

Managing Mathematics Instruction through the PDCA Cycle: Applying the Demonstration Method to Improve Student Motivation

Lisna Sari*, Iim Wasliman

Nusantara Islamic University, Bandung, Indonesia

*Corresponding Email: lisna@uninus.ac.id

Abstract. This study is motivated by the problem of low student learning motivation in elementary mathematics instruction, which is often caused by the dominance of conventional, teacher-centered teaching methods. The demonstration method is considered a potential alternative to create more active and engaging learning experiences. This study aims to analyze the application of the demonstration method in mathematics learning to improve student learning motivation through the PDCA (Plan–Do–Check–Act) cycle at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi in Garut Regency. The research employed a qualitative approach with a descriptive-analytical case study design. Data were collected through in-depth interviews, classroom observations, and document analysis involving school principals, mathematics teachers, and students. Data analysis was conducted using the interactive model of Miles, Huberman, and Saldaña, while data trustworthiness was ensured through triangulation, member checking, and systematic documentation. The analytical framework was guided by G.R. Terry’s management theory and Deming’s PDCA cycle. The findings indicate that the demonstration method, when implemented through systematic planning, execution, evaluation, and follow-up actions, effectively increases student learning motivation and engagement in mathematics learning. Students became more active, confident, and enthusiastic in participating during lessons, and their conceptual understanding showed noticeable improvement. The study concludes that the PDCA-based application of the demonstration method provides an effective instructional management model for enhancing student motivation and improving the quality of elementary mathematics learning.

Keywords: Demonstration Method, Mathematics Learning, Student Learning Motivation, PDCA Cycle, Elementary School

1 Introduction

Mathematics is a fundamental subject in elementary education that plays a crucial role in developing students’ logical, critical, and analytical thinking skills [1]–[3]. At the primary school level, mathematics learning is designed to build foundational competencies in numeracy, geometry, and problem solving, which are essential for

students' academic progression and daily life application [4]. In Indonesia, the importance of mathematics education is reinforced through national curriculum policies that emphasize not only conceptual understanding but also the ability to apply mathematical knowledge in real-life contexts[5].

Despite its strategic importance, mathematics learning in elementary schools often faces persistent challenges, particularly related to students' low learning motivation [6]. Learning motivation is a key psychological factor that significantly influences students' engagement, persistence, and achievement in learning activities[7]. When students lack motivation, they tend to show low participation, minimal effort, and limited interest in learning tasks, which ultimately affects learning outcomes. Previous studies have consistently reported that low motivation in mathematics learning is associated with poor academic performance and negative attitudes toward the subject[8]–[11].

Empirical evidence from various studies indicates that many elementary students experience difficulties and low motivation in mathematics learning. These conditions are often reflected in low achievement scores and passive classroom behavior. Observations in public elementary schools, including SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi in Garut Regency, reveal similar patterns. Based on school supervision reports, students tend to be less active during mathematics lessons, show limited enthusiasm, and rarely participate in problem-solving activities. Such learning conditions suggest that instructional approaches used in classrooms may not adequately stimulate students' interest and motivation.

One of the contributing factors to low student motivation in mathematics learning is the dominance of conventional teaching methods. In many classrooms, teachers still rely heavily on lecture-based instruction, positioning students as passive recipients of information [12]. This teacher-centered approach limits students' opportunities to actively engage with learning materials, explore concepts, and construct their own understanding. As a result, learning becomes monotonous, less meaningful, and disconnected from students' experiences, leading to decreased motivation and suboptimal learning outcomes.

In response to these challenges, instructional innovation is required to create more engaging and student-centered learning environments. One instructional approach that has the potential to enhance learning motivation is the demonstration method. The demonstration method involves presenting learning materials by showing processes, objects, or procedures directly, allowing students to observe, interact, and actively participate in the learning process. Through concrete examples and real-time demonstrations, abstract mathematical concepts become more accessible and understandable for students.

Previous research suggests that demonstration-based learning can increase student engagement, encourage questioning, and improve conceptual understanding. However, many existing studies focus primarily on learning outcomes, with limited attention to how the demonstration method is systematically planned, implemented, evaluated, and improved as part of instructional management. There remains a research gap regarding the application of the demonstration method viewed through a continuous improvement framework, particularly using management principles such as planning, implementation, checking, and action (PDCA cycle)[13], [14].

The novelty of this study lies in its integration of instructional methods and management theory. By applying the demonstration method within the framework of G.R. Terry's management functions and Deming's PDCA cycle, this research positions instructional practice as a dynamic and continuously improved process. Rather than viewing teaching methods as isolated techniques, this study conceptualizes mathematics instruction as a managed system that requires careful planning, implementation, evaluation, and follow-up actions to enhance student motivation.

Accordingly, this study aims to analyze the application of the demonstration method in mathematics learning to increase students' learning motivation at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi in Garut Regency. Specifically, the study seeks to examine how the demonstration method is planned, implemented, evaluated, and followed up within the PDCA framework. The findings are expected to contribute theoretically to instructional management and practically to teachers and school leaders in developing effective strategies to improve motivation and learning quality in elementary mathematics education.

2 Method

This study employed a qualitative approach with a descriptive-analytical case study design. The qualitative approach was chosen to obtain an in-depth understanding of the application of the demonstration method in mathematics learning and its role in increasing students' learning motivation. Qualitative research enables researchers to explore instructional processes, classroom interactions, and participants' experiences within their natural contexts, which is particularly relevant for examining pedagogical practices and instructional management [15], [16].

The research was conducted at two public elementary schools, namely SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi, located in Garut Regency, West Java, Indonesia. These schools were purposively selected based on their differing characteristics in instructional practices and their relevance to the research objectives. SD Negeri 2 Balewangi has been recognized for its relatively innovative instructional programs, while SD Negeri 3 Karamatwangi is in the early stages of implementing instructional quality improvement initiatives. This contrast provided a meaningful context for examining the effectiveness of the demonstration method in different school settings.

The research participants included school principals, mathematics teachers, and students from both schools. Principals and teachers were selected as key informants due to their direct involvement in instructional planning, implementation, evaluation, and follow-up actions. Students were included as supporting informants to capture learning experiences and motivational responses during mathematics instruction.

Data collection was conducted through methodological triangulation, consisting of in-depth interviews, classroom observations, and document analysis. In-depth interviews were used to explore teachers' and principals' perspectives on the planning and application of the demonstration method, as well as perceived impacts on student motivation. Classroom observations were carried out to examine instructional practices,

student engagement, and teacher–student interactions during mathematics lessons. Document analysis involved reviewing lesson plans, teaching materials, supervision reports, evaluation records, and school documentation related to mathematics instruction and instructional improvement programs [17]–[19].

In this qualitative study, the researcher served as the primary research instrument, as data interpretation was closely linked to the researcher’s engagement with the research setting and participants [20]. To support systematic data collection, several supporting instruments were developed, including semi-structured interview guides, observation checklists, and documentation review matrices. These instruments ensured consistency while allowing flexibility to capture emerging data during fieldwork.

Data trustworthiness was ensured by applying four criteria proposed by Lincoln and Guba: credibility, transferability, dependability, and confirmability. Credibility was enhanced through triangulation of data sources and techniques, as well as member checking to validate participants’ statements. Transferability was addressed by providing rich and detailed descriptions of the research context. Dependability and confirmability were strengthened through audit trails, systematic documentation of research procedures, and reflective notes to minimize researcher bias.

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña [21], which consists of three interconnected stages: (1) data reduction, involving the selection, coding, and condensation of raw data; (2) data display, where organized data were presented in narrative descriptions, matrices, and tables; and (3) conclusion drawing and verification, in which patterns and themes were identified and continuously validated. Data analysis was conducted concurrently with data collection, allowing the researcher to refine analytical focus in response to emerging findings.

The analytical framework of this study was guided by G.R. Terry’s management theory [22] and Deming’s PDCA (Plan–Do–Check–Act) cycle. These frameworks were used to analyze how the demonstration method was planned, implemented, evaluated, and improved as part of a continuous instructional improvement process. Through this methodological approach, the study aims to provide a comprehensive understanding of how demonstration-based mathematics instruction can enhance student learning motivation in elementary schools.

3 Results

3.1 Planning in the Application of the Demonstration Method

The planning stage represents the initial phase of the PDCA cycle in applying the demonstration method in mathematics learning. Findings from interviews, classroom observations, and document analysis at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi indicate that instructional planning was systematically designed to address the problem of low student learning motivation in mathematics.

Interview data reveal that teachers identified low student motivation and passive learning behavior as the primary issues motivating instructional planning. Teachers

emphasized that the demonstration method was deliberately selected to increase student engagement and active participation. One mathematics teacher stated:

“Lesson planning began with the problem of low student motivation. We chose the demonstration method because students need to directly observe the process and be actively involved in order to be more interested in learning mathematics.”
(Teacher 1, interview, March 2025)

Another teacher highlighted that planning involved collaborative discussions among teachers:

“The planning was carried out collaboratively through teacher discussions to determine the material suitable for demonstration, the teaching aids to be used, and the steps of the learning process.” (Teacher 2, interview, March 2025)

These findings indicate that planning was problem-oriented and collaborative in nature.

Observational data show that teachers entered mathematics lessons with clear instructional scenarios prepared in advance. Teachers prepared demonstration tools such as concrete objects, visual aids, and manipulatives to illustrate mathematical concepts. Lesson introductions were designed to stimulate curiosity, while core activities focused on step-by-step demonstrations that allowed students to observe and participate directly.

Observations also revealed that teachers anticipated potential learning obstacles by preparing alternative explanations and follow-up questions to maintain student engagement throughout the lesson.

Document analysis of lesson plans (RPP), supervision reports, and instructional schedules confirms that planning activities were formally documented. The reviewed lesson plans explicitly stated learning objectives related to increasing student motivation, outlined demonstration steps, and included observation indicators for student participation and enthusiasm. Documentation also shows that planning aligned with curriculum standards and school instructional improvement programs. Table 1 summarizes the key planning activities in the application of the demonstration method using the PDCA framework.

Table 1. Planning (Plan) Stage in the Application of the Demonstration Method

No.	Planning Component	Planned Activity	Description
1	Problem identification	Analysis of low motivation	Identification of passive learning behavior in mathematics
2	Method selection	Demonstration method	Chosen to increase student engagement and participation
3	Lesson design	Structured learning scenarios	Preparation of step-by-step demonstrations
4	Learning media	Concrete teaching aids	Use of manipulatives and visual tools
5	Success indicators	Motivation indicators	Student activeness, attention, and participation

Source: Interviews, classroom observations, and document analysis (2025)

Overall, the planning stage demonstrates that the application of the demonstration method was systematically designed to address students' low motivation in mathematics learning. Teachers acted as instructional planners who analyzed learning problems, selected appropriate methods, prepared instructional media, and established clear indicators of success. These findings suggest that effective planning within the PDCA framework provides a strong foundation for implementing demonstration-based instruction aimed at enhancing student learning motivation.

3.2 Implementation of the Demonstration Method in Mathematics Learning

The Do stage represents the implementation phase of the PDCA cycle, where the planned demonstration method is applied in actual mathematics learning activities. Findings from interviews, classroom observations, and document analysis at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi indicate that the demonstration method was implemented systematically to increase student engagement and learning motivation.

Interview data reveal that teachers implemented the demonstration method by actively involving students in observing, manipulating, and discussing mathematical concepts. One teacher explained:

"At the implementation stage, I demonstrated the steps for solving the problems using teaching aids, then asked the students to try them on their own in front of the class." (Teacher 1, interview, April 2025)

Another teacher emphasized the motivational impact of direct student involvement:

"When students were given the opportunity to participate in the demonstration, they became more confident and enthusiastic. Children who were usually passive began to dare to ask questions." (Teacher 2, interview, April 2025)

These statements indicate that the implementation stage focused on active learning and student participation.

Classroom observations show that mathematics lessons were conducted using concrete objects, visual representations, and step-by-step demonstrations. Teachers demonstrated mathematical procedures, such as solving arithmetic problems or understanding geometric concepts, while explaining each step clearly. Students were invited to observe closely, ask questions, and participate directly in demonstrations.

Observations also indicate increased student engagement compared to conventional instruction. Students paid closer attention, participated in discussions, and volunteered to solve problems at the front of the class. The classroom atmosphere became more interactive, with two-way communication between teachers and students.

Document analysis of lesson implementation reports, teacher reflection notes, and supervision records confirms that the demonstration method was applied as planned. Teaching journals indicate that teachers documented student responses, levels of participation, and learning challenges encountered during implementation. These documents show that the demonstration method was consistently applied across lessons and aligned with the instructional plans developed in the planning stage. Table 2 summarizes the implementation activities during the Do stage of the PDCA cycle.

Table 2. Do (Implementation) Stage of the Demonstration Method

No.	Implementation Aspect	Activity Description	Observed Outcome
1	Teaching approach	Step-by-step demonstrations	Clear understanding of mathematical procedures
2	Learning media	Concrete objects and visual aids	Increased student attention and interest
3	Student involvement	Active participation in demonstrations	Higher engagement and confidence
4	Classroom interaction	Two-way communication	More questions and discussions
5	Learning atmosphere	Interactive learning environment	Improved motivation and enthusiasm

Source: Interviews, classroom observations, and document analysis (2025)

The *Do* stage demonstrates that the implementation of the demonstration method effectively transforms mathematics learning from a teacher-centered to a more student-centered process. By engaging students directly in observing and performing demonstrations, teachers created meaningful learning experiences that increased motivation and participation. These findings suggest that effective implementation within the PDCA framework is essential for translating instructional planning into tangible improvements in student learning motivation.

3.3 Check (Evaluation) of the Demonstration Method in Mathematics Learning

The Check stage represents the evaluation phase of the PDCA cycle, focusing on assessing the effectiveness of the demonstration method in improving students’ learning motivation and understanding of mathematical concepts. Findings from interviews, classroom observations, and document analysis at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi indicate that evaluation was conducted systematically to measure instructional outcomes and identify areas for improvement.

Interview data reveal that teachers evaluated learning outcomes by observing changes in students’ motivation, participation, and conceptual understanding. One teacher stated:

“At the evaluation stage, we observed changes in students’ attitudes, such as increased confidence in asking questions, greater participation in learning activities, and enthusiasm when working on problems.” (Teacher 1, interview, May 2025)

Another teacher highlighted the importance of evaluation in refining instructional practices:

“Evaluation helps us determine whether the demonstration method has been effective or still needs improvement, especially for students who remain passive.”(Teacher 2, interview, May 2025)

These statements suggest that evaluation was viewed as a reflective process rather than merely a summative assessment.

Classroom observations indicate that teachers conducted formative evaluations during and after learning activities. Teachers monitored student engagement, participation levels, and responses during demonstrations. Informal questioning and short exercises were used to assess students’ understanding in real time.

Observations also show that teachers compared student behavior and performance before and after implementing the demonstration method. Increased attention, willingness to participate, and improved problem-solving performance were consistently observed during the evaluation stage.

Document analysis of assessment records, supervision reports, and teacher reflection journals confirms that evaluation findings were systematically documented. Teachers recorded student learning progress, motivation indicators, and challenges encountered during implementation. Evaluation results indicate improvements in student motivation, conceptual understanding, and learning outcomes compared to previous conventional teaching methods. Table 3 summarizes the key findings from the Check stage of the PDCA cycle.

Table 3. Check (Evaluation) Stage of the Demonstration Method

No.	Evaluation Aspect	Evaluation Method	Observed Result
1	Student motivation	Observation and reflection	Increased enthusiasm and participation
2	Conceptual understanding	Practice exercises	Improved accuracy in problem-solving
3	Classroom engagement	Behavioral indicators	More active questioning and interaction
4	Instructional effectiveness	Teacher reflection	Demonstration method more effective than conventional methods
5	Learning outcomes	Assessment records	Improved evaluation results

Source: Interviews, classroom observations, and document analysis (2025)

The *Check* stage demonstrates that systematic evaluation plays a crucial role in assessing the effectiveness of the demonstration method. By combining behavioral observation, formative assessment, and reflective analysis, teachers were able to identify positive changes in student motivation and learning outcomes. These findings indicate that the evaluation process within the PDCA framework provides essential feedback for refining instructional practices and sustaining improvements in mathematics learning motivation.

3.4 Act (Follow-up Action) in the Application of the Demonstration Method

The Act stage represents the follow-up and improvement phase of the PDCA cycle, where evaluation findings are used to refine instructional practices and sustain improvements in student learning motivation. Findings from interviews, classroom observations, and document analysis at SD Negeri 2 Balewangi and SD Negeri 3

Karamatwangi indicate that teachers implemented structured follow-up actions based on the results of the evaluation stage.

Interview data reveal that teachers used evaluation results as a basis for improving instructional strategies. One teacher explained:

“We use the evaluation results to improve the subsequent learning steps, for example by clarifying the demonstration or providing more opportunities for students to practice.” (Teacher 1, interview, May 2025)

Another teacher emphasized the importance of continuous improvement:

“Follow-up actions are carried out continuously. If there are still students who are less active, we try varying the teaching aids or using a simpler approach.” (Teacher 2, interview, May 2025)

These statements indicate that follow-up actions were adaptive and responsive to student needs.

Classroom observations show that teachers adjusted their instructional approaches in subsequent lessons based on evaluation findings. Improvements included clearer demonstrations, increased student participation opportunities, and differentiated guidance for students who required additional support. Teachers also encouraged peer learning by allowing students to assist each other during demonstrations.

Observations further indicate that classroom management and time allocation improved as teachers became more familiar with the demonstration method. Learning activities became more structured, allowing demonstrations and student practice to be balanced effectively.

Document analysis of revised lesson plans, teacher reflection notes, and supervision records confirms that follow-up actions were formally documented. Revised lesson plans show adjustments in demonstration steps, learning media, and participation strategies. Reflection notes indicate teachers’ awareness of strengths and weaknesses in instructional implementation, while supervision reports highlight continuous improvement in student motivation and engagement. Table 4 summarizes the key follow-up actions implemented during the Act stage of the PDCA cycle.

Table 4. Act (Follow-up Action) Stage of the Demonstration Method

No.	Follow-up Aspect	Improvement Action	Observed Impact
1	Instructional strategy	Refinement of demonstration steps	Clearer understanding of concepts
2	Learning media	Variation of teaching aids	Increased student interest
3	Student participation	Expanded practice opportunities	Higher engagement and confidence
4	Teacher reflection	Continuous self-evaluation	Improved instructional effectiveness
5	Sustainability	Integration into routine practice	Consistent improvement in motivation

Source: Interviews, classroom observations, and document analysis (2025)

The *Act* stage demonstrates that continuous improvement is a key element in the successful application of the demonstration method. By using evaluation results to refine instructional practices, teachers were able to sustain and enhance student learning

motivation over time. These findings suggest that the PDCA framework provides an effective model for managing instructional innovation and ensuring long-term improvements in mathematics learning quality.

4 Discussion

This study examined the application of the demonstration method in mathematics learning to improve students' learning motivation through the PDCA (Plan–Do–Check–Act) cycle. The findings demonstrate that instructional practices managed systematically using the PDCA framework contribute significantly to increased student motivation, engagement, and conceptual understanding in elementary mathematics learning.

The findings from the Plan stage indicate that effective instructional planning begins with a clear identification of learning problems, particularly students' low motivation and passive participation in mathematics lessons. Teachers deliberately selected the demonstration method to address these challenges by creating more concrete, engaging, and interactive learning experiences. This aligns with G.R. Terry's management theory, which emphasizes planning as a foundational function that determines the direction and effectiveness of organizational activities.

From a pedagogical perspective, careful planning supports meaningful learning by aligning instructional methods with student needs and learning characteristics. Previous studies have shown that instructional planning that incorporates active learning strategies can significantly enhance student motivation and engagement [23]. This study extends prior research by demonstrating that planning within the PDCA framework ensures that instructional decisions are data-driven and problem-oriented, rather than routine or incidental [24].

The Do stage findings reveal that the implementation of the demonstration method transformed mathematics learning into a more student-centered process. Students actively observed, participated in demonstrations, and practiced problem-solving tasks, which increased their confidence and willingness to engage in learning activities. These findings are consistent with constructivist learning theory, which posits that students construct knowledge through active involvement and interaction with learning materials and their environment[25].

Moreover, the demonstration method provided concrete representations of abstract mathematical concepts, making them more accessible to elementary students. This supports previous research indicating that the use of concrete and visual learning strategies enhances conceptual understanding and motivation in mathematics learning [26], [27]. The study contributes to the literature by showing that the effectiveness of the demonstration method is strengthened when its implementation is systematically managed rather than applied as an isolated instructional technique.

The findings from the Check stage highlight the importance of evaluation as a reflective process that informs instructional improvement. Teachers evaluated not only students' academic performance but also motivational indicators such as participation, enthusiasm, and confidence. This approach aligns with Deming's view of evaluation as

an integral part of continuous quality improvement rather than merely a mechanism for judgment.

Consistent with prior studies, the evaluation results in this study show that increased student motivation is associated with improved learning outcomes [28], [29]. The reflective evaluation practices observed in this study enabled teachers to identify instructional strengths and weaknesses, thereby providing a basis for informed decision-making and instructional refinement. This finding reinforces the role of evaluation as a critical managerial function in sustaining instructional effectiveness.

The Act stage findings demonstrate that follow-up actions based on evaluation results are essential for sustaining improvements in student motivation. Teachers refined demonstration steps, varied learning media, and increased opportunities for student participation in subsequent lessons. These adaptive actions reflect Deming's principle of continuous improvement and support the view that instructional quality is an ongoing process rather than a fixed outcome.

This study supports earlier research emphasizing that continuous reflection and instructional adjustment are key to effective teaching practices [30], [31]. The novelty of this study lies in illustrating how the PDCA cycle provides a practical and systematic framework for managing instructional innovation in mathematics learning. By integrating planning, implementation, evaluation, and follow-up actions, teachers can ensure that instructional strategies remain responsive to student needs and learning dynamics.

The findings of this study offer several theoretical and practical implications. Theoretically, the study reinforces the integration of instructional management theory and learning theory by demonstrating how PDCA-based management supports constructivist and student-centered learning approaches. Practically, the study highlights that the successful application of the demonstration method depends not only on the method itself but also on how it is systematically planned, implemented, evaluated, and improved.

Overall, the study suggests that the PDCA framework provides an effective model for managing mathematics instruction aimed at improving student learning motivation. Teachers and school leaders are encouraged to adopt continuous improvement approaches to instructional management, ensuring that teaching strategies evolve in response to evaluation findings and contribute to sustainable improvements in learning quality..

5 Conclusion

This study concludes that the application of the demonstration method in mathematics learning, when managed systematically through the PDCA (Plan–Do–Check–Act) cycle, has a positive and significant impact on improving students' learning motivation in elementary schools. The planning stage enabled teachers to identify instructional problems and design appropriate learning strategies, the implementation stage fostered active student participation and engagement, the evaluation stage provided reflective feedback on learning effectiveness, and the follow-

up action stage ensured continuous instructional improvement. Together, these stages contributed to increased student motivation, participation, and conceptual understanding in mathematics learning at SD Negeri 2 Balewangi and SD Negeri 3 Karamatwangi.

The findings also indicate that instructional methods alone are insufficient to improve learning motivation without effective management processes. The integration of the demonstration method within a continuous improvement framework allows teachers to refine instructional practices in response to evaluation outcomes and student needs. This study contributes theoretically by reinforcing the relevance of PDCA-based instructional management and practically by providing a viable reference for teachers and school leaders seeking to enhance motivation and learning quality in elementary mathematics education through systematic and reflective teaching practices..

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