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Lesson Study as a Strategy to Improve Mathematics Learning Based on the Learning Styles and Levels of Understanding of Middle School Students

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Abstract. *Mathematics learning must consider students' diverse needs to achieve optimal outcomes, including differences in learning styles, levels of understanding, and learning difficulties. Applying Bloom's Taxonomy helps teachers design more effective strategies, yet many still neglect thorough planning, treating it as a yearly routine. To overcome this, teacher collaboration is essential. This study aimed to facilitate a lesson study involving mathematics teachers from the Mathematics Teachers' Association (MGMPS) in Banyuwangi, junior high school students, pre-service teachers, and mathematics education lecturers. Using a descriptive qualitative approach, the research was conducted at a junior high school in Banyuwangi. The research used qualitative analysis with observations, reflections, and triangulation to align teaching strategies with students' learning styles and understanding levels. The findings show that lesson study effectively enhances mathematics learning by accommodating students' learning diversity. Through the stages of planning, observation, and reflection, teachers developed more responsive and differentiated lessons. Moreover, lesson study promoted professional growth among teachers through collaboration and reflective practice. Overall, lesson study provides a sustainable and adaptive approach to fostering inclusive and high-quality mathematics learning.*

Keywords: *Lesson study, learning style, mathematics learning*

INTRODUCTION

The preliminary study conducted by the research team in several junior high schools located in Banyuwangi Regency revealed three major findings related to the improvement of mathematics learning. The first finding indicates that 70% of students experience difficulties in learning mathematics due to their dislike of the teachers' instructional strategies, which leads to low learning outcomes. The second finding shows that teachers tend to conduct classroom activities without thorough planning, considering teaching as a routine repeated every year. Certified mathematics teachers in Banyuwangi Regency often perceive that there is no further

need to enhance their teaching competencies, even though curriculum development, technology integration, and pedagogical approaches continue to evolve over time. Consequently, teachers who do not update their competencies are at risk of applying less relevant methods that fail to meet the current learning needs of students. The third finding highlights that teachers rarely engage in collaboration and reflection with peers in the same subject area within the mathematics Musyawarah Guru Mata Pelajaran Sekolah (MGMPS) to optimize instructional practices. MGMPS is an Indonesian teachers' working group where educators of the same subject collaborate and share best teaching practices. To date, MGMPS activities have mostly focused on workshops such as developing student worksheets and organizing seminars. The Mathematics MGMPS in Banyuwangi Regency has never implemented a lesson study program.

Lesson study has rapidly evolved in mathematics education due to its significant benefits in enhancing teachers' collective and continuous professional competence in teaching (Amelia et al., 2023.; Farahsanti et al., 2021; Rahmawati, 2022; Sari et al., 2023; Wardi et al., 2023; Zawawi, 2023). It serves as a systematic approach that stimulates the development of instructional practices to promote teachers' professional growth through collaboration (Iksan et al., 2014; Nesusin et al., 2014). The collaborative process in lesson study typically involves three key stages: lesson planning (plan), implementation (do), and reflection (see) (Iqbal et al., 2021; Nurtanto et al., 2021). Lesson study has been proven effective as a professional development program because it encourages teachers to continuously improve their instructional strategies (Hrastinski, 2021; Uştuk & De Costa, 2021). Continuous improvement of instructional strategies is essential to maximize student learning outcomes, particularly in mathematics education (Anwar et al., 2021; Wuryandani, 2021).

The mathematics learning strategy integrated with lesson study in this research was designed by referring to students' learning styles and levels of understanding based on Bloom's Taxonomy. This approach was adopted because students' learning styles can serve as a foundation for analyzing their learning needs (Cabual, 2021; El-Sabagh, 2021). Furthermore, levels of understanding derived

from Bloom's Taxonomy can be incorporated into the design of instructional strategies to align with students' cognitive levels (Cheng et al., 2021; Hidayat & Qamariah, 2023). Therefore, the implementation of lesson study as an effort to enhance mathematics learning based on students' learning styles and levels of understanding in junior high schools in Banyuwangi Regency can be optimized through the framework illustrated in Figure 1.

Figure 1. Lesson Study Framework

(Research Data, 2025)

From Figure 1, students' learning needs are a crucial aspect that must be considered in the implementation of lesson study. These learning needs can be analyzed through students' learning styles and levels of understanding based on Bloom's Taxonomy (Anandhita, 2018; Laia, 2022; Supriyani & Winangun, 2024). Students' learning styles are generally categorized into three types: auditory, visual, and kinesthetic (Ikawati & Kowiyah, 2021; Ishartono et al., 2021; Zuana et al., 2023). Meanwhile, the levels of understanding according to Bloom's Taxonomy consist of six categories: C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5 (evaluating), and C6 (creating) (Faturrahman et al., 2025; Ramdhani & Susanti, 2024; Yunida & Arthur, 2023). The results of this analysis can be utilized by teachers during the lesson planning (plan) stage of lesson study to identify students' learning needs and to design relevant strategies, media, and instructional materials. Furthermore, mapping students' learning needs is conducted to improve the overall quality of instruction. High-quality learning is

achieved by developing lesson plans and mathematics learning materials that are aligned with students' characteristics (Inganah et al., 2023; Iqbal et al., 2021; Utami et al., 2021; Uyen et al., 2021). The implementation of lesson study aims to refine instructional strategies, thereby fostering teachers' professional development (Aimah et al., 2023; Richit et al., 2021). Moreover, the plan, do, and see stages in lesson study serve as a learning platform for teachers to broaden their knowledge and enhance the quality of the teaching and learning process.

Improving the quality of mathematics learning based on students' learning styles and levels of understanding can be achieved through a structured lesson study framework (Inprasitha, 2022; Nguyen & Tran, 2023). In this study, the lesson study framework consists of five key activities: (1) analysis, (2) plan, (3) do, (4) see, and (5) goal, which are systematically arranged to ensure that the intended goals are achieved. Therefore, the implementation of lesson study based on students' learning styles and levels of understanding is essential. However, many teachers still lack sufficient knowledge of how to improve instructional quality through lesson study. If junior high school teachers in Banyuwangi Regency do not possess adequate understanding of how to enhance learning through lesson study, the quality of classroom instruction is likely to remain stagnant. Furthermore, students may fail to achieve optimal mastery of learning outcomes, resulting in unsatisfactory educational performance indicators.

The relationship between lesson study and the improvement of learning quality based on students' learning styles and levels of understanding is shown at Figure 2.

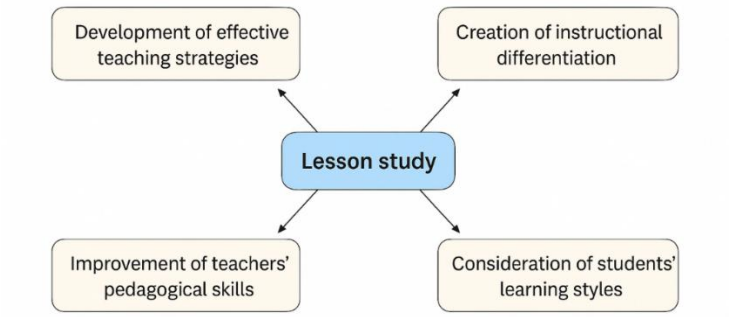


Figure 2. The Relationship Between Lesson Study and The Improvement Learning Quality Based on Students' Learning Style and Level of Understanding

The relationship, as shown in Figure 2, lies in lesson study's ability to enhance instructional quality through the development of effective teaching strategies, the creation of instructional differentiation, and the improvement of teachers' pedagogical skills. Moreover, lesson study in this research is designed by considering students' learning styles to ensure the relevance of teaching strategies and the integration of technology. Lesson study also functions as a continuous professional development program that adapts to technological and educational changes over time. Therefore, the implementation of lesson study is expected to improve the quality of mathematics instruction, leading to better student learning outcomes.

The objectives of this study are: (1) to determine how lesson study implementation can enhance mathematics teaching strategies in junior high schools in alignment with students' learning styles, and (2) to investigate how lesson study implementation can improve the professional competence of mathematics teachers in Banyuwangi Regency through the collaborative review of instructional strategies conducted within the Mathematics Teachers' Association (MGMPS) based on the analysis of students' learning needs.

The benefits of this research are: (1) improving mathematics teaching strategies in junior high schools that are aligned with students' learning styles, and (2) enhancing the professionalism of mathematics teachers in Banyuwangi Regency through collaborative MGMPS discussions on instructional strategies grounded in the analysis of students' learning needs.

RESEARCH METHOD

Research Design

This research employed a descriptive qualitative approach. It examined the collaboration between mathematics teachers who are members of the Mathematics Teachers' Association in Banyuwangi and mathematics education lecturers from Universitas Negeri Malang to enhance students' understanding based on their individual learning styles.

Participants

The participants in this study consisted of junior high school students, mathematics teachers, pre-service teachers, and mathematics education lecturers. One teacher served as the model teacher who conducted the classroom instruction, while four teachers acted as observers. Twenty-nine students participated in the learning activities, accompanied by two pre-service teachers and three university lecturers who collaborated as co-researchers in this study.

Location

This study was conducted at a private junior high school located in Banyuwangi Regency, East Java, Indonesia. The research focused on mathematics learning activities in a seventh-grade classroom, specifically on the topic of algebraic forms.

Research Procedure

The implementation of this lesson study consisted of several stages, namely: (1) analysis, (2) plan, (3) do, (4) see, and (5) goal.

1. Analysis

   The analysis stage began with identifying students' learning styles by distributing a learning style questionnaire/instrument to students at one of the schools serving as the location for the lesson study and selected as the sample for this purpose. This instrument refers to learning style classifications such as visual, auditory, and kinesthetic. The data obtained from the questionnaire were then analyzed to determine the distribution of dominant learning styles in each class.

2. Plan

   The planning stage of the lesson study implementation began with identifying the lesson study problem, formulating learning objectives, fostering collaboration, designing the learning scenario, selecting appropriate learning media, and preparing complete learning tools. The planning phase of Cycle 1 was conducted on August 22, 2025. After the implementation of Cycle 1 was completed, the plan for Cycle 2 was scheduled to be carried out on September 3, 2025. This stage began with an analysis of classroom problems identified by

teachers during the teaching and learning process. The problems encountered by teachers were documented in a problem list, which served as the basis for further collaborative discussions among mathematics MGMPS teachers to determine appropriate follow-up actions and solutions to overcome the identified challenges. After that, the teachers and the research team collaborated to design and develop a lesson plan and teaching materials, including instructional media to be implemented in the classroom. Once all materials were prepared, the mathematics MGMPS teachers selected a model teacher and the school where the designed lesson plan would be implemented.

3. Do

   This stage was carried out by implementing the lesson plan that had been previously designed. The do stage was carried out in two cycles. Cycle 1 was conducted on September 1, 2025, while Cycle 2 was conducted on September 4, 2025. The selected model teacher applied the prepared lesson design, while the chosen school served as the host for its implementation. Other teachers, both from the same school and from other schools within the MGMPS group, acted as observers during the implementation process. This stage served as a trial phase to examine whether the designed lesson plan was effective and suitable for classroom application.

   The observation conducted by the observers focused on students' learning styles and levels of understanding. The learning styles described in the observation sheet included visual, auditory, and kinesthetic types. Meanwhile, the cognitive levels were based on Bloom's Taxonomy, consisting of C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5 (evaluating), and C6 (creating).

4. See

   At this stage, a reflection was conducted on the learning process that had been implemented. The see stage was carried out in two cycles. Cycle 1 was conducted on September 1, 2025, while Cycle 2 was conducted on September 4, 2025 The reflection took place through a discussion between the model teacher and the observers, including other mathematics MGMPS teachers and

teachers from the host school. First, the model teacher shared impressions and difficulties experienced during the lesson. Second, the observers provided feedback and suggestions regarding classroom conditions during the implementation of the lesson plan. Third, the model teacher and observers jointly concluded students' learning styles and cognitive levels based on the completed observation sheets. Fourth, the results of this reflection served as the basis for planning subsequent lessons. If the identified problems were successfully addressed through the implemented lesson plan, the plan could be applied in other schools. However, if the developed lesson plan had not yet resolved the issues, the previous feedback and suggestions were used to make improvements in the next learning cycle.

5. Goal

   At this stage, an evaluation is conducted to assess the achievement of the designed learning objectives as well as the professional development of teachers after undergoing the plan, do, and see process. Furthermore, in the goal stage, an analysis of observation results and student learning products is carried out to determine the extent to which the developed learning is effective in enhancing student engagement and conceptual understanding. In addition, the goal stage also aims to assess the improvement of teachers' abilities in reflecting, identifying students' learning needs, and designing more adaptive and student-centered learning strategies. The results of this stage serve as the basis for formulating conclusions and recommendations for improving learning in the next cycle.

Instrument

The instruments used in the implementation of this lesson study consisted of two types, namely (1) a problem–solution list and (2) an observation sheet based on students' learning styles and levels of understanding. The problem–solution list was used to record challenges that occurred during the learning process, such as issues related to teaching strategies, student participation, and the effectiveness of instructional media, as well as to document alternative solutions agreed upon during the reflection stage. The observation sheet developed according to the classification

of learning styles (visual, auditory, and kinesthetic) and Bloom's Taxonomy cognitive levels (C1–C6), was used to identify students' learning characteristics and monitor their cognitive development throughout the lesson. Data obtained from both instruments served as the basis for analyzing the effectiveness of the lesson design and as a reference for improving the lesson plan in the following cycle. In addition, this study employed a supporting instrument, namely a learning style questionnaire, to identify the dominant learning style of the students.

Data Sources and Research Data

The data sources for this study consisted of teachers and students. The data analyzed were obtained from learning activities designed according to students' learning styles on the topic of algebraic expressions, with the aim of enhancing students' conceptual understanding. The collected data included classroom observation results and collaborative discussions conducted with the group of participating teacher

Data Analysis Technique

This study employed a qualitative descriptive method for data analysis. The process involved interpreting information gathered from classroom observations, learning style assessments, and teacher reflections conducted throughout the lesson study cycles. The collected data were systematically organized, simplified, and grouped to identify emerging themes related to the implementation of teaching strategies that corresponded to students' learning styles and levels of understanding. To ensure the trustworthiness and accuracy of the findings, data triangulation was carried out using inputs from teachers, students, and researchers. In addition, reflective meetings between the research team and participating teachers were held after each lesson study cycle to review outcomes, adjust instructional approaches, and enhance the overall quality of mathematics instruction.

The collected data were analyzed by categorizing students based on their dominant learning styles. To determine the dominant learning styles, data analysis was carried out by calculating the percentage of each learning style category. The percentage was calculated using the following formula:

$$P = \frac{F}{N}$$

Description:

- P represents the percentage of learning style,
- F denotes the number of students in each learning style category, and
- N refers to the total number of students.

RESULTS AND DISCUSSION

Results

Analysis: Students' Learning Styles

One of the approaches used in designing instruction is aligning teaching strategies and learning media with students' learning styles and levels of understanding. As part of this effort, the researchers identified students' learning styles by administering a learning style questionnaire to students at one of the schools where the lesson study was implemented, which also served as the research sample.

The collected data were analyzed by categorizing students based on their dominant learning styles. The sample consisted of 29 junior high school students from Banyuwangi Regency. To determine the dominant learning styles, data analysis was carried out by calculating the percentage of each learning style category. Furthermore, Table 1 presents the data on students' learning styles.

Table 1. Students' Learning Style Data

Learning Style	Number of Subjects	Percentage
Visual	18	62.07%
Auditory	6	20.69%
Kinesthetic	5	17.24%
TOTAL	29	100.00%

From Table 1, The analysis revealed that the majority of students exhibited a visual learning style, with 18 students (62.07%). This indicates that most students find it easier to understand the material when it is presented in the form of images, graphs, diagrams, or other visual media. The auditory

learning style was identified in 6 students (20.69%), suggesting that some students learn more effectively through verbal explanations, discussions, or listening activities. Meanwhile, 5 students (17.24%) demonstrated a kinesthetic learning style, indicating a preference for learning through movement, hands-on activities, or the manipulation of real objects.

These results indicate that most students tend to understand learning materials more effectively through visual representations such as images, videos, and diagrams. Therefore, during the lesson planning stage, the MGMPS teachers, together with the research team, emphasized the development of visual learning media. Nevertheless, the instructional strategies were also designed to incorporate auditory and kinesthetic elements to accommodate all students' learning styles within the classroom.

Cycle 1

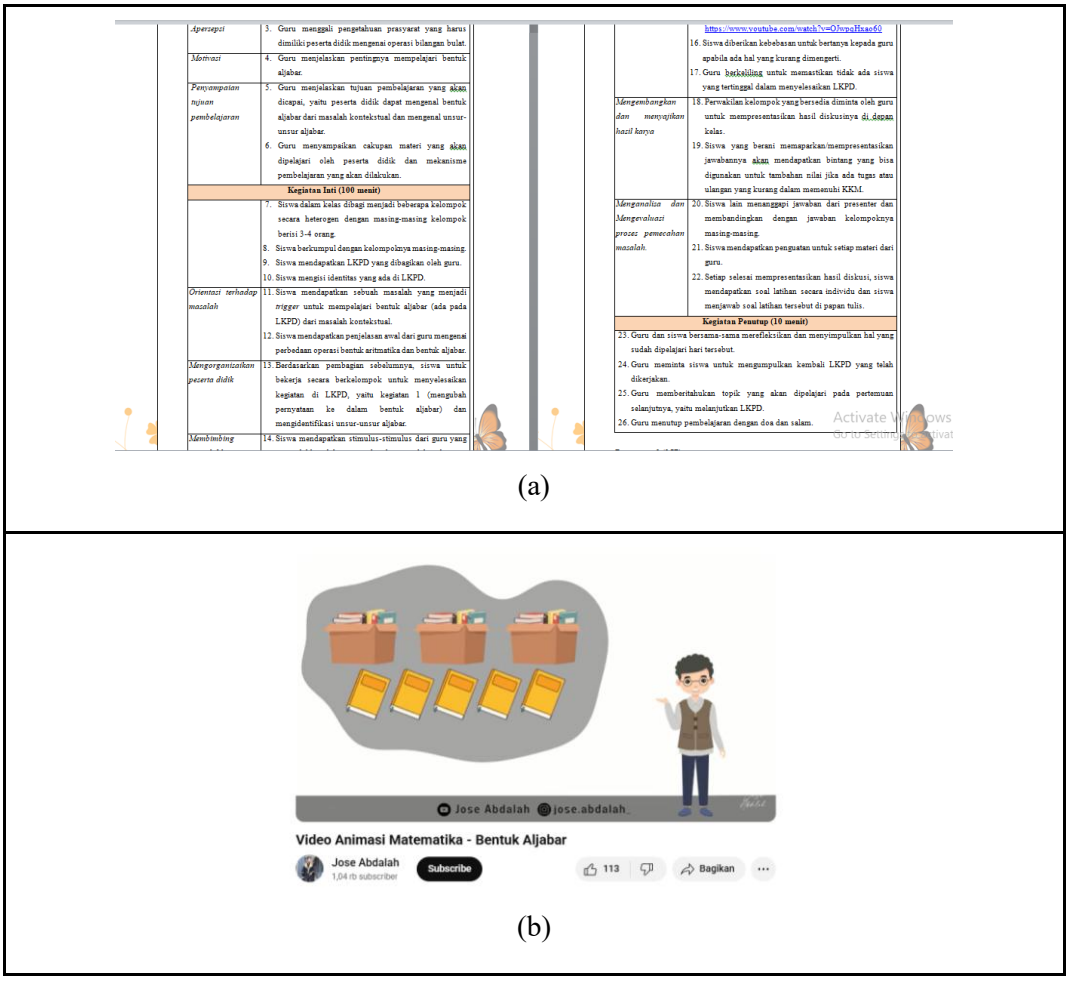
Plan

The planning stage of Cycle 1 was adjusted based on the results of discussions with all members of the Mathematics MGMPS, during which it was concluded that students experience considerable difficulty in understanding the topic of algebraic expressions. Therefore, this topic was chosen as the focus of the lesson study in the mathematics subject. Figure 2 illustrates the planning (plan) stage conducted by the mathematics teacher.

Figure 3. The Planning Stage

Figure 3 is shown the planning stage on Cycle 1, the learning plan was designed for three mathematics class periods. The learning model implemented was Problem-Based Learning (PBL). Furthermore, the instructional media used was an educational video obtained from the YouTube platform. The selection of this

medium aimed to provide a suitable and engaging learning resource for students with visual and auditory learning styles, serving as an effective means to facilitate their understanding of the lesson content. The use of video media allows students to visualize abstract mathematical concepts through moving images, colors, and symbolic representations, while simultaneously receiving auditory explanations that reinforce understanding. This combination of visual and auditory stimuli helps enhance students' attention, comprehension, and retention of the lesson content, making it particularly effective for introducing topics such as algebraic expressions, which often require concrete visualization to support conceptual understanding. Figure 4 presents the design of the lesson plan and learning media that have been used.



(a)

(b)

Figure 4. (a) Lesson Plan Design and (b) Learning Media in Cycle 1

Figure 4 (a) illustrates the lesson design implemented during the learning practice in Cycle 1, while Figure 4 (b) presents the instructional media used in the

same cycle. The learning process utilized an educational video that integrated contextual problems with visual illustrations to facilitate students' understanding. In addition to the use of educational video media, the implementation of the lesson study also utilized a worksheet (LKPD) designed to support students with visual learning styles, which were predominant in the class. The worksheet used in the cycle 1 lesson study is written in Bahasa Indonesia, as shown in Figure 5.

Kegiatan 1

Perhatikan permasalhan berikut ini!
Ibu Yuni adalah seorang petani jeruk. Dia ingin menjual hasil panen kebunnya dalam beberapa bentuk, yaitu keranjang, kantong, dan per biji. Banyaknya jeruk dalam setiap keranjang sama. Banyaknya jeruk setiap kantong adalah sama. Jika banyaknya keranjang yang dimiliki Ibu Yuni adalah 3 dan banyaknya kantong yang dimiliki Ibu Yuni adalah 5, serta masih ada 2 buah jeruk, maka bentuk aljabar dari kalimat tersebut adalah..

Alternatif Penyelesaian:
Sebelum disajikan kedalam bentuk aljabar, terlebih dahulu ditentukan permisalan dengan menggunakan variabel. Biasanya variabel dilambangkan dengan huruf kecil, misal:
p= banyaknya jeruk dalam satu kantong
q= banyaknya jeruk dalam satu keranjang
Sehingga, bentuk aljabar dari permasalahan tersebut disajikan pada tabel di bawah ini..

No.	Gambar	Bentuk Aljabar	Keterangan
1		1p atau p	1 kantong jeruk
2		... atau q	1 keranjang jeruk
3		2	2 buah jeruk
4		q + 3...	... dan ...
5		...	...

Jadi, banyaknya jeruk yang dimiliki Bu Yuni dalam bentuk aljabar adalah ...

Figure 5. Worksheet of Cycle 1

Figure 5 is shown the worksheet of Cycle 1. Furthermore, the learning materials, comprising the lesson plan design, learning media, and worksheet (LKPD), were thoroughly reviewed by members of MGMPS Mathematics to ensure their quality and alignment with the learning objectives. After the review process, all materials were deemed ready for implementation in the classroom.

Do

Based on the observation conducted during the "Do", the focus of the observation was directed toward the learning processes experienced and implemented by both the model teacher and the students. The instructional steps

implemented by the model teacher within the lesson study–based learning framework included three main stages, namely (1) introduction, (2) core activities, and (3) closing activities. The learning activities conducted by the model teacher are presented in Figure 6.

Figure 6. Introduction Stage

First, the introduction stage in Figure 6 lasted for approximately 10 minutes. During this stage, the model teacher implemented four instructional syntaxes, namely (1) orientation, (2) apperception, (3) motivation, and (4) communication of learning objectives. In the orientation phase, the model teacher began the lesson by greeting the students, asking about their well-being, and taking attendance. Subsequently, the teacher provided apperception by exploring students' prior knowledge relevant to algebraic forms, particularly arithmetic operations involving integers. The motivation phase was carried out by explaining the importance of learning algebraic forms in daily life and future studies. Furthermore, in the communication of learning objectives phase, the teacher conveyed the learning goals, the expected outcomes, the scope of the material to be studied, and the mechanisms of the learning process. After completing the introductory phase, the lesson proceeded to the core activities as shown in Figure 7.

Figure 7. Core Activities

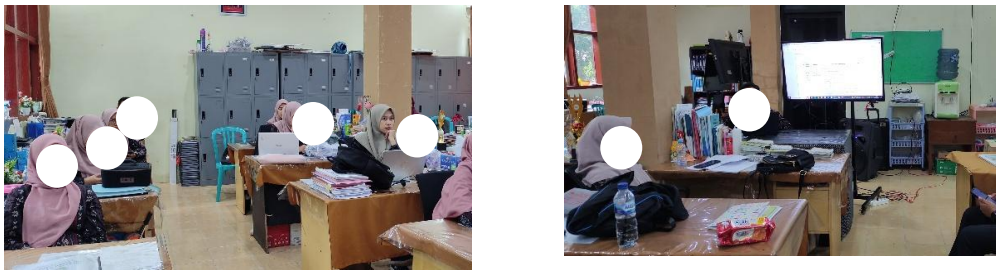
Second, the core activities in Figure 7 were conducted for approximately 100 minutes. During this stage, the model teacher applied five instructional syntaxes: (1) problem orientation, (2) organizing students, (3) guiding investigation, (4) developing and presenting students' work, and (5) analyzing and evaluating the problem-solving process. In the problem orientation phase, the model teacher divided students into heterogeneous groups and distributed student worksheets (LKPD). The students then gathered in their respective groups and were given a contextual problem that served as a trigger to explore algebraic forms through the worksheet. The teacher also provided a brief explanation to differentiate between arithmetic and algebraic operations. In the organizing students phase, the model teacher instructed each group to complete Activity 1, which involved translating verbal statements into algebraic expressions, identifying algebraic components, and simplifying algebraic forms. During the guiding investigation phase, the teacher provided scaffolding and stimulus to help students solve the problems presented in the worksheet. Additionally, an educational YouTube video about algebraic forms was shown as a form of digital stimulus. The teacher also moved around the classroom to ensure that no students were left behind and encouraged students to ask questions whenever they encountered difficulties. In the developing and presenting students' work phase, the teacher asked groups to present their discussion results in front of the class and gave appreciation for their efforts. Furthermore, during the analyzing and evaluating the problem-solving process phase, the teacher facilitated inter-group questioning sessions and

reinforced key concepts. After each group presentation, students were given individual practice problems, and selected students were invited to solve them on the whiteboard. After the core activities are completed, the learning activities continue with the closing activities.

Third, the closing activities lasted for approximately 10 minutes. In this stage, the model teacher and students reflected on the learning process and summarized the key points of the lesson. The teacher instructed students to submit their worksheets, informed them about the topic to be studied in the next meeting, and concluded the session with a prayer and farewell greeting.

See

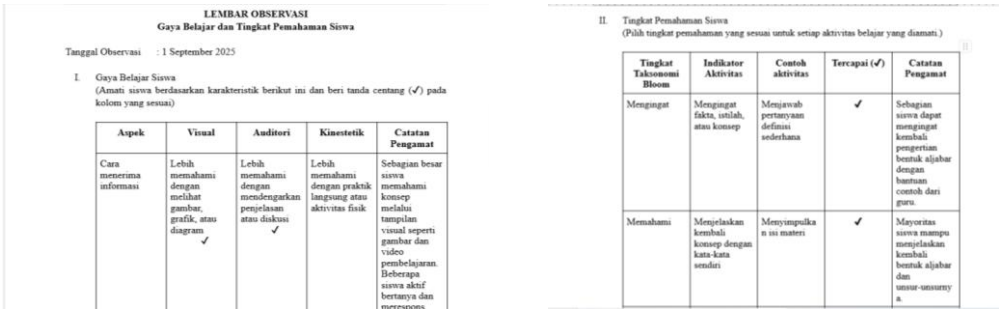
The "See" or reflection stage in Cycle 1 was carried out after the learning implementation in Cycle 1. This stage was attended by the model teacher, observers from the Mathematics MGMPS of Banyuwangi Regency, and the research team consisting of lecturers and students. The implementation of the "See" or reflection stage is presented in Figure 8.



(a) (b)

Figure 8. (a) Reflection Activity; (b) Discussion Between The Model Teacher and The Observers.

In Figure 8 (a), the reflection activity in Cycle 1 conducted together with mathematics teachers from the Banyuwangi Regency MGMPS is presented. Meanwhile, Figure 8 (b) shows the discussion between the model teacher and the observers. The reflection discussion focused on three main aspects: (1) the effectiveness of the implemented lesson design, (2) students' responses to the learning process based on their learning styles, and (3) students' levels of understanding as classified by Bloom's Taxonomy. The observation sheet completed by the observers is presented in Figure 9.



LEMBAR OBSERVASI
Gaya Belajar dan Tingkat Pemahaman Siswa

Tanggal Observasi : 1 September 2025

I. Gaya Belajar Siswa
(Amati siswa berdasarkan karakteristik berikut ini dan beri tanda centang (✓) pada kolom yang sesuai)

Aspek	Visual	Auditori	Kinestetik	Catatan Pengamat
Cara menerima informasi	Lebih memahami dengan melihat gambar, grafik, atau diagram ✓	Lebih memahami dengan mendengarkan penjelasan atau diskusi ✓	Lebih memahami dengan praktik langsung atau aktivitas fisik	Sebagian besar siswa memahami konsep melalui tampilan visual seperti gambar dan video pembelajaran. Beberapa siswa aktif bertanya dan merespons

(a)

II. Tingkat Pemahaman Siswa
(Pilih tingkat pemahaman yang sesuai untuk setiap aktivitas belajar yang diamati.)

Tingkat Taksonomi Bloom	Indikator Aktivitas	Contoh aktivitas	Tercapai (✓)	Catatan Pengamat
Mengingat	Mengingat fakta, istilah, atau konsep	Menjawab pertanyaan definisi sederhana	✓	Sebagian siswa dapat mengingat kembali pengertian bentuk aljabar dengan bantuan contoh dari guru.
Memahami	Menjelaskan kembali konsep dengan kata-kata sendiri	Menyimpulkan isi materi	✓	Mayoritas siswa mampu menjelaskan kembali bentuk aljabar dan unsur-unsurnya.

(b)

Figure 9. (a) Student Learning Style Observation Sheet; (b) Student Understanding Level Observation Sheet.

In Figure 9 (a), the observation sheet on students' learning styles completed by the observer is presented. Meanwhile, Figure 9 (b) shows the observation sheet on students' levels of understanding, also filled out by the observer. Based on the observation results and reflection discussions, two major findings were identified.

First, in terms of students' learning styles, the majority of students demonstrated a visual learning preference. This was evident from their strong attention to the educational video used during the lesson. Students with an auditory learning style were more engaged in listening to the teacher's explanations, participating in discussions, and asking questions verbally. Meanwhile, kinesthetic learners showed greater focus when directly involved in hands-on activities such as writing answers on the board, working collaboratively on student worksheets (LKPD), and presenting group discussion results in front of the class.

Second, regarding students' levels of understanding based on Bloom's Taxonomy, most students had reached levels C2 (understanding) and C3 (applying). This was reflected in their ability to explain algebraic concepts in their own words and apply them to simplify algebraic expressions. Furthermore, several students began to demonstrate C4 (analyzing) skills, as they were able to compare arithmetic operations with algebraic forms. However, only a few students reached levels C5 (evaluating) and C6 (creating). Therefore, in the second cycle, it was deemed necessary to include activities that promote higher-order thinking skills, such as open-ended problem-solving tasks.

Based on the reflection results, the model teacher stated that the lesson had run smoothly and that students were enthusiastic throughout the learning process. The use of video media and LKPD was proven effective in enhancing students' attention. However, the implementation of the core learning activities slightly exceeded the allocated time, as group discussions took longer than expected. The model teacher also noted that some students still relied heavily on their peers during group work; thus, individual assessments should receive more emphasis in the following cycle.

The observers provided several constructive suggestions, including: (1) the teacher could distribute a brief reflection sheet to students after group discussions to assess individual understanding, (2) the LKPD should be varied and adapted to students' dominant learning styles—for instance, incorporating more visual aids for visual learners and verbal steps for auditory learners, (3) the teacher is encouraged to use an assessment rubric based on Bloom's Taxonomy to objectively measure students' cognitive development, and (4) the time allocation for the core activities should be managed more tightly to ensure all lesson stages are implemented as planned.

Overall, the reflection results indicate that the learning implementation in Cycle 1 successfully increased student engagement and fostered active participation in mathematics learning. The lesson also began to accommodate differences in students' learning styles and levels of understanding. Nevertheless, several aspects still require improvement, such as time management, strengthening individual assessments, and incorporating more activities that stimulate higher-order thinking skills. These reflection results serve as the foundation for revising the lesson plan and instructional strategies in Cycle 2 to create more effective, inclusive, and student-centered mathematics learning.

Cycle 2

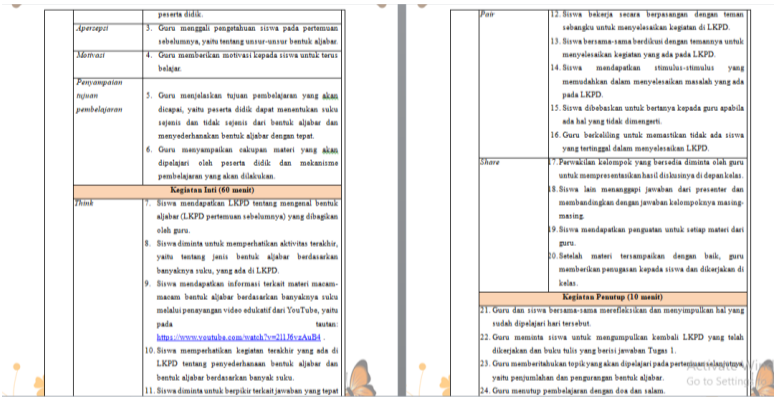
Plan

Cycle 1 was implemented and produced several important notes for improvement in the next cycle. Some aspects that require attention include time

management during the learning process, reinforcement of individual assessment, and the development of activities that challenge higher-order thinking skills (HOTS). Based on these reflections, adjustments and improvements were made during the planning stage of Cycle 2 to ensure that the subsequent learning implementation would be more effective, structured, and aligned with the intended learning objectives. Figure 10 illustrates the planning (plan) stage conducted by the mathematics teacher.

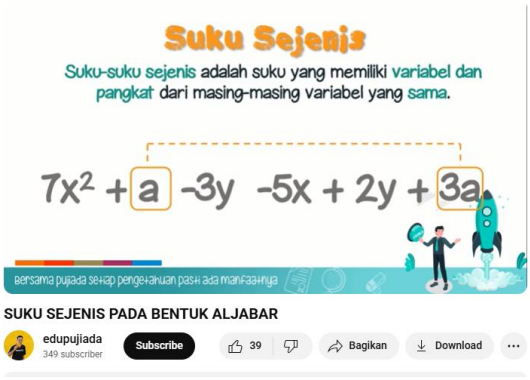
Figure 10. The Planning Stage

Figure 10 is shown the planning stage in Cycle 2, the learning plan was designed for two mathematics class periods. The learning model implemented was Cooperative Learning Think Pair Share Type. To address that issue, the learning model was modified into the Think Pair Share (TPS) model. This model was chosen because it allows more effective time management through structured learning phases, provides opportunities for individual accountability during the "Think" stage, and promotes higher-order thinking skills (HOTS) through peer discussion and collaborative idea sharing in the "Pair" and "Share" stages. Therefore, TPS was considered suitable to overcome the weaknesses identified in Cycle 1 and to enhance student engagement and learning outcomes in Cycle 2. Furthermore, the instructional media used was an educational video obtained from the YouTube platform. Overall, the instructional materials used were generally similar in type, with the primary difference lying in the learning model applied. Figure 11 presents the lesson plan and learning media used during Cycle 2.



	peserta didik.		
Apersepsi	3. Guru menggali pengetahuan siswa pada pertemuan sebelumnya, yaitu tentang unsur-unsur bentuk aljabar.	*Pair*	12. Siswa bekerja secara berpasangan dengan teman sebangku untuk menyelesaikan kegiatan di LKPD. 13. Siswa bersama-sama berdiskusi dengan temannya untuk menyelesaikan kegiatan yang ada pada LKPD. 14. Siswa mendapatkan stimulus-stimulus yang memudahkan dalam menyelesaikan masalah yang ada pada LKPD. 15. Siswa dibebaskan untuk bertanya kepada guru apabila ada hal yang tidak dimengerti. 16. Guru berkeliling untuk memastikan tidak ada siswa yang tertinggal dalam menyelesaikan LKPD.
Motivasi	4. Guru memberikan motivasi kepada siswa untuk terus belajar.		
Penyampaian tujuan pembelajaran	5. Guru menjelaskan tujuan pembelajaran yang akan dicapai, yaitu peserta didik dapat menentukan suku sejenis dan tidak sejenis dari bentuk aljabar dan menyederhanakan bentuk aljabar dengan tepat. 6. Guru menyampaikan cakupan materi yang akan dipelajari oleh peserta didik dan mekanisme pembelajaran yang akan dilakukan.	*Share*	17. Perwakilan kelompok yang bersedia diminta oleh guru untuk mempresentasikan hasil diskusinya di depan kelas. 18. Siswa lain menanggapi jawaban dari presenter dan membandingkan dengan jawaban kelompoknya masing-masing. 19. Siswa mendapatkan penguatan untuk setiap materi dari guru. 20. Setelah materi tersampaikan dengan baik, guru memberikan penugasan kepada siswa dan dikerjakan di kelas.
	Kegiatan Inti (60 menit)		**Kegiatan Penutup (10 menit)**
Think	7. Siswa mendapatkan LKPD tentang mengenal bentuk aljabar (LKPD pertemuan sebelumnya) yang dibagikan oleh guru. 8. Siswa diminta untuk memperhatikan aktivitas terakhir, yaitu tentang jenis bentuk aljabar berdasarkan banyaknya suku, yang ada di LKPD. 9. Siswa mendapatkan informasi terkait materi macam-macam bentuk aljabar berdasarkan banyaknya suku melalui penayangan video edukatif dari YouTube, yaitu pada tautan: https://www.youtube.com/watch?v=2I1J6vaAaB4 10. Siswa memperhatikan kegiatan terakhir yang ada di LKPD tentang penyederhanaan bentuk aljabar dan bentuk aljabar berdasarkan banyak suku. 11. Siswa diminta untuk berpikir terkait jawaban yang tepat		21. Guru dan siswa bersama-sama merefleksikan dan menyimpulkan hal yang sudah dipelajari hari tersebut. 22. Guru meminta siswa untuk mengumpulkan kembali LKPD yang telah dikerjakan dan buku tulis yang berisi jawaban Tugas 1. 23. Guru memberitahukan topik yang akan dipelajari pada pertemuan selanjutnya, yaitu penjumlahan dan pengurangan bentuk aljabar. 24. Guru menutup pembelajaran dengan doa dan salam.

(a)



(b)

Figure 11. (a) Lesson Plan Design and (b) Learning Media in Cycle 2

Figure 11 (a) illustrates the lesson plan design implemented during the learning practice in Cycle 2, while Figure 11 (b) presents the instructional media used in the same cycle. The learning process utilized an educational video that integrated contextual problems with visual illustrations to facilitate students' understanding. Furthermore, the lesson design in Cycle 2 was developed to promote students' higher-order thinking skills (HOTS), thereby enhancing their understanding more significantly than in the previous cycle. In addition to the use of educational video media, the implementation of the lesson study also employed a worksheet (LKPD) designed to support students with predominantly visual learning styles, similar to the previous cycle.

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Do

The "Do" stage in Cycle 2 was implemented by the model teacher based on the lesson plan developed during the planning phase. In this stage, the learning process employed the Cooperative Learning model of the Think Pair Share (TPS) type with the topic of algebraic expressions. The learning activities consisted of three main parts: introduction, core activities, and closing. The implementation of the *Do* stage in Cycle 2 is presented in Figure 12.

Figure 12. Learning Activities Using the Think–Pair–Share Model

Figure 12 is shown the learning activities using the Think-Pair-Share Model. First, during the introduction stage, which lasted for approximately 10 minutes, the model teacher began the lesson by greeting the students, checking attendance, and motivating them to actively participate in the learning process. The teacher then conducted an apperception activity by reviewing the previous lesson on the elements and basic forms of algebraic expressions. Afterward, the teacher conveyed the learning objectives, namely for students to be able to simplify algebraic expressions accurately through addition and subtraction operations.

Second, during the core activities, which lasted for approximately 100 minutes, the teacher implemented the three main phases of the Think–Pair–Share (TPS) model. In the *Think* phase, students were provided with student worksheets (LKPD) containing exercises on simplifying algebraic expressions and grouping like terms. The students' worksheet activities are presented in Figure 13.

Figure 13. Students Working on the Worksheet (LKPD)

In Figure 13, students are shown working on the worksheet (LKPD). During this activity, students were instructed to think independently and complete the given problems individually in the *Think* phase. Subsequently, in the *Pair* phase, students worked in pairs with their seatmates to discuss and compare their answers. The model teacher played an active role by providing stimuli and guiding questions to help students reason through the steps of simplifying algebraic expressions. In the *Share* phase, students were asked to present the results of their discussions in front of the class, while other students provided comments or alternative solutions. The model teacher offered reinforcement and conceptual clarification on key points and corrected any misconceptions that arose during the discussion.

Throughout the learning process, the model teacher used educational video media to support students with visual learning styles, while those with auditory and kinesthetic learning styles were engaged through listening activities, discussions, writing on the whiteboard, and manipulating algebraic forms directly. This approach helped students achieve C4 (analyzing) and C5 (evaluating) levels of thinking according to Bloom's Taxonomy, as it required deep understanding and the application of concepts in various contexts.

Third, the closing activity, which lasted for approximately 10 minutes, involved a joint reflection between the model teacher and the students on the learning process. The model teacher guided students to summarize the key steps in simplifying algebraic expressions and asked them to complete a brief reflection sheet as a form of self-assessment. The teacher also provided feedback on students' participation and informed them of the topic to be studied in the next meeting.

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See

The "See" or reflection stage in Cycle 2 was carried out after the learning implementation in Cycle 2. This stage was attended by the model teacher, observers from the Mathematics MGMPS of Banyuwangi Regency, and the research team consisting of lecturers and students. The implementation of the "See" or reflection stage is presented in Figure 14.

(a) (b)

Figure 14. (a) Reflection Activity; (b) Discussion Between The Model Teacher and The Observers

In Figure 14 (a), the reflection activity in Cycle 2 conducted together with mathematics teachers from the Banyuwangi Regency MGMPS is presented. Meanwhile, Figure 14 (b) shows the discussion between the model teacher and the observers. The reflection discussion focused on three main aspects: (1) the effectiveness of the implemented lesson design, (2) students' responses to the learning process based on their learning styles, and (3) students' levels of understanding as classified by Bloom's Taxonomy. The observation sheet completed by the observers is presented in Figure 15.

LEMBAR OBSERVASI
Tingkat Pemahaman Siswa

Tanggal Observasi : 4 September 2025

I. Tingkat Pemahaman Siswa
(Pilih tingkat pemahaman yang sesuai untuk setiap aktivitas belajar yang diamati.)

Tingkat Taksonomi Bloom	Indikator Aktivitas	Contoh aktivitas	Tercapai (✓)	Catatan Pengamat
Mengingat	Mengingat fakta, istilah, atau konsep	Menjawab pertanyaan definisi sederhana	✓	Sebagian siswa dapat mengingat kembali pengertian bentuk aljabar dengan bantuan contoh dari guru.
Memahami	Menjelaskan kembali	Menyimpulkan isi materi	✓	Mayoritas siswa mampu

Figure 15. The Observation Sheet on Students' Level of Understanding

Figure 15 illustrates the observation sheet on students' levels of understanding, which was also completed by the observer. Based on the results of observations and reflective discussions, it was found that, according to Bloom's Taxonomy, most students had reached levels C4 (analyzing) to C6 (creating). This was evident from their ability to analyze similarities and differences between arithmetic operations and algebraic expressions, as well as to identify patterns in coefficients and variables during the simplification process. Furthermore, several students were able to evaluate the problem-solving steps performed by their peers and provide logical justifications for the most efficient methods. At the C6 (creating) level, some students even demonstrated the ability to design new problems or real-world contexts involving algebraic forms and to solve them using self-constructed strategies. These findings indicate that learning algebraic forms through lesson study not only enhances students' conceptual understanding but also fosters the development of their Higher Order Thinking Skills (HOTS) within the context of mathematics learning.

The reflection results also revealed that the learning media used in Cycle 2 similar in type to that used in Cycle 1 remained effective in supporting students' learning processes according to their individual learning styles. The model teacher reported that the lesson proceeded smoothly and that students exhibited high enthusiasm throughout the process. The use of video media and student worksheets (LKPD) proved effective in increasing students' attention and engagement. Issues related to time management in the core activities, which had occurred in the previous cycle, were successfully resolved. Moreover, students began to demonstrate greater learning independence and reduced reliance on their peers. Overall, the reflection indicated that the implementation of learning in Cycle 2 successfully enhanced student engagement and encouraged active participation in mathematics learning. The lesson also began to accommodate differences in students' learning styles and levels of understanding. Therefore, the lesson study was deemed successful, and the teaching practice concluded at Cycle 2.

Goal

The goal of the Lesson Study across Cycle 1 and Cycle 2 was to improve the effectiveness of mathematics learning by enhancing student engagement, conceptual understanding, and higher-order thinking skills, while fostering teacher reflection and adaptability.

In Cycle 1, the focus was on evaluating the achievement of learning objectives and the impact of the implemented lesson design on students' engagement and understanding. The application of Problem-Based Learning, supported by educational videos and visual worksheets (LKPD), demonstrated a significant improvement in student engagement. Students were able to maintain focus, follow learning stages systematically, and participate actively in group discussions. Cognitive outcomes reached the levels of understanding (C2) and applying (C3) according to Bloom's Taxonomy, with some students achieving higher levels. For teachers, Cycle 1 strengthened awareness of diverse learning styles and encouraged adaptation of instructional approaches to be more inclusive.

Building on these findings, Cycle 2 aimed to address areas for improvement identified in Cycle 1, particularly in time management, individual accountability, and the development of activities that promote higher-order thinking skills (HOTS). The Think-Pair-Share (TPS) learning model was implemented to structure learning phases more effectively, facilitate independent thinking, and stimulate analysis, evaluation, and creation (C4–C6). Instructional media such as educational videos and LKPD were further optimized to accommodate visual, auditory, and kinesthetic learners, supporting engagement and understanding. Cycle 2 also emphasized individual assessment and reflective practices to ensure all students could demonstrate their learning progress independently. Overall, the integrated goal of the two cycles was to create a more effective, structured, and student-centered mathematics learning process that not only improves engagement and cognitive outcomes but also develops teachers' reflective and adaptive instructional skills.

Discussion

The results of this study reveal that the implementation of lesson study serves as an organized mechanism for responding to the heterogeneity of students' learning styles and levels of understanding in mathematics classrooms. This result is consistent with the findings of previous studies Farahsanti et al. (2021) & Zawawi et al. (2023), which demonstrated that lesson study contributes to improving students' achievement in mathematics. dapat mrningkatkan prestasi belajar matematika. Beside that, the findings indicate that collaborative lesson planning among MGMPS teachers effectively improves the design of learning activities and the use of instructional media. This is in line with previous studies which indicate that through collaborative lesson design and shared observation, teachers were able to identify visual, auditory, read/write, and kinesthetic tendencies that align with students' preferred learning styles in mathematics classrooms (Inprasitha, 2022; Nguyen & Tran, 2023). The results show that lesson study acts as a structured way to address the differences in students' preferred learning styles in math (Amelia et al., 2023; Utami et al., 2021). Through collaborative lesson planning and shared observations, teachers identified how visual, auditory, and kinesthetic preferences influence both participation and understanding of concepts. The group reflection sessions then led to specific teaching improvements, such as adding multimodal representations and active tasks, that lessened the gap between learning styles and created a more inclusive teaching environment, which affected both participation and concept acquisition (Cabual, 2021; El-Sabagh, 2021). The collective reflective sessions then informed targeted pedagogical refinements, for example, the incorporation of multimodal representations and active tasks, that reduced disparity between learning preferences and promoted a more inclusive instructional environment.

Beyond addressing learning styles, lesson study was effective in catering to differences in students' levels of understanding (Richit et al., 2021; Uyen et al., 2021). Classroom enactments revealed that learners with emerging comprehension benefited most from structured scaffolds and peer-supported activities, while more advanced learners gained from open-ended problem solving and investigative tasks

(Ishartono et al., 2021; Uştuk & De Costa, 2021). Because lesson study operates as a cyclical process, insights gained in one iteration were systematically used to recalibrate subsequent lessons, enabling progressively differentiated instruction that better matched students' readiness.

Taken together, the evidence suggests that lesson study advances both teacher development and student achievement in mathematics. Its collaborative planning-observation-reflection loop embodies constructivist tenets by foregrounding active meaning-making through social interaction and context-rich tasks. Consequently, lesson study represents a viable, enduring approach for improving instructional quality, especially in settings where variability in learning preferences and competency levels is a persistent instructional concern.

CONCLUSION

This study concludes that lesson study is an effective strategy for enhancing mathematics learning in middle school by systematically addressing both the diversity of students' learning styles and their varying levels of understanding. The collaborative cycle of planning, observation, and reflection enabled teachers to design and implement lessons that were more responsive to visual, auditory, and kinesthetic preferences, while also differentiating instruction to support students across different levels of comprehension. The iterative nature of lesson study not only improved classroom practices but also promoted teacher professional growth through shared inquiry and evidence-based reflection. These findings highlight lesson study as a sustainable and adaptable framework for improving mathematics instruction, particularly in contexts where inclusivity and responsiveness to learner diversity are essential. Future research is encouraged to further explore its application across broader educational settings and subject areas.

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