THE IMPLEMENTATION OF INQUIRY-BASED TEACHING THROUGH OPEN-ENDED QUESTIONS TO IMPROVE GRADE 4 STUDENTS' MULTIPLICATION PROBLEM-SOLVING PERFORMANCE

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ABSTRACT

This study examined the implementation of inquiry-based teaching through open-ended questions to improve Grade 4 students' multiplication problem-solving performance at Mentari Intercultural School Jakarta. The study was conducted because many students showed low engagement, limited participation, and difficulty explaining their strategies when solving multiplication problems. A Classroom Action Research design was applied through three stages: pre-cycle, Cycle I, and Cycle II. The participants were 21 Grade 4 students. Data were collected using multiplication problem-solving tests, teacher and student observation sheets, and semi-structured interviews. The results showed progressive improvement in students' learning outcomes. The class average increased from 62.19 in the pre-cycle to 68.57 in Cycle I and 79.52 in Cycle II. Classical mastery also increased from 19.05% in the pre-cycle to 42.86% in Cycle I and 85.71% in Cycle II. Observation and interview findings indicated that students became more engaged, more confident in explaining reasoning, and more flexible in using strategies such as arrays, equal groups, repeated addition, and decomposition. The findings suggest that inquiry-based teaching supported by open-ended questions can improve multiplication problem-solving performance by promoting active exploration, reasoning, and strategy comparison.

Keywords: inquiry-based teaching, open-ended questions, multiplication, problem-solving

ABSTRAK

Penelitian ini mengkaji implementasi pembelajaran berbasis inkuiri melalui pertanyaan terbuka untuk meningkatkan kinerja pemecahan masalah perkalian siswa kelas 4 di Sekolah Antarbudaya Mentari Jakarta. Penelitian ini dilakukan karena banyak siswa menunjukkan keterlibatan yang rendah, partisipasi terbatas, dan kesulitan menjelaskan strategi mereka ketika menyelesaikan masalah perkalian. Desain Penelitian Tindakan Kelas diterapkan melalui tiga tahap: pra-siklus, Siklus I, dan Siklus II. Partisipan penelitian adalah 21 siswa kelas 4. Data dikumpulkan menggunakan tes pemecahan masalah perkalian, lembar observasi guru dan siswa, dan wawancara semi-terstruktur. Hasil penelitian menunjukkan peningkatan progresif dalam hasil belajar siswa. Rata-rata kelas meningkat dari 62,19 pada pra-siklus menjadi 68,57 pada Siklus I dan 79,52 pada Siklus II.

Penguasaan klasik juga meningkat dari 19,05% pada pra-siklus menjadi 42,86% pada Siklus I dan 85,71% pada Siklus II. Hasil observasi dan wawancara menunjukkan bahwa siswa menjadi lebih terlibat, lebih percaya diri dalam menjelaskan penalaran, dan lebih fleksibel dalam menggunakan strategi seperti susunan, kelompok yang sama, penjumlahan berulang, dan dekomposisi. Temuan ini menunjukkan bahwa pengajaran berbasis inkuiri yang didukung oleh pertanyaan terbuka dapat meningkatkan kinerja pemecahan masalah perkalian dengan mendorong eksplorasi aktif, penalaran, dan perbandingan strategi.

Kata Kunci: Pembelajaran Inquiry, Open Ended Questions, Perkalian, Pemecahan Masalah

A. Introduction

Mathematics learning in elementary school should develop not only procedural fluency but also reasoning, conceptual understanding, and problem-solving ability. However, multiplication is often taught through memorization and repeated procedures, causing students to focus on obtaining correct answers rather than understanding why a strategy works. This condition can limit students' ability to solve non-routine mathematical problems and explain their reasoning.

Mathematical problem-solving is a central goal of mathematics education because it requires students to understand problems, select strategies, apply procedures, and evaluate whether their answers make sense. Polya's problem-solving framework emphasizes four major stages: understanding the problem, devising a plan, carrying out the plan, and looking back. These stages show that problem-solving is not limited to computation but also involves interpretation, planning, reasoning, and reflection.

At Mentari Intercultural School Jakarta, several Grade 4 students showed low engagement in mathematics lessons. Many students tended to wait for direct instruction, rarely asked questions, and had difficulty explaining the steps used in solving multiplication problems. This classroom problem indicated the need for a learning approach that could encourage active participation, reasoning, and flexible strategy use.

Inquiry-based teaching is relevant because it positions students as active learners who explore problems, test ideas, and construct

understanding through guided questioning. Open-ended questions strengthen this approach by allowing students to solve problems in more than one way, justify their answers, and compare strategies. Therefore, this study aimed to examine how inquiry-based teaching through open-ended questions could improve Grade 4 students' multiplication problem-solving performance.

Inquiry-based teaching supports mathematical problem-solving because it encourages students to investigate mathematical situations rather than merely receive formulas from the teacher. In inquiry learning, students are guided to ask questions, explore possible strategies, discuss findings, and draw conclusions. Previous studies show that inquiry-based learning can improve conceptual understanding, mathematical engagement, and problem-solving skills when implemented with sufficient teacher guidance (Ashari, 2025; Bhoke et al., 2024; Sartika, 2023).

Open-ended questions are also important in mathematics learning because they allow students to use multiple methods and express different forms of reasoning. Such questions help teachers observe students' thinking processes, including misconceptions, strategy choices, and justification ability. Open-ended mathematical tasks can promote deeper reasoning because students are not restricted to one fixed procedure or one expected explanation (Aziza, 2021; Rahayuningsih et al., 2021; Wulanningtyas, 2024).

B. Methods

This study used Classroom Action Research based on the cyclical model of planning, action, observation, and reflection. The research was conducted at Mentari Intercultural School Jakarta from 4 to 25 November 2025. The participants were 21 Grade 4 students from one homeroom class.

The study consisted of three stages. The pre-cycle stage was used to identify students' initial multiplication problem-solving performance. Cycle I implemented inquiry-based teaching through open-ended questions. Cycle II refined the strategy based on reflection from Cycle I, especially by improving scaffolding, teacher questioning,

group monitoring, and lesson reflection.

The instruments included a multiplication problem-solving test, teacher activity observation sheet, student learning activity observation sheet, and semi-structured interviews. The test consisted of 10 items covering contextual word problems, open-ended strategy tasks, and structured multiplication problems. Student achievement was classified using the school's IB progress levels: Consistently High Progress, Consistent Progress, Satisfactory Progress, Minimal Progress, and Not Yet Apparent. Mastery was defined as achieving at least Satisfactory Progress, equal to a score of 70 or above.

Quantitative data were analyzed using average scores and mastery percentages. Observation results were analyzed using percentage categories. Qualitative data from interviews and field notes were analyzed thematically to support interpretation of students' engagement, reasoning, and strategy development.

C.Results and Discussion

The pre-cycle results showed that students' multiplication problem-solving performance was still low. The class average was 62.19, and only 4 of 21 students, or 19.05%, achieved mastery. Most students were categorized as Minimal Progress or Not Yet Apparent. This indicated that many students still had difficulty understanding multiplication problems, selecting strategies, and explaining their reasoning.

After Cycle I, the class average increased to 68.57. The number of students who achieved mastery rose to 9 students, or 42.86%. Although improvement occurred, the result had not reached the success criterion of 75% classical mastery. Observation results also showed that student participation remained limited. Some students responded to teacher questions, but fewer students could propose more than one strategy, use mathematical language, or explain why their method worked. Reflection from Cycle I showed that the teacher needed to provide clearer scaffolding, improve follow-up questions, monitor group work more systematically, and allocate more time for reflection.

Cycle II showed stronger improvement. The class average increased to 79.52, and 18 of 21 students, or 85.71%, achieved mastery. This result exceeded the classical mastery criterion. Teacher activity also improved, with more consistent use of inquiry problems, open-ended questions, guided examples, and reflective discussion. Student activity increased from low participation in Cycle I to higher engagement in Cycle II. More students attempted problems independently, participated in group discussion, proposed multiple strategies, and explained their reasoning.

The qualitative findings supported the test results. The teacher reported that before the intervention, many students waited for direct steps and focused mainly on correct answers. After Cycle II, students were more willing to try different strategies and explain why their answers made sense. Student interviews also showed changes in learning behavior. Some students stated that they began drawing groups or boxes before solving problems, while others reported checking whether their answers were reasonable. These responses indicate that students developed better reasoning awareness and strategy flexibility.

The findings are consistent with previous studies showing that inquiry-based learning can improve mathematical problem-solving by engaging students in exploration and reasoning (Ashari, 2025; Bhoke et al., 2024; Sartika, 2023). The results also support studies on open-ended questions, which argue that open-ended tasks help students express multiple strategies and make their thinking more visible (Aziza, 2021; Rahayuningsih et al., 2021; Wulanningtyas, 2024). In this study, improvement occurred not simply because students practiced more multiplication problems, but because the learning process required them to think, explain, compare, and reflect.

However, some limitations remained. Not all students reached mastery by the end of Cycle II. Some students still needed support in solving problems independently and using precise mathematical language. Strategy comparison also required further strengthening, because some students could present different methods but had difficulty evaluating which method was more efficient or conceptually clear. Therefore, inquiry-

based teaching should be implemented with consistent scaffolding, structured discussion, and repeated opportunities for reasoning.

D. Conclussion

The implementation of inquiry-based teaching through open-ended questions improved Grade 4 students' multiplication problem-solving performance at Mentari Intercultural School Jakarta. The improvement was shown by the increase in class average from 62.19 in the pre-cycle to 68.57 in Cycle I and 79.52 in Cycle II. Classical mastery also increased from 19.05% to 42.86% and finally reached 85.71% in Cycle II.

The intervention also improved students' engagement, participation, strategy flexibility, and reasoning ability. Students became more confident in using representations such as arrays, equal groups, repeated addition, and decomposition. They also became more willing to explain why their strategies worked. Therefore, inquiry-based teaching supported by open-ended questions is an effective classroom strategy for improving multiplication problem-solving performance, especially when teachers provide clear scaffolding, probing questions, group monitoring, and reflection activities.

Future research may apply this approach to other mathematical topics, larger student groups, or comparative designs involving control classes. Teachers are also encouraged to strengthen independent problem-solving, mathematical language use, and systematic strategy comparison during classroom discussion.

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