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Improving Mathematics Learning Outcomes in Addition and Subtraction Through the Direct Instruction Model among Third-Grade Elementary School Students

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Abstract: This study aimed to improve third-grade students' mathematics learning outcomes in addition and subtraction through the Direct Instruction model. The study employed classroom action research conducted in two cycles, each consisting of two meetings, with 10 third-grade students at an elementary school in Tangerang, Indonesia. Because no formal minimum mastery criterion was specified in the available research record, action success was operationally defined as a marked increase in the class mean together with improvement in student and teacher observation scores in Cycle II. Data were collected using cycle-end evaluation tests, student activity observation sheets, teacher instruction observation sheets, and field notes. The data were analyzed descriptively by comparing class means and observation scores across cycles and interpreting changes recorded in the field notes. The mean evaluation score increased from 54 in Cycle I to 94 in Cycle II, representing a 40-point increase. Student observation scores increased from 60 to 74, while teacher observation scores increased from 69 to 87. Cycle II refinements included animated PowerPoint media, contextual problems, gradual guided practice, immediate feedback, and targeted assistance for students who experienced difficulty. The results indicate a marked improvement within the classroom studied. However, the findings should be interpreted within the limits of the small sample, short duration, absence of a comparison group, and incomplete student-level and instrument documentation.

Keywords: Direct Instruction, learning outcomes, elementary mathematics, addition, subtraction, classroom action research

Introduction

Mathematics in elementary school serves not only as a collection of computational procedures but also as the foundation for developing a logical, systematic, and methodical way of thinking. In the early grades, mastery of addition and subtraction is a prerequisite for understanding multiplication, division, fractions, measurement, and problem-solving. The Mathematics textbook for PGSD/PGMI positions number concepts and arithmetic operations as foundational material that teachers must understand both conceptually and procedurally so that learning does not stop at merely memorizing steps (Sukiyanto et al., 2021).

In reality, basic arithmetic operations remain a source of difficulty for some students. Difficulties can arise when students do not understand place value, incorrectly identify the operation, lack precision in the process of carrying or borrowing, and fail to convert word problems into mathematical statements. Rosanti et al. (2022) show that difficulties in learning addition and subtraction are related to conceptual understanding, precision, and problem-solving skills. More recent findings also show that third-grade students' conceptual understanding of addition and subtraction may still fall into the low category if instruction does not provide gradual experiences and adequate feedback (Oktapiana et al., 2025).

A similar problem was found among 10 third-grade students at an elementary school in Tangerang. During Cycle I, some students did not consistently pay attention to the explanations and still struggled when completing student worksheets (LKPD) and assessment questions. The average assessment score was only 54. Observation notes also indicated that the learning materials were not engaging enough and that the questions used were not sufficiently related to everyday situations. These conditions indicate that the problem does not lie solely with the students' abilities. The design of the explanations, the quality of the examples, the appeal of the teaching materials, the intensity of practice, and the nature of the teacher's guidance also determine learning success.

One relevant alternative for procedural mathematics content is Direct Instruction. The model organizes teaching into explicit stages: presenting objectives and preparing students, demonstrating knowledge or skills, conducting guided practice, checking understanding and providing feedback, and assigning further practice and application (Handayani et al., 2020). Direct Instruction is closely related to explicit instruction, in which content is divided into manageable steps, procedures are modeled, students respond frequently, and support is gradually reduced as competence develops (Archer & Hughes, 2011; Rosenshine, 2012). This structure is relevant to addition and subtraction because novice learners benefit from clear examples, consistent procedures, guided attempts, and immediate correction.

Recent research reinforces the need to treat explicit instruction as more than teacher explanation alone. Evidence-informed mathematics instruction combines clear modeling, frequent opportunities to respond, guided practice, cumulative review, and checks for understanding (Codding et al., 2023). A scoping review of experimental studies likewise found that effective elementary mathematics instruction commonly blends explicit explanation with problem solving, visualization, individual practice, and active monitoring rather than relying on a single isolated technique (Bognar et al., 2025).

A number of studies support the use of direct instruction in elementary school mathematics. Anggraini (2022) reported improved learning outcomes through direct instruction supported by concrete materials. Carlina and Fadliansyah (2024) found that the implementation of Direct Instruction increased the percentage of students achieving mastery in mathematics from Cycle I to Cycle II. Ramdhani et al. (2024) also demonstrated an improvement in second-grade mathematics learning outcomes after instruction was conducted systematically through the phases of Direct Instruction. In addition to improved scores, Sasmito and Lukitiawati (2024) found that the implementation of Direct Instruction can simultaneously improve teacher performance, student engagement, and learning outcomes. In other words, the effectiveness of this model depends on the accuracy of its implementation, not merely on the use of the model's label in lesson plans.

Teaching materials and the context of the problems need to be integrated with the Direct Instruction framework. Engaging visual aids can help maintain students' attention and make computational steps more concrete. Arsella et al. (2022) demonstrated differences in mathematics learning outcomes when instruction utilized animated media versus PowerPoint. Nabila et al. (2025) also reported that interactive PowerPoint presentations can enhance conceptual understanding and motivation for learning mathematics among elementary school students. In arithmetic operations, manipulatives or visual place-value aids can also help students understand the processes of addition and subtraction more tangibly (Diyana et al., 2024).

The educational value of digital media depends on its instructional purpose and implementation. Digital technologies can support mathematical representation, practice, feedback, and exploration, but their effectiveness varies according to how they are integrated into classroom activity (Drijvers & Sinclair, 2024). Evidence from supplemental computer-assisted mathematics instruction also shows that technology should be treated as structured instructional support rather than as a substitute for teacher guidance (Foster, 2024). For contextual tasks, difficulty is influenced by linguistic and numerical characteristics such as lexical consistency, the position of the unknown, irrelevant information, and the number of operations (Vessonen et al., 2024). Recent syntheses further show that carefully designed, multi-component interventions can strengthen mathematical problem posing and word-problem solving, although effects depend on intervention quality and implementation fidelity (Zhang et al., 2024; Vessonen et al., 2025).

Based on these issues, the interventions in this study focused on the implementation of Direct Instruction, which was reflectively refined from Cycle I to Cycle II. The main improvements included the use of PowerPoint animations, the presentation of more contextual problems, step-by-step practice, immediate feedback, and specialized guidance for students who were still experiencing difficulties. This study aims to describe improvements in mathematics learning outcomes for addition and subtraction operations, increased student engagement, and improved quality of teaching practices among third-grade elementary school students.

Methodology

This study employed Classroom Action Research (CAR). CAR was chosen because it focuses on improving teaching practices through repeated action, observation, and reflection. CAR provides teachers with the opportunity to identify real problems in the classroom, test improvement strategies, and use the results of their reflection as a basis for refining subsequent actions (Azizah, 2021). The research design consisted of two cycles. Each cycle comprised four stages: planning, implementation of actions, observation, and reflection.

The research subjects were 10 third-grade students at an elementary school in Tangerang. The identities of the school and the students have been withheld to protect their confidentiality. The study was conducted in July 2026 and consisted of four sessions. The schedule is presented in Table 1.

Table 1. Research Timeline

Cycle	Meeting	Date	Focus of Activities
I	1	July 3, 2026	Explanation of the concept and demonstration of addition; guided practice using worksheets.
I	2	July 4, 2026	Subtraction demonstrations and mixed practice; Cycle I evaluation.
II	1	July 6, 2026	Improved learning through PowerPoint animations, contextual examples, and personalized guidance.
II	2	July 7, 2026	Gradual contextual practice, reinforcement, feedback, and evaluation Cycle II.

The learning process follows the five phases of Direct Instruction. In the first phase, the teacher communicates the learning objectives, relates the material to the students' experiences, and prepares the students' attention. The second phase involves a step-by-step demonstration of addition and subtraction. The third phase consists of guided practice using worksheets. The fourth phase involves assessing understanding, discussing errors, and providing immediate feedback. The fifth phase consists of advanced practice and application to a wider variety of problems. In Cycle II, all of these phases are maintained, but the quality of the teaching materials, the context of the problems, the intensity of feedback, and student support are enhanced.

Table 2. Focus of Action in Each Phase of Direct Instruction

Phase	Teacher Activities	Applications in Research
1. Orientation	State the objectives and prepare the students.	Apperception, learning objectives, attention guidelines, and connections to daily activities.
2. Demonstration	Explain the concepts or skills step by step.	Modeling addition and subtraction based on place value and step-by-step procedures.
3. Guided practice	Supervise initial practice.	Completing worksheets with guiding questions and assistance as needed.
4. Feedback	Check for understanding and correct mistakes.	Discussion of answers, immediate correction, reinforcement, and further explanation.
5. Advanced practice	Assign independent practice and application exercises.	Assessment questions and contextual problems relevant to students' lives.

The research instruments comprised cycle-end learning-outcome tests, student activity observation sheets, teacher instruction observation sheets, and field notes. The evaluation tasks addressed addition, subtraction, place-value procedures, and contextual problem solving. Student activity indicators covered attention to explanations, participation in practice, willingness to respond, independence, and accuracy. Teacher instruction indicators covered implementation of the Direct Instruction phases, clarity of demonstrations, use of media, relevance of examples, management of guided practice, checking for understanding, feedback, classroom management, and individualized guidance.

The evaluation content covered addition accuracy, subtraction accuracy, place-value procedures, and the application of operations to contextual problems. Student observation indicators comprised attention, participation in guided practice, willingness to respond, independence, and accuracy. Teacher observation indicators comprised implementation of the Direct Instruction phases, clarity of demonstrations, use of media, relevance of examples, classroom management, feedback, and individualized guidance. Detailed observation categories are important because feedback and instructional interactions need clearly defined, consistently applied indicators (Aumann et al., 2024). However, the available research record did not preserve the exact number and format of test items, item-level scoring rules, numerical observation-category cutoffs, the identity of the individual observer, or formal validity and reliability coefficients. These details are therefore not reconstructed and are acknowledged as limitations of the present report.

Quantitative data were analyzed by calculating the average evaluation scores and comparing observation scores across cycles. The absolute increase was calculated by subtracting the Cycle I score from the Cycle II score. The relative percentage increase was calculated using the formula: (Cycle II score − Cycle I score) / Cycle I score × 100%. Qualitative data from field notes were analyzed by grouping issues, determining corrective actions, and interpreting changes in learning behavior. Because no formal KKM was specified in the available research record, the action was operationally considered successful when the class mean showed a marked increase and both student and teacher observation scores improved in Cycle II. No inferential significance test was conducted.

Result and Discussion

Results of Cycle I

Cycle I was conducted over two sessions on July 3 and 4, 2026. The teacher implemented the Direct Instruction model by explaining the objectives, demonstrating the steps of arithmetic operations, guiding students through their worksheets, discussing the answers, and providing feedback. The average student assessment score at the end of Cycle I was 54. Student observation scores reached 60, falling into the "good" category, while teacher observation scores reached 69, also falling into the "good" category.

Although the observation category was rated as "good," field notes revealed substantial weaknesses. Many students still do not pay attention when the teacher is explaining. Some students are not yet able to follow the steps independently and experience difficulties when working on worksheets or assessment questions. On the teachers' side, the teaching materials used are not engaging enough, and the questions provided lack context. This means that simply following the model's procedures does not automatically guarantee that students will pay attention or understand the material. Explanations that rely too heavily on verbal descriptions, examples that are far removed from students' experiences, and undifferentiated practice exercises cause some students to fall behind.

Reflections on Cycle I led to four improvement decisions. First, teachers used PowerPoint animations to visually demonstrate calculation steps in a step-by-step manner. Second, problems were made more contextual, for example, by using situations involving the number of objects, simple transactions, and changes in quantity that were relevant to the students' experiences. Third, exercises were structured from simple to complex levels. Fourth, the teacher provided specialized guidance to students who had not yet achieved mastery. This decision aligns with findings that instructional media, concept reinforcement, and individual guidance are crucial components in addressing difficulties in learning mathematics (Nabila et al., 2025; Rosanti et al., 2022).

Results of Cycle II

Cycle II was held on July 6 and 7, 2026. During the orientation phase, the teacher clarified the objectives and focused the students' attention. Demonstrations were conducted using PowerPoint animations so that the sequence of steps could be observed more closely. Examples and problems were related to everyday situations. During the guided practice, the teacher checked students' work, asked guiding questions, and provided individual assistance to students who were still struggling. Feedback was provided immediately so that mistakes would not persist until the final evaluation.

The results of Cycle II showed improvements across all indicators. The average evaluation score reached 94. Student observation scores rose to 74, falling into the "very good" category, while teacher observation scores rose to 87, also falling into the "very good" category. Field notes indicate that students began to pay close attention to explanations and started to understand how to complete the worksheets and evaluation questions. Teachers also used more engaging teaching materials, presented contextual problems, and provided individualized guidance to students who needed help.

Table 3. Summary of Aggregate Research Results

Indicators	Cycle I	Cycle II
Average student evaluation	54	94
Student observations	60	74
Teacher observations	69	87

Note. Individual scores and mastery counts are unavailable because no formal KKM or student-level score list was retained; Table 3 therefore reports aggregate data only.

Tabel 4. Magnitude of Improvement from Cycle I to Cycle II

Indicator	Absolute Increase	Relative Increase	Interpretation
Average student evaluation	40 points	74,07%	The class mean showed a marked improvement.
Student observation	14 points	23,33%	Observed student attention and engagement improved.
Teacher observation	18 points	26,09%	Observed instructional implementation improved.

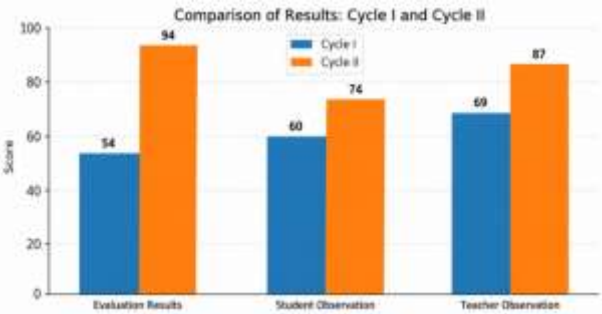

Figure 1. Comparison of Results from Cycle I and Cycle II

Discussion on Improving Learning Outcomes

The increase in the average evaluation score from 54 to 94 represents a marked change during the two action-research cycles. The result suggests that the Cycle II refinements were useful within the classroom studied. However, it should not be interpreted as evidence that Direct Instruction alone caused the improvement. The study involved only 10 students, did not include a comparison group, and introduced several changes simultaneously, including animated media, contextual problems, progressive practice, immediate feedback, and individualized guidance. Therefore, the findings support the practical value of the combined intervention in this specific classroom rather than a broad causal claim applicable to all elementary students.

The Direct Instruction framework helps reduce the burden on students when learning computational procedures. Step-by-step demonstrations provide concrete examples of what to do and the correct sequence of actions. Guided practice gives students the opportunity to try things out without being left to guess on their own. Comprehension checks and immediate feedback prevent procedural errors from recurring. The advanced practice stage then tests whether students can apply these steps more independently. This mechanism aligns with the nature of Direct Instruction, which integrates objectives, modeling, practice, correction, and application into a single learning sequence (Handayani et al., 2020).

Recent primary-mathematics research helps explain why the feedback phase matters. Formative feedback can support mathematical reasoning and self-efficacy when it is connected to students' current strategies and followed by opportunities to revise their thinking (Smit et al., 2023a). Interactive dialogue within feedback episodes also provides teachers with evidence of student reasoning instead of reducing feedback to an answer judgment (Smit et al., 2023b). Moreover, children's responses differ according to the content and source of feedback, so correction should be specific, credible, and directed toward the process used to solve the task (Merrick & Fyfe, 2024).

The results of this study are consistent with those of Ramdhani et al. (2024), who found an improvement in second-grade mathematics learning outcomes after Direct Instruction was implemented in action research. These findings are also in line with those of Carlina and Fadliansyah (2024), who reported an increase in mastery from Cycle I to Cycle II in elementary school mathematics instruction. Sasmito and Lukitiawati (2024) even demonstrated a very similar pattern, namely a simultaneous improvement in teacher performance, student activity, and learning outcomes. This similarity in patterns reinforces the interpretation that Direct Instruction is effective when used for material that requires the gradual mastery of procedures.

Discussion of Student Activities

Students' observation scores increased from 60 to 74. Field notes clarify the significance of these numbers. In Cycle I, students were easily distracted and struggled when transitioning from the teacher's explanation to working on the worksheets. In Cycle II, students began to pay closer attention and understood the tasks better. This change indicates that attention is not a fixed trait that is entirely the students' responsibility.

Attention can be shaped through clear instructions, relevant visuals, the pace of the explanation, guiding questions, and activities that prompt students to immediately apply the information they have just learned.

The use of PowerPoint animations helps illustrate calculation processes step by step and keeps students focused on key information. The findings of Arsella et al. (2022) support the use of animations and PowerPoint in mathematics instruction. Nabila et al. (2025) also demonstrated that interactive PowerPoint presentations can enhance conceptual understanding and motivation. However, the use of such media must remain aligned with learning objectives, as excessive animation can distract students. In this study, the benefits of the media were evident because animations were used to emphasize steps, rather than to fill slides with movements unrelated to the learning objectives.

Contextual problems also play a role in helping students understand the meaning of operations. Addition is no longer viewed as merely a sequence of symbols, but as a process of combining quantities. Subtraction can be understood as taking away, finding the difference, or determining the remainder. When examples are linked to objects and situations familiar to students, they gain a bridge between concrete experiences and mathematical symbols. This approach is important because research findings indicate that third-grade students may struggle with the basic concepts of addition and subtraction if instruction is too abstract (Oktapiana et al., 2025).

Discussion on Teacher Performance Quality

The teacher's observation score increased from 69 to 87. This 18-point increase indicates that action research reflections were used to tangibly improve teaching practices from Cycle I to Cycle II. In Cycle I, the teacher had not yet used engaging media, and the questions were not contextual. In Cycle II, the teacher improved on these two aspects and added specialized guidance. These actions made the phases of Direct Instruction more comprehensive: demonstrations became clearer, practice exercises more relevant, comprehension checks more active, and feedback more targeted.

The improvement in teacher observation scores is relevant because changes in teacher knowledge and classroom instruction are plausible mechanisms through which instructional interventions affect student achievement. A recent meta-analysis found that mathematics and science professional-development interventions improved teacher-level outcomes and that stronger teacher-level effects were associated with stronger student outcomes (Lynch et al., 2025). In addition, recent mathematics-education research treats student errors and misconceptions as evidence that can guide instructional decisions, not merely as responses to be marked wrong (Shimizu & Kang, 2025). This supports the Cycle II emphasis on checking student work and providing targeted re-explanation.

Targeted instruction for students who have not yet met proficiency standards is a crucial part of improvement. Direct Instruction should not devolve into a one-way lecture for the entire class. Teachers still need to monitor individual responses, identify areas of difficulty, and tailor their support. Students who do not yet understand place value require a different explanation than those who are simply inattentive. Specific guidance shortens the gap between errors and corrections. Findings regarding difficulties in learning mathematics also indicate that the use of media and the provision of specialized guidance are relevant strategies for helping students who are falling behind (Rosanti et al., 2022).

This study has several limitations. The sample comprised only 10 students in one classroom, the intervention lasted four meetings, and no comparison group or delayed assessment was included. In addition, the available research archive did not contain student-level scores, mastery counts, an explicit KKM, the exact number and format of evaluation items, item-level results, numerical observation-category cutoffs, observer identity, or formal evidence of instrument validity and reliability. Consequently, the distribution and durability of the score improvement, the proportion of students who achieved mastery, measurement quality, and inter-rater consistency could not be examined. The findings should therefore be understood as evidence of change in the specific classroom studied rather than as a generalizable or isolated causal effect. Future studies should preserve and report complete instruments and student-level data, involve larger and more diverse samples, use longer implementation periods, and include follow-up assessments.

Conclusion

The implementation of the Direct Instruction model, together with animated PowerPoint media, contextual problems, gradual guided practice, immediate feedback, and individualized assistance, was associated with improved mathematics learning outcomes in addition and subtraction among the 10 third-grade students in the classroom studied. The average evaluation score increased from 54 in Cycle I to 94 in Cycle II, a rise of 40 points. Student observation scores improved from 60 to 74, while teacher observation scores improved from 69 to 87.

Improvements occurred after instruction in Cycle II was refined through PowerPoint animations, more contextual examples and problems, step-by-step practice, comprehension checks, immediate feedback, and specialized guidance for students who had not yet achieved mastery. The effectiveness of Direct Instruction in this study was linked to the structured presentation of material, the provision of clear examples, guided practice, and immediate correction of students' errors. Teachers are advised to continue using relevant visual aids, develop a variety of contextual problems, and document individual learning outcomes so that remedial follow-up can be carried out more precisely. These findings apply to the specific participants, classroom conditions, and short duration of this action research and should not be generalized to all elementary-school settings. Further studies should involve larger and more diverse samples, longer implementation periods, complete student-level and mastery data, validated instruments, clearly documented observation procedures, and delayed assessments to determine whether the improvement is sustained.

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