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Optimizing Mathematics Instruction in Accordance with Vision and Mission in a Favorite School through Lesson Study

Shahnaz Nurazizah[1], Suparni[1]*, Tantyo Margono[2]
[1]Mathematics Education, Universitas Islam Negeri Sunan Kalijaga, Indonesia
[2]SMA Negeri 8 Yogyakarta, Indonesia
*suparni@uin-suka.ac.id

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Abstract

This study employs a qualitative descriptive approach to optimize mathematics instruction at SMA Negeri 8 Yogyakarta through lesson study, aligning with the school's vision of fostering Higher Order Thinking Skills (HOTS) and critical thinking. Conducted in Class X E7 during the 2024/2025 academic year, the research was implemented over two cycles, encompassing planning, implementation, and reflection phases. An expository teaching model combined with the drill method was utilized to enhance conceptual understanding and problem-solving skills. Findings indicate that lesson study facilitated structured instructional refinements, improving student engagement and mathematical proficiency. Summative assessment results showed that 60% of students met the mastery criteria, reflecting progress in instructional effectiveness. However, challenges remained, particularly in students' ability to interpret HOTS-based contextual problems and manage time effectively during problem-solving tasks. Adjustments in cycle II, including extended time allocation and structured sequencing of exercises, led to improved problem-solving accuracy but did not fully address all learning gaps. This study highlights the effectiveness of lesson study in integrating HOTS and fostering critical thinking in mathematics instruction. Future recommendations include strengthening conceptual foundations, diversifying contextual HOTS-based problems, and incorporating time management strategies to optimize instructional outcomes.

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INTRODUCTION

Education is one of the main pillars in building quality human resources (Deffinika et al., 2021), enabling individuals to adapt and thrive in the face of global challenges. As a basic foundation for forming individuals who are smart, skilled, and characte As a fundamental pillar of progress, education equips individuals with the intelligence, skills, and character necessary to contribute meaningfully to the advancement of society (Widiyarti et al., 2023). With a good education, every

individual has the opportunity to develop their potential and contribute to the development of various fields. The increasing pace of globalization underscores the importance of preparing the younger generation to navigate significant changes in various aspects of life (Permana, 2020; Sardiyanah, 2016). Quality education serves as a cornerstone for fostering individuals who are smart, resilient, competitive, and ready to face these global challenges (Mundiri & Bariroh, 2018).

SMA Negeri 8 Yogyakarta is a leading institution known for its outstanding academic performance and strong reputation. This school's excellence is reflected in its top ranking in the 2023 national assessment, where 100% of its students achieved literacy and numeracy competencies above the national standard. Additionally, according to the Lembaga Tes Masuk Perguruan Tinggi (LTMPT), SMA Negeri 8 Yogyakarta ranked first among high schools in the Special Region of Yogyakarta and eleventh nationwide in the 2022 Ujian Tulis Berbasis Komputer (UTBK). Such achievements align closely with the school's vision, which emphasizes excellence in academics, character, cultural appreciation, environmental awareness, global competitiveness, and moral integrity. To realize this vision, SMA Negeri 8 Yogyakarta implements strategic, sustainable efforts to enhance its educational programs, ensuring alignment with its mission to develop outstanding, competitive graduates.

The achievements of SMA Negeri 8 Yogyakarta reflect the school's vision and mission, which focus on fostering excellence in academics, character, and global competitiveness. The vision emphasizes achievement, courteous behavior, cultural appreciation, environmental awareness, mastery of science and technology, and strong faith and piety. To realize this vision, the school implements strategies outlined in its mission, which include developing students who are academically exceptional, morally upright, and ready to compete globally. This is achieved through high-quality learning experiences and a supportive environment. Additionally, the mission prioritizes enhancing students' knowledge, skills, and character-building initiatives to produce graduates who are competitive, exceptional, and ethical. Effective learning activities are essential in achieving these goals, as they ensure students gain meaningful educational experiences through careful planning, implementation, reflection, and continuous improvement (Sunarto et al., 2021; Qadry et al., 2023; Ramadhan, 2024). To support these efforts, the school places significant emphasis on improving instructional quality in key subjects, such as mathematics, which plays a critical role in fostering logical thinking and problem-solving skills.

Mathematics, as a foundational discipline, plays a critical role in fostering logical thinking and problem-solving skills (Talelu et al., 2022). However, despite its achievements, challenges remain in mathematics instruction. Observations during grade X mathematics classes revealed that while students were enthusiastic about solving practice problems, some faced difficulties in mastering fundamental concepts. These challenges hindered their ability to solve problems requiring HOTS, which demand critical thinking and advanced problem-solving strategies. Addressing these issues requires innovative instructional approaches that align with the school's vision of integrating critical thinking into education.

To overcome these challenges, the researcher implemented a lesson study approach aimed at enhancing the quality of mathematics instruction. Lesson study is a professional development model that emphasizes collaborative planning,

implementation, and reflection to improve teaching practices and student learning outcomes (Coenders & Verhoef, 2019; Ewe, 2020). This lesson study not only supports the improvement of pedagogical skills but also ensures that the learning process is aligned with the vision and mission of SMA Negeri 8 Yogyakarta, particularly in fostering critical thinking and preparing students for global competitiveness. This study aims to optimize mathematics instruction in accordance with the vision and mission of SMA Negeri 8 Yogyakarta through lesson study that enhance students' critical thinking skills and contribute to their academic success.

RESEARCH METHODS

This research employs a qualitative descriptive approach to enhance mathematics instruction through a lesson study conducted at SMA Negeri 8 Yogyakarta. The research subjects included one model teacher (the researcher), 35 students from class X E7, and two observers (a peer and a mathematics teacher) actively involved in the learning process. The study was carried out during the odd semester of the 2024/2025 academic year in class X E7 over two sessions: the first on Thursday, September 26, 2024, and the second on Thursday, October 3, 2024. The teaching model employed was expository with a drill method, focusing on the topic of Sequences and Series. Each session followed the phases of lesson study: planning, implementation, and reflection.

Planning

In the planning phase, the model teacher prepared all materials required for the learning activities, incorporating observations, feedback, and suggestions from the mathematics teacher and a peer. This phase involved identifying Learning Outcomes, formulating learning objectives, and determining learning goal pathways. The model teacher developed a comprehensive learning plan, including teaching modules, instructional materials, media, and assessment instruments. All plans underwent refinement based on feedback to ensure alignment with student development goals and effective teaching delivery (Herlindawati et al., 2021).

Implementation

During the implementation phase, the model teacher conducted the planned learning activities (Hikmawati et al., 2018). Observers, including the mathematics teacher and a peer, recorded observations and findings related to instructional delivery and student engagement.

Reflection

The reflection phase involved collaborative discussions between the model teacher, the mathematics teacher, and the peer observer. Feedback from these discussions provided insights into student behavior and teaching effectiveness. This reflection informed adjustments to teaching strategies and preparations for subsequent sessions (Tanujaya & Mumu, 2020).

The study utilized multiple instruments, including observation sheets for both the peer and the mathematics teacher, as well as test instruments for students. Qualitative data included feedback, critiques, video documentation of lessons, and

observer notes, which were analyzed descriptively to identify areas for improvement. Student assessment scores were considered satisfactory if they met the Achievement Criteria for Learning Objectives, with scores of 75 or higher.

RESULTS AND DISCUSSION

Before conducting the lesson, the model teacher administered a diagnostic test to evaluate students' prior knowledge of sequences and series. The average score achieved by class X E7 was 27 out of 100, with no students meeting the passing grade of 75. This low average can be attributed to the challenges of online learning during the COVID-19 pandemic, which limited the students' understanding of fundamental mathematical concepts. This indicated a clear need for targeted instructional strategies to address these deficiencies. To improve students' learning outcomes, the lesson study approach was implemented over two instructional cycles, encompassing planning, implementation, and reflection phases. Observations and consultations with the mathematics teacher emphasized the importance of aligning learning activities with the school's vision and mission to support its educational goals as one of the leading schools in Yogyakarta. These insights align with the findings of Lewis and Hurd (2011), who stated that lesson study allows teachers to collaboratively refine their instructional strategies, resulting in more effective teaching practices. Similarly, Fernandez and Yoshida (2004) highlighted that lesson study promotes continuous improvement in education by fostering collaboration among teachers to enhance instructional quality. Recognizing the importance of structured and reflective teaching practices, this study implemented lesson study in a leading high school setting to align mathematics instruction with the school's vision of academic excellence. The following section details the lesson study process, conducted in two instructional cycles, to systematically improve teaching strategies and student learning outcomes at one of the top-performing schools in Yogyakarta.

Planning (Cycle I)

During the planning phase, the model teacher prepared materials based on discussions and feedback from the mathematics teacher and academic peers. Learning objectives focused on arithmetic sequences and series, aiming to develop both foundational understanding and HOTS. A teaching module, instructional materials, media, and assessment tools were designed in alignment with the Merdeka Curriculum. Diagnostic test results were incorporated into the planning to identify areas requiring targeted instruction.

The selected instructional method combined an expository teaching model with a drill method. It was chosen to efficiently manage time while gradually transitioning students from basic comprehension exercises to moderate and difficult HOTS-based problems. Initial exercises focused on reinforcing foundational concepts, ensuring that all students had a baseline understanding before progressing to more complex problem-solving tasks. This instructional method aligned with the school's mission of integrating HOTS and critical thinking into learning and assessment activities.

Implementation

The lesson on arithmetic sequences and series was conducted on Thursday, September 26, 2024. The mathematics teacher and a peer observer used lesson study observation sheets to document the teaching process. The session began with attendance and a motivational introduction, followed by the presentation of learning objectives. The main activity adhered to the expository model, progressing through preparation, presentation, correlation, generalization, application, and concluding with reflection and feedback for the next session.

Students engaged in two types of practice exercises. The first set, delivered via Google Forms, included comprehension questions to confirm understanding of fundamental concepts. The second set comprised moderate and challenging HOTS-based questions designed to encourage critical thinking. Observers noted high student engagement during these activities, although time management issues emerged as some students required additional time to complete tasks.

Figure 1. Implementation of Lesson Study (Cycle I)

Figure 1 highlights the phases of planning, implementation, and reflection. It provides a visual representation of the structured approach to improve mathematics instruction, demonstrating how each phase contributes to the overall process.

Reflection

In the reflection phase, discussions with the mathematics teacher and peer observer highlighted both the strengths and areas that required improvement in the lesson. The instructional approach effectively facilitated foundational understanding, as evidenced by increased student engagement. However, challenges persisted, particularly in students' misconceptions about arithmetic sequences versus arithmetic series. Similar difficulties have been reported by Parapat and Wandini (2023), who found that misconceptions in understanding arithmetic definitions often result in difficulties when applying these concepts to problem-solving. Their study highlighted that errors frequently occur when individuals misinterpret definitions related to arithmetic, leading to mistakes in mathematical reasoning and solution strategies. At this stage, respondents are required to accurately interpret given definitions before attempting to solve the problems.

Furthermore, student feedback also revealed mixed perceptions: while some students appreciated the structured approach, others found mathematics inherently difficult. This variation in learning experiences underscores the importance of differentiated instruction. In line with this, this study also found that one of the main challenges was that learners still required extra time due to insufficient allocated

time for completing HOTS-based tasks. These findings highlight the need for continuous instructional refinement across cycles to ensure that students receive the appropriate level of challenge and support. Moving forward, the insights gained from cycle I were applied in cycle II, allowing for targeted interventions that addressed student difficulties more effectively. As a result, adjustments were made to provide additional time for HOTS-based problem-solving tasks, ensuring that learners had sufficient opportunity to process complex concepts and apply appropriate strategies. This modification contributed to a more structured learning experience, where students demonstrated improved confidence and accuracy in solving higher-order problems.

Planning (Cycle II)

After completing the reflection phase in cycle I, the planning phase for cycle II was conducted with more thorough preparations. the model teacher designed a teaching module by considering the learning model, methods, and steps to be implemented based on students' conditions and discussions with the observer. The expository teaching model with the drill method was retained for the second session, as it allowed detailed concept delivery and provided opportunities to address student misconceptions effectively. The drill method was selected to deepen understanding through ample practice problems, enabling learners to handle various problem types while fostering critical thinking through HOTS-based questions.

Based on reflections from cycle I, several improvements were made. One key adjustment was the allocation of additional time for HOTS-based problem-solving, ensuring that learners had sufficient opportunity to process complex concepts without feeling rushed. The expository model and drill method were refined to balance structured instruction with extended practice time, allowing students to apply concepts more effectively. Enhancements also focused on addressing misconceptions, improving student participation, and optimizing HOTS-based learning to align with the vision and mission of SMA Negeri 8 Yogyakarta. Practice exercises were structured to begin with comprehension questions, followed by medium- to high-difficulty problems requiring critical thinking. These refinements aimed to improve students' engagement, problem-solving skills, and overall conceptual understanding.

Implementation

The learning activities in cycle II were conducted on Thursday, October 3, 2024, focusing on geometric sequences and series. Adjustments were made in response to the challenges identified in cycle I, particularly the need for additional time to complete HOTS-based tasks. The session structure remained similar, beginning with attendance, apperception, motivation, and the presentation of learning objectives. However, modifications were implemented in the core activities to allocate extended time for problem-solving, ensuring that learners had sufficient opportunity to process complex concepts and apply appropriate strategies. These activities followed the expository model and drill method to reinforce conceptual understanding and problem-solving skill.

Two sets of practice questions were implemented during this phase. The first set, delivered via Google Forms, assessed comprehension of material concepts. The second set consisted of medium- to high-difficulty problems that required critical

thinking. Based on insights from cycle I, additional time was allocated for HOTS-based questions, allowing learners to engage more thoroughly with problem-solving tasks without feeling rushed. Observations by the mathematics teacher and peer observers documented increased confidence, as students demonstrated better problem-solving accuracy with the adjusted time allocation. While some learners still found HOTS-based problems challenging, they exhibited improved reasoning and performance compared to cycle I. To further enhance students' learning experiences, modifications were also made to the sequencing of practice exercises. Tasks were arranged progressively, ensuring a smooth transition from fundamental concept reinforcement to more complex problem-solving activities. This structured approach aimed to provide learners with a more systematic understanding of the material, enabling them to tackle HOT questions with greater confidence and accuracy.

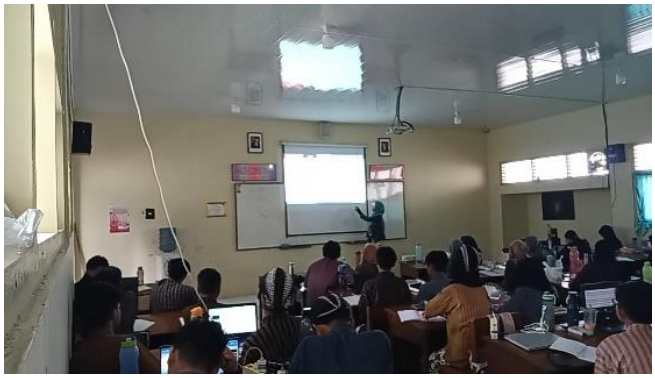

Figure 2. Implementation of Lesson Study (Cycle II)

Figure 2 illustrates the implementation phases during cycle II. It visually represents the iterative approach of refining instructional practices to address challenges and enhance student outcomes, highlighting the importance of continuous improvement in mathematics instruction.

Reflection

During the reflection phase, the model teacher engaged in in-depth discussions with the mathematics teacher and peer observer to evaluate the learning process and student outcomes. Adjustments made in response to cycle I insights, such as the additional time allocated for HOTS-based problem-solving and the progressive structuring of practice exercises, contributed to improved student engagement. Observations revealed that teacher-student interactions were more active in cycle II, with learners demonstrating greater enthusiasm and participation. The structured questioning and guided problem-solving approach proved effective in fostering deeper engagement and encouraging students to articulate their reasoning more confidently.

Despite these improvements, challenges remained. While students benefited from extended time allocations, some still struggled with the cognitive demands of HOTS-based problems, requiring additional scaffolding. Additionally, the increased complexity of problem-solving discussions occasionally led to noisier classroom interactions, as students sought peer assistance. The timing of the lesson also posed difficulties for some learners, with fatigue impacting their focus and

motivation toward the end of the session. Student feedback further reinforced these observations. Many expressed appreciation for the structured approach, stating that it enhanced their understanding of fundamental concepts and allowed them to approach HOTS-based questions with greater confidence. However, some still found these questions challenging, emphasizing the need for further refinement in instructional strategies to provide clearer problem-solving frameworks and additional support where needed.

Student Learning Outcomes

To evaluate the effectiveness of the lesson study implementation, a summative assessment was conducted using HOTS-based questions on sequences and series in an essay format. The assessment results revealed that 21 out of 35 students achieved the Learning Objective Criteria with scores of 75 or higher, resulting in a 60% success rate, while 40% of students did not meet the criteria. This indicates that more than half of the students demonstrated proficiency in the material, reflecting the improvements made in cycle II, particularly the structured approach to problem-solving and the additional time allocated for HOTS-based questions.

Despite these improvements, some challenges remained. Feedback from students who did not meet the criteria highlighted several key issues. One recurring difficulty was the need for additional time to fully process HOTS-based problems, an issue that was initially identified in cycle I and addressed in cycle II. However, while extended time allocation in cycle II helped alleviate some of these challenges, certain students still struggled to complete all questions within the given time frame, indicating that time management strategies need further refinement. This aligns with the findings of Apriani and Sudiansyah (2024), who noted that insufficient time allocation can hinder students' ability to effectively engage with mathematical problems.

Additionally, difficulties in interpreting complex word problems persisted, particularly when students encountered technical terms within the HOTS-based assessment. While the structured questioning and guided problem-solving approach in cycle II contributed to greater engagement and conceptual understanding, some students still found it difficult to independently formulate solutions. This observation is consistent with the findings of Moneti (2024), who noted that unfamiliarity with problem contexts and mathematical terminology often leads to difficulties in understanding and solving HOTS-based questions

These findings emphasize the need for continued instructional refinements, such as targeted scaffolding techniques, gradual exposure to more complex HOTS-based problems, and additional reinforcement of problem-solving strategies to build students' confidence in tackling high-level mathematical tasks independently.

Solution for Future Instructional Improvement

The lesson study approach implemented in Class X E7 has provided valuable insights into the strengths and challenges of integrating HOTS and critical thinking into mathematics instruction. While improvements were observed in cycle II, particularly in problem-solving accuracy and engagement, several areas still require further refinement to optimize student learning outcomes.

Future instructional improvements will focus on reinforcing conceptual clarity to address misconceptions observed in cycle I and cycle II. Targeted instructional

interventions, such as structured remedial exercises and personalized feedback, will be incorporated to strengthen students' foundational understanding before progressing to complex problem-solving tasks, as seen in several studies (e.g., Adulyasas et al., 2024; Pereda Loriente et al., 2025). Additionally, enhancing the variety of HOTS-based exercises will be a priority, with an emphasis on incorporating real-world applications to improve students' ability to analyze and apply mathematical concepts in different contexts, as implemented in several studies (e.g., Sari et al., 2024; Sarnoko et al., 2024).

Another key area of improvement is developing students' time management skills, as time constraints remained a challenge in both cycles despite the adjustments made in cycle II. Future lessons will integrate guided practice sessions with timed HOTS-based assessments, allowing students to gradually develop pacing strategies to improve efficiency during problem-solving tasks. Moreover, leveraging interactive digital tools and collaborative learning strategies will be explored to facilitate active engagement and deeper mathematical reasoning.

By addressing these areas, future instructional refinements will ensure that mathematics instruction not only aligns with SMA Negeri 8 Yogyakarta's vision of academic excellence but also better equips students with the critical thinking and problem-solving skills necessary for higher-order mathematical reasoning.

CONCLUSION

This study examined the implementation of mathematics instruction through a lesson study approach in Class X E7 at SMA Negeri 8 Yogyakarta, focusing on integrating HOTS and critical thinking into the learning process. Conducted over two instructional cycles, this study highlighted the impact of structured lesson planning, targeted problem-solving exercises, and reflective instructional practices on student engagement and mathematical proficiency.

Findings indicate that the lesson study approach contributed to notable improvements in students' problem-solving accuracy, conceptual understanding, and engagement. The introduction of structured problem-solving strategies and additional time allocation for HOTS-based tasks in Cycle II led to increased confidence and improved student performance. However, the study also revealed persistent challenges, particularly in students' ability to interpret complex mathematical problems, apply higher-order reasoning independently, and manage time effectively during assessments.

These findings underscore the importance of continuous instructional refinement to accommodate diverse learning needs. The iterative nature of lesson study provides a framework for identifying student difficulties, implementing targeted interventions, and systematically improving instructional quality. By integrating structured problem-solving approaches, reinforcing conceptual understanding, and expanding the variety of HOTS-based exercises, lesson study has the potential to enhance mathematical learning outcomes significantly.

This study reaffirms the role of lesson study in fostering adaptive teaching strategies, ensuring that mathematics instruction remains aligned with the school's vision of producing critical thinkers and globally competitive graduates. Moving forward, sustaining this reflective teaching practice will be essential in maintaining

instructional effectiveness and fostering deeper mathematical understanding among students.

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