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Numeracy Learning Management to Improve Students' Mathematical Logic

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Abstract: This study is motivated by the importance of numeracy learning as a foundation for developing elementary school students' logical thinking skills. Numeracy is not merely related to counting skills, but also involves reasoning abilities, pattern recognition, and contextual problem-solving in daily life. However, in practice, numeracy learning in elementary schools still faces various challenges in terms of planning, implementation, and evaluation. This study aims to describe and analyze numeracy learning management in improving students' mathematical logic. This research employed a qualitative approach using a case study method conducted at SDN Tanjungjaya, Cianjur Regency, and SDN Mandalasari, West Bandung Regency, Indonesia. Data were collected through observation, in-depth interviews, and documentation involving principals, teachers, students, parents, and school committees. Data analysis was carried out using the interactive model of Miles and Huberman, consisting of data reduction, data display, and conclusion drawing. Data validity was ensured through source, technique, and time triangulation. The findings indicate that systematically managed numeracy learning through the Plan–Do–Check–Act (PDCA) cycle effectively improves students' mathematical logic. Learning planning is designed by considering learning objectives, student characteristics, and real-life contexts. The implementation emphasizes active student engagement through problem-solving and contextual activities. Evaluation is conducted continuously by focusing on students' thinking processes. Follow-up actions include improving learning strategies, strengthening numeracy practices, and enhancing collaboration between schools and parents. Therefore, well-planned and sustainable numeracy learning management plays a crucial role in improving the quality of mathematics learning in elementary schools.

Keywords: elementary school; learning management; mathematical logic; numeracy.

Introduction

Numeracy learning is one of the basic competencies that elementary school students must master as a foundation for developing logical thinking and mathematical problem-solving skills (Iasha et al., 2025). Numeracy is not only related to counting skills but also encompasses the ability to understand, analyze, and apply mathematical concepts in various everyday contexts. Therefore, numeracy learning needs to be managed systematically to optimally impact students' mathematical logic development. Numeracy learning at the elementary school level plays a crucial role as the main foundation in shaping students' cognitive structures, particularly in facilitating logical and systematic thinking skills (Hendratno et al., 2026). Numeracy should not be misunderstood as merely counting or manipulating numbers; rather, it is the ability to flexibly apply mathematical concepts to solve complex real-world problems. In today's information age, students are required to be adept at understanding, analyzing, and interpreting quantitative data to make informed decisions. Without a solid understanding of numeracy, students will struggle to develop the critical reasoning that is at the heart of mathematical logic.

However, achieving these competencies cannot happen instantly without structured management. Effective numeracy learning management includes integrative curriculum planning, the selection of interactive teaching methods, and ongoing evaluation. When learning is managed systematically, teachers can create a learning ecosystem that focuses not only on memorizing formulas but also on strengthening logical reasoning. Through an organized approach, each mathematical concept taught serves as a bridge for students to hone their logical acumen, enabling them to see patterns, make deductions, and draw valid conclusions in various everyday contexts. In practice, the quality of numeracy learning is greatly influenced by the learning management implemented in schools. Learning management encompasses the planning, implementation, evaluation, and follow-up of learning, carried out in a focused and continuous manner (Hidayat et al., 2025). Teachers play a strategic role in designing and implementing numeracy learning that is appropriate to student characteristics, the curriculum, and school conditions. Suboptimal learning management has the potential to lead to low student engagement and the underdevelopment of logical thinking skills.

In practice, the quality of students' numeracy achievement is a direct reflection of the effectiveness of the learning management implemented in the school environment. This management is not merely an administrative routine, but rather a strategic cycle encompassing thorough planning, adaptive implementation, accurate evaluation, and constructive follow-up. Measured planning allows schools to map students' specific needs, while targeted implementation ensures that each numeracy material is delivered through a relevant methodology. Without continuous management, the knowledge transfer process will lose direction, hindering students' potential in processing mathematical logic. As learning architects, teachers hold full control in orchestrating all educational components in the classroom. Their strategic role lies in their ability to align the demands of the national curriculum with the unique characteristics of each student and the availability of school facilities. Competent teachers not only convey formulas but also design learning scenarios that challenge students' critical thinking. They must be able to transform abstract concepts into concrete and meaningful learning experiences. Conversely, if learning management is carried out partially or suboptimally, the impact will be immediately visible in low student engagement in class. Students tend to become passive, and ultimately, their ability to construct logical arguments and perform mathematical deductions will not develop optimally (Sumarmo et al., 2012).

The results of a preliminary study at Tanjungjaya Elementary School in Cianjur Regency and Mandalasari Elementary School in West Bandung Regency indicate that numeracy learning has been implemented, but its management is not yet fully structured and sustainable. Learning planning is not fully based on student needs analysis, learning implementation is still dominated by conventional approaches, and learning evaluation has not been optimally utilized as a basis for further learning improvements. These conditions indicate a gap between the ideal conditions for numeracy learning and the learning practices taking place in the field. Based on the results of a preliminary study conducted at Tanjungjaya Elementary School in Cianjur Regency and Mandalasari Elementary School in West Bandung Regency, an objective picture was found regarding the reality of numeracy implementation in the field that requires serious attention. Although numeracy learning has been formally integrated into teaching and learning activities, its effectiveness still hampers governance or management that is not fully structured, systematic, and sustainable. This phenomenon reflects the stagnation in the instructional management cycle, where classroom activities often run as administrative routines without being based on a vision of developing in-depth mathematical logic for students.

The first gap is clearly visible at the planning stage, where the development of numeracy learning programs is not fully based on a comprehensive needs analysis of student characteristics and competency levels. As a result, the materials and methods prepared are often "one-size-fits-all" and fail to address the root causes of students' difficulties in reasoning. At the implementation stage, the process of transforming knowledge is still dominated by a conventional, teacher-centered approach. This pattern tends to prioritize memorization of mathematical algorithmic procedures over stimulating critical thinking, resulting in passive and mechanistic student interaction with numeracy concepts. The evaluation mechanisms implemented in both schools have not been optimally utilized as diagnostic instruments for continuous improvement. Evaluation is often viewed merely as a means of fulfilling cognitive grades at the end of the lesson, rather than as a basis for designing precise follow-up strategies. This misalignment between the ideal conditions envisioned by the national curriculum and actual practice in the field creates an urgent need to reconstruct the numeracy learning

management model. Without integrative management improvements, efforts to improve students' mathematical logic will struggle to achieve optimal results, given the current low student absorption and active engagement in the learning process.

In the context of educational quality management, efforts to improve learning quality need to be carried out through a continuous improvement process. Edward Deming emphasized that quality improvement can only be achieved through a systematic and continuous improvement cycle, known as the Plan, Do, Check, and Act (PDCA) concept (Zar'an, 2024). The PDCA cycle requires thorough learning planning (plan), consistent implementation (do), objective evaluation (check), and follow-up oriented towards continuous improvement (act). This concept is relevant for application in numeracy learning management to improve elementary school students' mathematical logic. The application of the concept of integrated quality management in the instructional realm is crucial for bridging the gap between field practice and the desired ideal standards. In this context, Edward Deming's philosophy of continuous improvement provides a highly relevant framework through the Plan, Do, Check, and Act (PDCA) cycle. Deming emphasized that quality is not a static result achieved once, but rather a dynamic process born from the repetition of disciplined and systematic improvement cycles. When this concept is adapted to numeracy learning management, each learning element no longer stands alone, but rather becomes part of a mutually reinforcing ecosystem to hone students' mathematical logic comprehensively.

Operationally, the PDCA cycle in numeracy learning requires transformation at each phase. In the Plan phase, teachers must develop a design based on diagnostic data, where the primary target is the development of logical thought processes, not simply the completion of the material (Inayatul, 2025). The Do phase requires consistent implementation of strategies in the classroom, where numeracy is presented as a tangible and interactive problem-solving tool. Next, in the Check phase, objective monitoring is conducted to determine the extent to which students are able to apply their mathematical reasoning, the results of which are not simply a score, but a snapshot of the effectiveness of the teaching method. Finally, in the Act phase, all evaluation findings are reintegrated to improve strategies in the next cycle. Through this continuous internalization of PDCA, structural barriers such as those found at SDN Tanjungjaya and SDN Mandalasari can be intervened precisely, so that numeracy learning management can truly become a catalyst for improving elementary school students' mathematical logic. Various studies have confirmed that the implementation of systematic learning management contributes to improving the quality of student learning processes and outcomes. However, studies specifically examining numeracy learning management within the PDCA cycle framework, particularly at the elementary school level, are still relatively limited. Furthermore, research comparing the implementation of numeracy learning management in two educational institutions with different characteristics is also rare.

Based on these conditions, this study focuses on the study of numeracy learning management in improving elementary school students' mathematical logic through the application of the PDCA cycle at SDN Tanjungjaya, Cianjur Regency and SDN Mandalasari, West Bandung Regency. This study aims to analyze the planning, implementation, evaluation, and follow-up of numeracy learning as an effort to continuously improve students' mathematical logic. The results of the study are expected to provide theoretical contributions to the development of numeracy learning management as well as practical recommendations for elementary schools in improving the quality of learning. The novelty of this research lies in the disclosure of a PDCA cycle-based numeracy learning management model through a comparative study of two elementary schools with different characteristics. The findings of this study are expected to serve as a reference for more systematic, measurable, and sustainable numeracy learning management in elementary schools.

Learning management is a series of activities encompassing planning, implementation, evaluation, and follow-up of learning activities carried out systematically to achieve learning objectives effectively and efficiently. Learning management requires thorough planning, targeted implementation, and continuous evaluation as a basis for learning improvement. In the context of elementary schools, learning management is a crucial factor in optimizing students' learning processes according to their developmental characteristics and learning needs (Rukajat, 2018). Learning management is an integrative orchestration of educational activities, encompassing a systematic series of carefully designed processes, from planning, implementation, evaluation, to follow-up, to ensure the effective and efficient achievement of instructional objectives. In practice,

this management is not merely a routine activity in the classroom, but rather a manifestation of educator professionalism in managing resources, time, and strategies so that each knowledge transfer process has high utility. The emphasis on systematic aspects requires that each learning step has a strong argumentative basis, where planning is not merely formulated as an administrative requirement, but as a visionary roadmap to guide the interaction between teachers, students, and teaching materials (Ridwan, 2026).

At the elementary school level, learning management plays a fundamental role because it must accommodate the cognitive and psychological developmental characteristics of students who are still in the concrete operational phase. At this stage, focused management enables teachers to align complex curricula with diverse student learning needs, allowing abstract material such as numeracy to be more easily internalized. Furthermore, the continuous evaluation aspect of learning management serves as a vital quality control mechanism; through objective evaluation, teachers can obtain accurate data on student learning barriers, which can then be used as a basis for strategic improvements in the follow-up phase. With optimal and sustainable management, schools can create a conducive learning ecosystem, where students' intellectual potential is not only maximally explored but also precisely guided according to future competency demands.

Good learning management enables teachers to manage learning resources, methods, media, and learning strategies in a planned manner. With systematic management, the learning process is not only oriented towards delivering material, but also towards achieving competencies and developing students' thinking skills as a whole. High-quality learning management provides a framework for teachers to orchestrate all educational instruments—from learning resources, methodologies, media, to instructional strategies—in a measurable and visionary manner. The essence of this management lies in the ability of educators to become not merely transmitters of information (transmitters of knowledge), but also managers of learning environments capable of synergizing various educational variables to achieve specific competency targets. In practice, planned management ensures that every medium used and every method applied has a direct correlation to strengthening student understanding, so that no classroom activity is wasted or without a clear purpose.

Through a systematic approach, the learning orientation undergoes a paradigm shift from initially focusing solely on mastering material (curriculum-centric) to focusing on the growth of competencies and the holistic development of students' cognitive structures. Structured management allows teachers to map students' thought processes, identify their zones of proximal development, and design appropriate interventions to hone logic and critical thinking. Thus, the learning process transforms into an organized intellectual journey, where each stage students go through is designed to build independent thinking, problem-solving skills, and mental readiness to face more complex academic challenges in the future (Adiputra & Hidayah, 2025).

Numeracy is a basic skill related to understanding mathematical concepts, using numbers, and reasoning and solving problems in various everyday contexts. Numeracy learning in elementary schools emphasizes not only counting skills but also logical, analytical, and critical thinking skills in solving mathematical problems. Numeracy is a fundamental competency that goes beyond mastering basic arithmetic; it encompasses the comprehensive ability to understand mathematical concepts, manipulate numbers, and utilize reasoning to solve problems in various dynamic everyday contexts. At the elementary school level, numeracy learning holds a strategic mandate to equip students not only with technical numeracy skills but also to build a solid cognitive structure. This means the primary focus of learning shifts from simply memorizing formulas to developing logical, analytical, and critical thinking capacities. With strong numeracy skills, students are not only able to answer problems on paper but also able to identify patterns, make estimates, and make decisions based on quantitative data when faced with real phenomena in their environment.

The integration of numeracy into the elementary school curriculum serves as a catalyst for students' overall intellectual development. Analytical thinking skills honed through numeracy enable students to break down complex problems into simpler components for systematic solution. Meanwhile, critical thinking skills encourage students to question the validity of mathematical arguments and seek more effective alternative solutions. Therefore, mastery of numeracy is seen as an essential literacy that enables students to participate actively and intelligently in modern society, where understanding numerical information is key to navigating future social and academic life (Badu et al., 2025).

Effective numeracy learning needs to be designed contextually and meaningfully so that students can connect mathematical concepts to real-world situations. Therefore, numeracy learning requires planned learning management, starting from the planning of objectives and materials, selecting appropriate learning strategies, and evaluating learning outcomes as a basis for further learning improvement. Effective numeracy learning must be designed with a contextual and meaningful approach so that students do not simply view mathematics as a series of cold numbers, but as a relevant navigation tool for understanding the real situations around them. The connection between abstract concepts and everyday phenomena is key in building cognitive bridges for elementary school students, enabling them to see the practical utility of each material learned. However, creating meaningful learning requires highly planned and integrated learning management. This begins with the formulation of objectives and the selection of materials that align with real-world challenges, which must then be supported by the selection of instructional strategies that can spark students' curiosity and independent exploration.

Successfully linking numeracy concepts to reality relies heavily on a closed and continuous management cycle. The chosen learning strategy, whether through problem-based learning or real-life projects, must be periodically evaluated to gauge the extent to which students have grasped the connections (Mugara & Ali, 2025). Evaluation of learning outcomes serves not only as a cognitive measurement tool but also as crucial diagnostic data for reflection and improvement in the next learning cycle. With systematic management, each learning process will continue to evolve to become more precise in responding to students' needs, ensuring that the foundation of mathematical logic formed is truly solid and reliable in solving complex problems in the future.

Mathematical logic is a thinking skill related to reasoning, decision-making, and systematic problem-solving based on mathematical concepts and rules. In elementary school, mathematical logic serves as an essential foundation for mastering more complex mathematical concepts at subsequent levels of education. Mathematical logic is a manifestation of higher-level cognitive abilities that involve deductive and inductive reasoning processes, accurate decision-making, and systematic problem-solving mechanisms based on rigid mathematical structures and rules. At the elementary school level, the development of mathematical logic is not merely an academic complement, but rather the formation of a fundamental intellectual foundation for students. This ability enables students to not only passively receive information but also process it through a logical filter to discover cause-and-effect relationships, identify patterns, and construct valid arguments. Without a solid logical foundation in this early phase, students will face significant obstacles when confronted with the abstraction of much more complex and theoretical mathematical concepts at the secondary and tertiary levels.

Internalizing mathematical logic from an early age serves as a framework that trains the brain to work in an organized and methodical manner when facing various challenges, both inside and outside the classroom (Dwi et al., 2023). The ability to break down large problems into smaller, logical components helps students develop effective and efficient solution strategies. Therefore, instilling mathematical logic through appropriate learning management in elementary schools is a crucial investment in producing a generation with critical reasoning and intellectual resilience. This ensures that every step of learning students go through is a process of accumulating competencies that will sustain their long-term academic success. The development of students' mathematical logic is influenced by the quality of numeracy instruction implemented in the classroom. Structured learning, involving higher-order thinking activities, and providing opportunities for students to solve problems independently can encourage optimal development of students' mathematical logic.

The Plan, Do, Check, and Act (PDCA) cycle, developed by Edward Deming, is a quality management concept that emphasizes the importance of continuous improvement. The plan phase includes learning planning based on needs analysis and the desired objectives. The do phase is the implementation of learning according to the plan. The check phase is carried out through evaluation of the learning process and outcomes, while the act phase focuses on follow-up and improvement of learning based on the evaluation results (Munifah et al., 2025). The implementation of the Plan, Do, Check, and Act (PDCA) cycle, pioneered by Edward Deming, brings the industrial quality management paradigm into the classroom by emphasizing the principle of continuous improvement. Within the educational ecosystem, this cycle ensures that learning quality is not left to chance but rather controlled through a disciplined, data-driven system. The Plan phase is a central point,

requiring teachers to conduct an in-depth analysis of students' specific needs and formulate learning objectives that not only pursue curriculum targets but also strengthen reasoning. Thorough planning includes selecting relevant numeracy materials, designing challenging instructional strategies, and preparing evaluation instruments that can accurately capture students' logical development.

Next, the Do (Implementation) stage acts as a vehicle for the realization of the prepared plan, where the teacher orchestrates the teaching-learning interactions in the classroom while maintaining consistency with the planned strategy. After the implementation process, the Check (Evaluation) stage is present as a quality control mechanism to test the effectiveness of the methods used through objective assessment of the learning process and outcomes. The data obtained at this stage does not stop as a pile of grades, but becomes the main fuel for the Act (Follow-up) stage. In this final phase, the teacher conducts critical reflection and makes strategic decisions to correct any deficiencies found, so that in the next cycle, numeracy learning can be carried out with a higher level of precision. Through the consistent rotation of the PDCA cycle, numeracy learning management is transformed into an adaptive and progressive process in optimizing students' logical thinking abilities. In the context of numeracy learning, the PDCA cycle can be used as a learning management framework to improve students' mathematical logic. Applying PDCA allows teachers to systematically and continuously improve learning based on objective evaluation results.

Various studies have shown that planned and sustainable learning management significantly improves the quality of student learning processes and outcomes. Studies related to mathematics and numeracy learning confirm that systematically managed learning can improve students' logical thinking and problem-solving abilities. Planned and sustainable learning management is a crucial foundation for creating a quality educational ecosystem. Theoretically and practically, thorough planning allows teachers to precisely map students' cognitive pathways, ensuring that each topic is presented in a logical sequence that aligns with the students' level of mental readiness. In the domain of mathematics and numeracy, this is especially vital due to the cumulative nature of the disciplines; failure to manage understanding of basic concepts will hinder mastery of more complex material in the future. Systematic management includes setting clear instructional objectives, selecting relevant pedagogical strategies, and creating a classroom environment conducive to intellectual exploration.

Sustainability in learning management ensures a consistent cycle of evaluation and reflection. Rather than simply assigning grades at the end of a chapter, effective management involves monitoring student progress in real time to identify misconceptions early. In numeracy learning, this approach has proven effective in transforming the way students process information, from simply memorizing formulas to the ability to reason logically and solve problems adaptively. With a professionally managed process, students not only master numbers but also develop critical thinking patterns that can be applied to real-world challenges beyond the classroom. Furthermore, research on the application of quality management in education shows that using the PDCA cycle in learning management can improve learning effectiveness through continuous evaluation and follow-up. However, studies specifically examining PDCA-based numeracy learning management at the elementary school level are still relatively limited.

Based on theoretical studies and previous research findings, this study uses Edward Deming's PDCA cycle as the primary theoretical framework. Numeracy learning management is analyzed through four PDCA stages: learning planning (plan), learning implementation (do), learning evaluation (check), and corrective action (act). These four stages are seen as contributing to improving elementary school students' mathematical logic. The integration of Edward Deming's PDCA (Plan, Do, Check, Act) cycle into numeracy learning management in elementary schools creates a scientific and measurable framework for improving students' logical thinking skills. In the Plan phase, teachers not only prepare materials but also conduct competency mapping and diagnostic assessments to determine the numeracy strategies most relevant to students' needs. The Do phase then becomes the implementation space where the plan is executed through active learning activities that stimulate reasoning, such as problem-based learning or the use of concrete mathematical props. In this context, systematic classroom management ensures that every second of the learning process focuses on developing logical thinking, not simply memorizing formulas.

The Check (Evaluation) stage serves as a monitoring instrument to measure the effectiveness of the implemented method on students' mathematical logic achievement. Through analysis of

learning outcome data and process observations, teachers can identify obstacles or misconceptions experienced by students early on. This cycle is completed by the Act (Follow-up) stage, where evaluation results are used to make continuous improvements. If weaknesses are found in students' reasoning on a particular topic, teachers immediately intervene or modify strategies in the next cycle. The continuity of these four stages ensures that the quality of numeracy learning continues to improve consistently, ultimately significantly strengthening elementary school students' problem-solving abilities and mathematical logic acuity.

This theoretical framework is used to analyze how numeracy learning management is systematically and sustainably implemented to improve students' mathematical logic in elementary schools. This theoretical framework, which adopts Edward Deming's PDCA (Plan-Do-Check-Act) cycle, serves as a comprehensive analytical instrument to examine the extent to which numeracy learning management is carried out scientifically and sustainably. In the context of elementary education, the use of this framework allows researchers to view learning not as a series of incidental or discontinuous classroom activities, but as an ecosystem of continuous improvement specifically designed to stimulate students' logical nerves. Through the Plan phase, management is analyzed from the perspective of the maturity of instructional design and the mapping of strategies that trigger higher-order thinking skills, so that planning is not merely an administrative document but a roadmap for the development of students' deductive and inductive reasoning from an early age.

Next, the implementation of the Do phase analyzes how classroom pedagogical practices are able to transform abstract numerical concepts into concrete logic through active interaction and problem-solving. The effectiveness of this process is then tested in the Check phase, where systematic management audits students' thinking processes to detect any logical misconceptions before moving on to more complex material. This cycle is completed by the Act phase, which ensures the continuity of quality through specific interventions and strategy modifications based on the results of previous evaluations. Overall, the implementation of this PDCA framework confirms that the improvement in elementary school students' mathematical logic is a tangible result of precise learning management, which psychologically shapes students' thinking structures to be more disciplined, critical, and analytical in facing various numeracy challenges.

Method

This study employed a qualitative approach with a descriptive-analytical approach. The qualitative approach was chosen because it aimed to gain a deeper understanding of numeracy learning management in improving elementary school students' mathematical logic, specifically from the perspective of the Plan, Do, Check, and Act (PDCA) cycle (Saleh et al., 2026). The descriptive-analytical approach was used to systematically describe the facts and phenomena of numeracy learning that occur in the field, while simultaneously analyzing them based on an educational quality management framework. This research was conducted at two elementary schools: Tanjungjaya Elementary School, Cianjur Regency, and Mandalasari Elementary School, West Bandung Regency, West Java Province. The selection of these two schools was based on the differences in school characteristics and numeracy learning conditions, allowing for a comparative analysis of the implementation of numeracy learning management. Furthermore, both schools have implemented numeracy learning in the mathematics learning process, making them relevant to the research focus. The research was conducted over a specific timeframe according to the needs of field data collection and was conducted in stages, starting from initial data collection, observation of the learning process, and evaluation of numeracy learning management.

The research subjects consisted of school principals and class teachers directly involved in the planning and implementation of numeracy learning. The research subjects were selected purposively, considering the informants' involvement, experience, and relevance to the research focus. The principals were positioned as key informants regarding learning policies and management, while the class teachers served as primary informants, providing data on the planning, implementation, evaluation, and follow-up of numeracy learning. Data collection techniques in this study included interviews, observations, and documentation studies. In-depth interviews were conducted with the principal and class teachers to gather information regarding numeracy learning management at each stage of the PDCA cycle, starting from learning planning (plan), learning implementation (do),

learning evaluation (check), to follow-up improvements (act). Observations were conducted to directly observe the implementation of numeracy learning in the classroom, including the learning strategies used by teachers, student engagement, and learning activities that support the development of mathematical logic. Documentation studies were used to examine supporting documents, such as learning tools, lesson plans, syllabi, learning evaluation results, and other documents relevant to numeracy learning management. These documents were analyzed to assess the suitability between learning planning and implementation.

Data analysis was conducted using the Miles and Huberman interactive analysis model, which includes data reduction, data presentation, and conclusion drawing and verification. The analysis process was conducted continuously from data collection to conclusion drawing, enabling researchers to gain a deep and comprehensive understanding of numeracy learning management in improving students' mathematical logic. The validity of the data in this study was maintained through source and technical triangulation techniques. Source triangulation was conducted by comparing data obtained from the principal and class teachers, while technical triangulation was conducted by comparing the results of interviews, observations, and documentation studies. Furthermore, member checking was conducted with key informants to ensure consistency between the data obtained and the researcher's interpretation, thereby increasing the credibility and validity of the research findings.

Results and Discussion

The results of the study indicate that numeracy learning management at SDN Tanjungjaya, Cianjur Regency and SDN Mandalasari, West Bandung Regency is implemented through the Plan, Do, Check, and Act (PDCA) cycle stages in a planned, systematic, and sustainable manner in an effort to improve elementary school students' mathematical logic. The implementation of numeracy learning management involves the role of the principal and class teachers in managing the learning process from the planning stage to the follow-up of learning improvements.

The results of the study revealed that the effectiveness of improving students' mathematical logic at SDN Tanjungjaya, Cianjur Regency, and SDN Mandalasari, West Bandung Regency, was not the result of incidental activities, but rather the fruit of the implementation of highly structured learning management based on the Plan, Do, Check, and Act (PDCA) cycle. In both schools, this cycle is implemented as the main breath in managing the numeracy curriculum, where the planning stage (Plan) is not only limited to the preparation of administrative documents, but also includes an in-depth analysis of students' cognitive readiness and the selection of pedagogical strategies that can stimulate reasoning power. This shows that these schools have had the managerial awareness to map numeracy challenges early on to ensure that each material presented has a logical flow that can be understood by elementary school students.

Field implementation during the implementation (Do) phase demonstrates a strong integration between the principal's role as supervisor and the classroom teacher's role as front-line learning manager. The principal ensures the availability of resources and a conducive learning environment, while the classroom teacher executes numeracy learning through an interactive approach, directly training students' problem-solving and critical thinking skills. This success is then validated through a systematic evaluation (Check) phase, where students' mathematical logic achievements are periodically monitored to identify learning obstacles or conceptual misconceptions. The monitoring results are not merely reported, but are followed by a follow-up (Act) phase in the form of continuous improvements, such as targeted remediation or enrichment of teaching methods. The synergy between the principal's instructional leadership and teachers' creativity in sustainably managing the PDCA cycle creates an adaptive educational ecosystem, significantly contributing to strengthening the foundation of students' mathematical logic in both regions.

Planning Stage (Do)

The planning stage of numeracy learning is the initial step that receives the main attention of teachers and principals in both schools. Planning is carried out by compiling learning tools that integrate numeracy objectives and the development of students' mathematical logic. Teachers map students' initial abilities as a basis for determining numeracy learning strategies that will be applied in the classroom. Interviews with school principals revealed that numeracy lesson plans are designed to

ensure that mathematics learning is not solely oriented toward conceptual mastery but also toward developing students' logical thinking skills. Classroom teachers develop lesson plans, materials, and numeracy learning activities, taking into account student characteristics and the relevant learning context. The analyzed lesson plan documents demonstrate adjustments to numeracy learning strategies and methods to meet the needs of students in each school.

The numeracy learning planning phase at Tanjungjaya Elementary School and Mandalasari Elementary School is positioned as a strategic pillar that determines the success of the entire instructional cycle. In this phase, the principal and class teachers collaborate intensively to develop learning tools that are not merely administrative in nature, but substantively integrate numeracy targets with strengthening students' mathematical logic. This planning begins with the crucial step of mapping initial abilities (diagnostic assessment), in which teachers carefully identify the starting point of students' understanding. The resulting data from this mapping then serves as a compass in determining the most relevant teaching strategies, ensuring that the cognitive load provided is within the appropriate developmental zone so that students are able to build solid reasoning without feeling overburdened.

The principal's commitment to directing the learning orientation demonstrates a paradigm shift from merely memorizing concepts to developing applicable logical thinking skills. This is reflected in the Lesson Implementation Plan (RPP) documents prepared by teachers, where each material and activity is designed with consideration of students' psychological characteristics and the environmental context relevant to elementary school children. Analysis of these planning documents demonstrates managerial flexibility; numeracy learning strategies and methods are not rigidly applied, but rather adapted to the unique needs and learning modalities of students in each school. Thus, this systematic planning serves as a blueprint, ensuring that every classroom activity has a clear direction in continuously sharpening students' analytical and problem-solving skills.

Implementation Stage (Do)

The implementation of numeracy learning in both schools shows that teachers are trying to implement contextual learning and encourage active student involvement. Teachers implement numeracy learning through problem-solving activities, discussions, and exercises that require students to use mathematical logic in solving problems. Learning observations show that teachers provide opportunities for students to explain their thinking processes in solving numeracy problems. At Tanjungjaya Elementary School, numeracy learning emphasizes the use of contextual examples close to students' lives, while at Mandalasari Elementary School, teachers utilize a variety of exercises and group discussions to train students' reasoning. The implementation of numeracy learning proceeds according to the established plan, although there are adjustments to learning strategies in class based on student responses and abilities.

The implementation of numeracy learning at Tanjungjaya Elementary School and Mandalasari Elementary School reflects the concrete implementation of active, student-centered pedagogy, where teachers strive to bring mathematical concepts to life through a contextual approach. In classroom practice, teachers no longer position themselves as the sole source of knowledge, but rather as facilitators who encourage students to engage in problem-solving activities, group discussions, and intensive exercises that require in-depth use of mathematical logic. Field observations revealed an interesting dynamic: teachers consistently provide space for students to verbalize or explain their thought processes when solving problems. This practice is crucial because it forces students to reflect on their own reasoning, so that their critical thinking skills and logical acuity are naturally honed through mathematical communication.

Although both schools share a common vision of improving numeracy skills, there are differences in strategies tailored to their respective local contexts. At SDN Tanjungjaya, learning feels very down-to-earth, with an emphasis on using contextual examples drawn directly from students' everyday environments, so that mathematics is no longer perceived as a foreign and abstract subject. Meanwhile, at SDN Mandalasari, teachers place greater emphasis on a variety of exercises and strengthening group discussions to cultivate collective reasoning skills. Interestingly, while implementation generally adheres to the established lesson plan (RPP), teachers demonstrate high managerial flexibility by adjusting strategies on the spot based on student responses and absorption

in the classroom. This adaptability ensures that learning remains inclusive and effective, with each student receiving logical challenges appropriate to their current cognitive capacity.

Evaluation Stage (Check)

Numeracy learning evaluations are conducted periodically to assess the achievement of learning objectives and the development of students' mathematical logic. Teachers conduct evaluations through assessments of learning outcomes, observations of the learning process, and reflections on the effectiveness of the learning strategies used. The evaluation documents analyzed show that the results are used not only to assess students' academic achievement but also as a basis for assessing the effectiveness of numeracy learning management. The principal and teachers regularly discuss the evaluation results to identify any obstacles and weaknesses encountered in the numeracy learning process.

The evaluation phase of numeracy learning management at both schools serves as a comprehensive quality control mechanism to ensure that students' mathematical logic development goals are optimally achieved. This evaluation is not conducted sporadically, but rather regularly and systematically through a combination of various assessment techniques, ranging from cognitive learning outcomes to in-depth observation of student behavior during the learning process. Teachers are not solely focused on the final scores achieved by students but also critically reflect on the effectiveness of the pedagogical strategies implemented in the classroom. Through process observation, teachers can capture the phenomenon of how students construct reasoning, identify points of logical impasse, and assess the extent to which discussion methods or contextual approaches provided are able to stimulate their problem-solving abilities.

Analysis of the evaluation documents shows that the collected data has broader strategic value, namely as a parameter for measuring the effectiveness of overall learning management. The results of this evaluation serve as an objective database for principals and teachers in regular discussion forums aimed at conducting managerial analyses of the instructional process. In these meetings, any technical obstacles and methodological weaknesses identified in the field are openly discussed to identify the root causes. This demonstrates that the evaluation at SDN Tanjungjaya and SDN Mandalasari has gone beyond the administrative function of student assessment; it has transformed into a vital managerial diagnostic tool to ensure that the numeracy learning ecosystem remains relevant, responsive to learning obstacles, and consistently oriented towards improving the quality of students' mathematical reasoning.

Follow-up Stage (Act)

Follow-up numeracy learning is carried out based on the results of the evaluation. Teachers make improvements and adjustments to learning strategies, such as enriching materials for students who have achieved competency and providing additional support for students who are still having difficulty understanding numeracy concepts. Follow-up documents demonstrate changes and developments in numeracy learning strategies, including the selection of learning methods, material development, and time management. The principal plays a role in monitoring the implementation of follow-up actions and encouraging teachers to continuously improve their learning. Observations indicate that the PDCA cycle is repeatedly implemented as part of efforts to improve the quality of numeracy learning.

The follow-up (Act) phase of the learning management cycle at SDN Tanjungjaya and SDN Mandalasari is a concrete manifestation of the schools' commitment to the principle of continuous improvement. The results of previous evaluations are not simply a pile of data, but are converted into concrete actions in the form of more inclusive and personalized learning strategy adjustments. Teachers differentiate instruction by providing enrichment programs for students who have demonstrated excellence in mathematical logic to further develop their potential, while also providing intensive mentoring and reinforcement of basic concepts for students who still face obstacles in understanding aspects of numeracy. This step ensures that every student, regardless of their learning pace, continues to receive appropriate managerial attention to achieve the expected standard of reasoning competency.

The analyzed follow-up documents revealed substantive transformations in classroom governance, ranging from updating teaching methods to be more adaptive, restructuring materials to

be more systematic, and optimizing learning time management for greater effectiveness. The principal's role was crucial in this phase as a catalyst, monitoring the consistency of follow-up implementation and motivating teachers to remain satisfied with the results achieved. Field observations clearly confirmed that the PDCA cycle does not stop at a single round, but operates repetitively and spirally. This recurrent cycle creates a culture of quality where every shortcoming in the previous period becomes valuable input for improvement in the next period, ultimately consistently improving the quality of numeracy learning and the acuity of students' mathematical logic in both schools.

General Findings

Overall, the research results indicate that the implementation of PDCA cycle-based numeracy learning management at Tanjungjaya Elementary School and Mandalasari Elementary School contributed positively to improving students' mathematical logic. Careful planning, active learning implementation, regular evaluation, and continuous follow-up are key to the success of numeracy learning management. However, several obstacles were still identified, such as differences in students' initial abilities and limited learning time, which require continuous adjustments to learning strategies. These findings suggest that structured numeracy learning management oriented towards continuous improvement can support the improvement of elementary school students' mathematical logic.

Comprehensively, the findings of this study confirm that the adoption of the PDCA (Plan-Do-Check-Act) cycle in numeracy learning management at SDN Tanjungjaya and SDN Mandalasari has significantly contributed to strengthening students' mathematical logic structure. This success is rooted in the synergy between thorough planning based on students' initial ability data, the implementation of active pedagogy that prioritizes reasoning over memorization, and routine evaluation mechanisms that accurately capture cognitive development. Continuous follow-up ensures that each educational intervention is not static, but rather dynamic, following fluctuations in classroom learning needs. Through this structured management, the schools have succeeded in creating a predictive yet adaptive learning environment, where students' logical thinking processes are consistently stimulated through precise instructional governance.

However, this study also identified real challenges in the field, such as the wide disparity in students' initial abilities and limited learning time allocation, which often hinders the in-depth understanding of complex numeracy material. These obstacles require teachers to be creative in adapting strategies instantly and continuously to ensure all students remain on an effective learning path. These findings ultimately provide a deeper understanding that numeracy learning management oriented towards continuous improvement is not merely an administrative matter, but a crucial instructional leadership strategy. By consistently implementing each phase of the PDCA, elementary schools can build a solid foundation of mathematical logic, which will become valuable intellectual capital for students in subsequent levels of education and in their daily lives.

The results of the study indicate that numeracy learning management at Tanjungjaya Elementary School, Cianjur Regency, and Mandalasari Elementary School, West Bandung Regency, is implemented in a structured manner through planning, implementation, evaluation, and follow-up stages, referring to the Plan, Do, Check, and Act (PDCA) cycle. This finding aligns with educational management theory, which emphasizes the importance of systematic learning management and continuous improvement to enhance the quality of student learning processes and outcomes. In the planning stage, teachers and principals develop numeracy learning materials, taking into account learning objectives, student characteristics, and the need for mathematical logic development. This planning reflects the principles of learning management, which place needs analysis as the basis for determining learning strategies. These findings reinforce the view that thorough planning is a critical factor in the success of numeracy learning in elementary schools.

The results of this study confirm that the effectiveness of numeracy improvement at Tanjungjaya Elementary School, Cianjur Regency, and Mandalasari Elementary School, West Bandung Regency, is rooted in the implementation of highly structured and quality-oriented learning management. By adopting the Plan, Do, Check, and Act (PDCA) cycle, both schools successfully transformed the teaching and learning process from mere classroom routines into a scientific managerial system. This finding aligns with the fundamental principles of modern educational management, which emphasize that the quality of student learning processes and

outcomes is not a matter of chance, but rather the product of systematic governance and a commitment to continuous improvement. The synergy between precise planning and measurable execution creates an educational ecosystem that is stable yet adaptive to the dynamics of students' cognitive needs in the field.

In the crucial planning phase, collaboration between teachers and the principal determines the direction of the instructional policies to be implemented. This stage focuses not only on fulfilling administrative requirements but also on developing a numeracy learning blueprint that explicitly integrates the development of mathematical logic into every component of the teaching materials. By carefully considering students' psychological characteristics and conducting an in-depth needs analysis, this planning becomes a strategic instrument to ensure that the material presented remains relevant and challenging for students' reasoning abilities. These findings strengthen the theoretical basis that thorough, data-driven planning is the most essential determinant of successful numeracy learning, as this is where the foundation for all students' intellectual activities in elementary school begins to be built in a directed manner.

The implementation (do) phase shows that teachers implement numeracy learning through various strategies that encourage active student engagement, such as problem-solving, discussions, and contextual exercises. Numeracy learning is not only oriented towards conceptual mastery but also focuses on students' thinking processes in solving mathematical problems. The differences in implementation strategies in the two schools indicate that numeracy learning management is contextual and adapts to students' conditions and characteristics. During the evaluation (check) stage, teachers assess the results and process of numeracy learning to determine the development of students' mathematical logic. Evaluation serves not only as a tool to measure learning outcomes but also as a basis for reflection on the effectiveness of the implemented learning strategies. These findings indicate that ongoing evaluation allows teachers to more objectively identify weaknesses and obstacles in numeracy learning.

The follow-up (act) stage is realized through improvements and adjustments to learning strategies based on evaluation results. Teachers provide enrichment for students who have achieved competency and provide additional guidance for students who are still experiencing difficulties. This follow-up demonstrates a commitment to continuous improvement in numeracy learning management. Thus, the PDCA cycle is not merely a theoretical concept but is implemented in real-life classroom learning management. The implementation (Do) phase of learning management at SDN Tanjungjaya and SDN Mandalasari provides a space for teachers to transform theoretical planning into dynamic, student-centered pedagogical practices. Teachers at both schools consciously implement strategies that encourage active engagement, where numeracy learning is no longer simply a transfer of knowledge or mastery of abstract formulas, but rather an exploratory process through problem-solving activities, collaborative discussions, and exercises based on everyday contexts. The main focus in this phase is to uncover students' thought processes; teachers act as facilitators who guide how students use their logic to analyze and solve mathematical problems. The differences in approach found in the two schools—between the emphasis on contextualization on the one hand and the variety of exercises on the other—demonstrate that effective numeracy learning management is flexible and contextual, adapting to the unique characteristics and mental readiness of students in each educational environment.

Next, in the evaluation (Check) stage, a comprehensive monitoring process is carried out to measure the effectiveness of the interventions implemented on the development of students' mathematical logic. Evaluation here has a dual role: as an instrument for measuring students' academic achievement and as a critical reflection tool for educators to assess the extent to which the implemented learning strategies are able to stimulate reasoning. By conducting assessments that include both final results and the process during class, teachers can obtain more objective data regarding learning obstacles or logical misconceptions experienced by students. These findings confirm that ongoing evaluation is a crucial step in educational management, as it allows teachers to accurately diagnose weaknesses in the teaching system before moving on to the improvement stage.

This cycle culminates in the follow-up (Act) phase, which demonstrates the school's commitment to the principle of continuous improvement. Evaluation results are not left as mere administrative reports, but are immediately followed up with more personalized and inclusive adjustments to learning strategies. This is evident in the enrichment program for students who have

exceeded competency standards to maintain their logical acceleration, as well as the provision of special assistance or remediation for students who still struggle to grasp basic numeracy concepts. This close integration between evaluation results and corrective actions demonstrates that the PDCA cycle in both schools has transcended theoretical concepts and become a tangible work culture in classroom management. Thus, this consistent implementation of numeracy learning management ensures a progressive improvement in instructional quality to strengthen the foundation of elementary school students' mathematical logic. Overall, the results of this study reinforce previous research findings that systematic and sustainable learning management contributes to improving the quality of learning. The main contribution of this study lies in revealing the practice of PDCA-based numeracy learning management at the elementary school level, specifically in improving students' mathematical logic through planned learning management oriented towards continuous improvement.

Conclusion

Based on the research results and discussion, it can be concluded that the numeracy learning management at Tanjungjaya Elementary School, Cianjur Regency, and Mandalasari Elementary School, West Bandung Regency, is implemented in a planned, systematic, and sustainable manner, referring to the Plan, Do, Check, and Act (PDCA) cycle principle. In the planning stage, teachers develop numeracy learning based on an analysis of students' needs and characteristics. The implementation stage is carried out through learning that encourages students' active involvement in thinking and solving mathematical problems. The evaluation stage is carried out periodically to assess the achievement of learning objectives and the development of students' mathematical logic. The follow-up stage is realized through improvements and development of learning strategies based on the evaluation results.

Despite challenges, such as differences in students' initial abilities and limited learning time, the implementation of PDCA-based numeracy learning management still demonstrated a positive contribution to improving students' mathematical logic. Thus, this study confirms that implementing the PDCA cycle in numeracy learning management can be an effective approach to improving the quality of learning in elementary schools.

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