an initial test (pretest) prior to the implementation of the teaching materials, followed by a final test (posttest) after the instructional process using the teaching materials. This approach allows the researcher to compare students' abilities before and after the treatment, making it possible to objectively observe changes in learning outcomes.

To present the trial results concisely, descriptive statistics were used, consisting of minimum score, maximum score, mean, and standard deviation (SD) of the pretest and posttest scores. Additionally, the researcher calculated the gain (Post–Pre) as the difference in score improvement for each student, as well as the N-gain to determine the normalized level of improvement against the maximum score (making the improvement assessment fairer by considering students' starting positions). This statistical presentation is important because it not only shows the high score increase but also displays the average improvement and the variation in students' results in the clas.

Next, the results of the descriptive statistics calculations for the pretest and posttest scores, as well as the gain and N-gain for students (N = 50), are presented in the following table.

Table 4. Descriptive Statistics for Pretest and Posttest Scores (N = 50)

Variable	N	Min	Max	Mean	SD
Pretest	50	32	77	54.04	11.04
Posttest	50	54	100	77.12	13.54
Gain (Post–Pre)	50	10	39	23.08	5.86
N-gain	50	0.204	1.000	0.545	0.232

Based on Table 1, this study involved 50 students (S) and shows that the pretest score had a mean of 54.04 with a minimum score of 32 and a maximum score of 77 (P), while the posttest score had a mean of 77.12 with a minimum score of 54 and a maximum score of 100 (P). Furthermore, the improvement in student scores, indicated by a mean gain of 23.08 with a gain range of 10–39 (P), and a mean N-gain of 0.545 with a range of 0.204–1.000, suggests that the learning outcomes showed a medium-level improvement (K).

Table 2. Frequency Distribution of Pretest and Posttest Scores (N = 50)

Score Interval	Pretest Frequency	% Pretest	Frekuensi Posttest	% Posttest
0–39	6	12.0	0	0.0
40–49	9	18.0	0	0.0
50–59	20	40.0	4	8.0
60–69	9	18.0	13	26.0
70–79	6	12.0	15	30.0
80–89	0	0.0	9	18.0
90–100	0	0.0	9	18.0

Based on Table 2, the distribution of pretest scores (S) shows that most students are in the 50–59 score range, with 20 students (40%) (P), followed by the 60–69 range with 9 students (18%), the 40–49 range with 9 students (18%), the 0–39 range with 6 students (12%), and the 70–79 range with 6 students (12%) (K). After learning with the teaching materials, the distribution of posttest scores (S) shifted to higher intervals, with the 70–79 range becoming the most frequent, with 15 students (30%), and the 60–69 range with 13 students (26%) (P). Meanwhile, the 80–89 and 90–100 intervals each appeared with 9 students (18%), while the 50–59 interval decreased to 4 students (8%), and no students remained in the 0–39 and 40–49 intervals (K)

Table 3. N-gain Categories (Hake) (N = 50)

N-gain Categories	Frequency	Percentage
Low (<0.30)	6	12.0
Medium (0.30–0.69)	32	64.0
High (≥0.70)	12	24.0

Based on Table 3, the N-gain categories (Hake) for 50 students (S) show that the greatest improvement in learning outcomes is in the medium category (0.30–0.69), with 32 students (64%) (P), while the high category (≥0.70) was achieved by 12 students (24%) and the low category (<0.30) was experienced by 6 students (12%) (K).

In the fifth stage, evaluation, the findings indicate an improvement in students' learning outcomes after students used the local wisdom-based teaching materials with a deep learning approach. In Table 1, the average pretest score of 54.04 increased to 77.12 in the posttest, resulting in an average gain of 23.08. The average N-gain of 0.545 indicates that the improvement in understanding fraction concepts is in the medium category. This improvement is also evident in Table 2, which shows a shift in the score distribution: in the pretest, there were still students in the 0–39 (12%) and 40–49 (18%) intervals, while in the posttest, these intervals no longer appeared, and students' scores shifted to higher intervals, including the appearance of the 80–89 (18%) and 90–100 (18%) intervals, which were previously absent. Furthermore, based on Table 3, most students were categorized in the medium N-gain category (64%), followed by the high category (24%) and the low category (12%), indicating that the developed teaching materials effectively enhanced students' conceptual understanding of fractions for most students.

Discussion

Mathematics learning on the topic of fractions in fourth grade often presents challenges due to its abstract concepts, which can easily turn into simple procedures if students are only directed towards memorizing steps (Hani & Apriani 2024). Understanding becomes stronger when new information "sticks" to the knowledge that students already possess and is connected to meaningful experiences. According to the concept of meaningful learning, the connection between prior knowledge and new concepts determines the quality of understanding (Sumarsono et al., 2020). Thus, the creation of teaching materials that direct students from the very beginning to fractions with real-life situations becomes an effective strategy for building meaning, not just answering questions.

Local wisdom plays a role as a context close to students' lives, allowing the concept of fractions to be understood through authentic experiences (Siregar, 2025). When traditional foods, local traditions, or everyday activities are used as examples and exercises, students do not feel like they are learning something distant from their world; instead, they are understanding mathematics that exists around them. This approach aligns with contextual learning, which emphasizes that the meaning of concepts is

formed when students are united with real-life materials and their environment, and it is also in line with culturally responsive teaching, which uses students' cultural backgrounds as a learning strength (Aminah et al., 2022).

The deep learning approach encourages students to build understanding actively through exploration, dialogue, and reflection, rather than through one-way information reception. When students are given the space to try, discuss strategies, and then reflect on the reasoning behind their answers, they are constructing concepts and organizing relationships between ideas more stably, as emphasized in constructivist theory (Ismaimuza, 2025). Discussions also enrich students' mathematical language because they learn to express their thoughts, compare strategies, and improve their thinking through interactions with peers and teachers (Kadek & Purwati, 2023).

Area models, segment diagrams, number lines, and local wisdom illustrations, such as brem, help students understand the relationship between parts and wholes, fraction equivalence, and the size of changes in the part when the denominator changes. For example, square-shaped brem can be visualized as a whole and then divided into 1/2, 1/4, 1/8, and so on, allowing students to see directly that the larger the denominator, the smaller the part obtained. The brem illustration also helps students compare equivalent fractions, for example demonstrating that 1/2 has the same value as 2/4 or 4/8 by dividing brem pieces into equal parts. The transition from concrete experiences to visual representations and then to fractional symbols aligns with the idea that effective learning uses the enactive–iconic–symbolic representation stages, ensuring that students do not get trapped in meaningless symbols (Supono, 2023). Consistent visuals also help students detect common misconceptions, such as assuming that fractions with larger denominators are always larger (Putri et al., 2025).

The structured teaching material, arranged from easy to difficult, can be understood as a form of scaffolding that guides students from initial understanding to more complex understanding (Widodo et al., 2025). When exercises are placed after explanations in each subtopic, students can practice when the concept is still clear and the context is still relevant, encouraging them to test their understanding rather than simply guess the answers (Nurhayati, 2024). Such gradual assistance aligns with Vygotsky’s zone of proximal development, where appropriate support enables students to complete tasks they initially could not do independently (Suardipa, 2020). Thus, the sequence of material, examples, exercises, and summaries is not only presented systematically but also has a strong pedagogical foundation to reinforce understanding of fraction concepts.

Simple and clear language is key to success because fractions require understanding of terms, relationships, and the meaning of sentences, especially in story problems. When teaching materials use concise sentences, consistent terminology, and easy-to-understand instructions, students can focus on mathematical ideas instead of being distracted by language (Zainuddin, 2025). Clear language also strengthens independent learning and helps teachers maintain consistency, preventing class time from being wasted on repeated explanations due to ambiguous instructions. This principle is relevant to learning because the meaning of a concept is difficult to form if students do not understand the message they read or hear (Darman, 2020).

Concept maps help students see the connections between parts of fraction material, which are often understood in isolation. Fractions do not stand alone; they relate to representations, equivalence, comparison, and operations. Thus, students need tools to organize knowledge into a complete network. Concept maps can serve as a "roadmap" that shows the relationships between ideas, aids memory reinforcement, and facilitates students' transfer of knowledge to new situations. With this arrangement, learning supports depth, as students understand "why" and "how" things are related, not just "what" the steps are.

Quick feedback after exercises prevents small mistakes from becoming misconceptions that persist, especially with fractions that are prone to procedural and conceptual errors. When teachers immediately provide corrections and explanations, students can adjust their thinking strategies before moving on to the next subtopic, ensuring the understanding pathway remains clear. The habit of receiving feedback also encourages reflection, as students learn to check their reasoning, compare answers, and develop self-regulation in learning (Zai et al., 2024). This practice aligns with the deep learning approach that places the thinking process at the core of learning, not just the final outcome (Sari et al., 2025; Prayoga et al., 2025)

CONCLUSION

The findings of this study indicate that local wisdom-integrated teaching materials applying a deep learning approach are effective in enhancing fourth-grade elementary students' conceptual understanding of fractions. The use of local wisdom, such as traditional regional foods, not only makes the material more relevant and contextual but also helps students connect mathematical concepts to their daily lives. The trial results show a significant improvement in understanding fraction concepts, with most students showing progress in the medium to high improvement levels.

Additionally, the structure of the teaching materials, which is designed progressively from easy to difficult and includes quick feedback after exercises, has proven effective in helping students deepen their understanding. This approach also strengthens students' active engagement in the learning process, encouraging them to better understand concepts and develop critical thinking skills. The use of images, concept maps, and structured exercises helps students more easily organize and connect mathematical knowledge.

Overall, the developed teaching materials have proven to not merely improve the understanding of fraction concepts while also providing meaningful and enjoyable learning experiences. Therefore, the incorporation of local wisdom into mathematics instruction with a deep learning approach can be a highly beneficial strategy to improve the quality of elementary education while also supporting the preservation of local culture as part of the nation's identity.

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