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Lesson Study-Based Mathematics Learning Using Cooperative Model on Single Interest and Compound Interest Materials

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ABSTRACT
The implementation of lesson study-based mathematics learning with cooperative model at Colombo High School showed positive results in improving students' engagement and understanding of single and compound interest material. This study aims to explore the effectiveness of the cooperative learning model, particularly through two cycles of lesson study. The method used was a case study with data collection through observation, interviews, and observation sheets. In the first cycle, using the Think Pair Share (TPS) model, it succeeded in making student participation active although there were still challenges such as lack of focus. To overcome this problem, the second cycle applied the Team Games Tournament (TGT) model, which proved more effective in increasing student enthusiasm and engagement. The reflection results showed the need for improvement in group division to be more heterogeneous and increase students' problem-solving literacy. Continuous evaluation through discussions between model teachers and subject teachers is essential to identify and improve strengths and weaknesses in the implementation of learning. The implication of this research shows that the implementation of lesson study can be an effective strategy to improve the quality of mathematics learning in secondary schools.
Keywords: Lesson Study; Cooperative Model; Think Pair Share; Team Games Tournament: Mathematics Learning

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INTRODUCTION

Education is a place to improve the quality of human resources. Quality education plays an important role in improving competent and competitive human resources (Achyanadia, 2016). Great attention is directed to the progress of education with the aim of improving the quality and quality of human resources (Prihatiningtyas et al., 2022). One of the factors that determine the improvement of the quality of education is the teacher. The point of learning activities is the effort made by the teacher in encouraging the learning process in students by selecting, determining, and developing methods to achieve the expected learning outcomes (Ifan Junaedi, 2019). When looking at the reality in the field, the education system in Indonesia still tends to apply learning methods that make students less active. The same applies to mathematics learning, where teachers in this case do not utilize learning models that make students more active in the learning process.

Teachers are expected to be able to make classes in mathematics learning an arena to increase student activeness. This is because the success of the learning process is strongly influenced by student learning activeness, where the higher the activeness, the greater the chance of achieving learning success (Pramudya et al., 2022). One of the learning programs that can support these efforts is lesson study, which is designed to improve the quality of learning while attracting students' interest in mathematics. Lesson study is a professional learning program that originated in Japan, involving teachers in planning,

implementing, and observing mathematics lessons together to examine and improve teaching practices, with a focus on achieving specific research objectives, such as improving students' ability to become independent learners (Fernandez & Yoshida, 2004). There are several studies that prove that lesson study is able to improve learning for the better and able to increase student activeness. According to (Yusrina, 2019), lesson study has been proven to be able to improve the learning atmosphere to be better, increase student enthusiasm and activeness, and develop teacher skills in teaching, as supported by previous research (Rohaeti & Hendriana, 2016; Izzah & Qohar, 2020; Yayuk & Ekowati, 2017; Lomibao, 2016; Bocala, 2015). Teachers' skills in teaching are certainly created from the stages of the lesson study.

Lesson study is divided into 3 stages, namely Plan Stage, Do Stage, See (Reflection) Stage (Abizar, 2017). At the Plan stage, the team designs learning needs both theory and practice, at the planning stage. The Do stage, which is an application that involves the model teacher in teaching and observers who monitor student activities. The see/reflection stage, which is carried out by evaluating student learning outcomes, requires team coordination and understanding in supporting the learning process. Through this learning activity, it is expected to achieve better mathematics learning outcomes.

One of the mathematics subject matters in class X is single interest and compound interest. Single interest and compound interest materials are part of economic mathematics, which are generally more difficult for students to understand. Given the existence of formulas or the use of terms that are different from other math materials. So, it needs different and active teaching in the teaching process.

Based on observations made in class X E2 at Colombo High School, Depok, Sleman, Yogyakarta, students' enthusiasm in participating in math learning is still relatively lacking. Math learning, which is usually done in the first hour, in the case of the class, is carried out in the last hour with an allocation of 3 lesson hours in one meeting. A cooperative learning model is needed to overcome these problems. Cooperative learning model is a strategy that involves students working collaboratively in groups to help each other understand concepts, solve problems, or conduct inquiry in order to achieve predetermined learning goals (Amalia et al., 2023).

Further observations found several other conditions. The condition of the classroom is not equipped with a projector to support learning. In addition, students are not provided with books specifically and uniformly. So that there are still many students who come to school only carrying notebooks. During the assignment process, there are some students who then just cheat on their friends. Based on further interviews with the math teacher, students tend to be less willing to explore the material that has been delivered. This can be seen when students are given the same problem, with modifications made to some numbers, they tend to be confused and unable to work. The alternative they do is wait for other students to finish working and then cheat. Based on the description of these problems, the researcher wants to examine how lesson studybased mathematics learning using a cooperative model on single flower and compound flower material.

METHOD

The research method used in this research is a case study design with a lesson study cycle with two cycles. The first cycle carried out the plan, do, and see stages. After the first cycle was carried out, the next cycle was the second cycle where this cycle was an improvement and advance from the first cycle, namely at the see stage. The second cycle starts from the plan stage, continues with the do stage, and ends with the see stage.

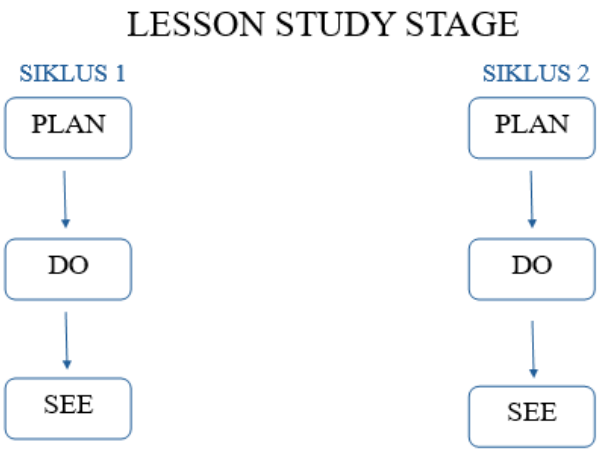

Figure 1. Lesson Study Stages

This research was conducted at Colombo High School on September 9, 2024 to October 25, 2024, which coincided with the academic year 2024/2025 odd semester. The subjects used in this study were students of class X E2 at Colombo High School. Data collection was carried out in three ways, namely observation, interviews, and observer sheets. Observation was conducted to obtain data, as input to the planning stage (plan). The data was obtained from mathematics learning activities by the mathematics teacher of class X E2. Data in the form of teachers when teaching, students' responses to learning, students' enthusiasm, and the availability of learning support infrastructure. Interviews were conducted with teachers, to explore deeper data on the process, as well as obstacles during learning. The observer sheet was given to the teacher as the teacher of mathematics subjects and to fellow students. This observer sheet was given at the implementation stage (do) which was later used as input at the reflection stage (see). Data analysis was carried out using qualitative analysis using data contained in the teaching module, observation data, interview data, and data on the observer sheet.

RESULTS AND DISCUTION

Cyle 1

Plan

Based on the description in the introduction, it has been mentioned that several problems were encountered during the preliminary observation activities. These problems were identified and addressed in the planning phase through appropriate solutions. The following table summarizes the problems and the corresponding solutions in the planning stage:

Table 1. Problems and Solutions of the Plan Stage

Problem	Solution
The lesson was held during the last hour, 3 lessons in one meeting,	Cooperative Model
No projector and uniform student handbooks available	The material is presented using the blackboard
Students tend to be less willing to try and cheat when given assignments	Using the Think Pair Share type, with the think stage (working individually)

Learning was scheduled in the final hours of the school day, combining three lesson periods into one session. This long and late time slot often leads to physical and mental fatigue among students, reducing their focus and motivation to learn. To address this issue, the planning team decided to implement a cooperative learning model, specifically the Think-Pair-Share (TPS) approach. This model was chosen to foster collaborative learning while ensuring individual accountability, thus keeping students engaged despite the lengthy session.Another significant challenge faced in the planning stage was the lack of teaching aids—there were no projectors available in the classroom, and not all students had access to the same student handbooks. These limitations necessitated a more traditional method of delivery, prompting the teacher to utilize the blackboard as the central medium of instruction. Although considered conventional, the blackboard served as an effective tool to ensure all students could simultaneously access the material being taught.

Additionally, one behavioral challenge identified was that many students were reluctant to work independently and frequently resorted to copying answers from peers. To mitigate this, the TPS model was designed with a strong emphasis on the “think” phase, where students were first required to attempt the task individually. This step aimed to develop their confidence and independent problem-solving skills before they proceeded to collaborate and share with their peers in subsequent stages. In developing the lesson plan, the model teacher—who is also a student-teacher—worked collaboratively with the supervising teacher to set clear and relevant learning objectives. These objectives were aligned with the core competencies of the subject and focused on real-life problem-solving contexts that are familiar to students, thus integrating the principles of contextual learning. Materials and reference sources were carefully selected, and activities were designed to stimulate critical thinking while maintaining student interest.

Do

In the implementation phase, the model teacher carried out the learning process based on the lesson plan that had been previously developed. This phase consisted of two main activities: the implementation of the lesson and the observation of student behavior and learning processes. The implementation activity was led by the model teacher (a student-teacher), while observation activities were conducted by the supervising mathematics teacher along with fellow student-teachers. During the implementation, the Think-Pair-Share strategy was applied systematically. In the initial "think" stage, students were asked to solve a given problem individually. This stage encouraged students to engage independently with the task, and many students were seen putting in genuine effort. Several students also approached the model teacher with questions, seeking clarification about how to approach the task, which indicated an increased willingness to try compared to prior observations.

In the "pair" stage, students worked in pairs to discuss their individual thoughts and compare answers. The classroom atmosphere became more active, and students appeared to be more enthusiastic as they exchanged ideas. This stage significantly enhanced student interaction and helped clarify misunderstandings through peer discussion. The final "share" stage involved students presenting their answers in front of the class. Notably, many students volunteered to write their answers on the board and explain their reasoning, reflecting increased confidence and participation. The class discussion that followed each presentation allowed for the correction of mistakes and reinforcement of key concepts. Overall, the learning session progressed smoothly and in alignment with the designed plan.

See

The reflection stage (See) involved a comprehensive evaluation of the lesson implementation, guided by the observation notes and feedback collected during the learning session. Reflection was conducted jointly by the supervising teacher and the model teacher through structured discussions. Although the lesson implementation was generally considered effective, several issues still emerged. Some students were observed sleeping during the lesson, especially during the early “think” phase, which may indicate a lack of motivation or physical fatigue. Additionally, some students were found chatting or

walking around the classroom, disrupting the focus of their peers. These behaviors were particularly noticeable during the "think" and "share" stages.

The reflection team identified that the primary cause of these distractions might stem from students' feelings of boredom or disengagement during certain segments of the lesson. It was also noted that some students preferred to ask for answers rather than trying to solve problems independently. This situation posed a challenge for the model teacher, who struggled to accommodate numerous simultaneous questions, especially because the classroom was divided into groups representing about half the total number of students. Moving forward, this insight will be used to further refine the implementation strategy. For example, grouping strategies might be adjusted, or the teacher could incorporate more dynamic and varied activities to maintain student interest. The lesson plan may also benefit from integrating short movement breaks or ice-breaker activities to re-energize students during long sessions.

Cycle 2

Plan

At this stage, the model teacher designs learning based on the results of the reflection obtained in cycle 1. The learning model chosen is the Team Games Tournament (TGT) type cooperative learning model. The selection of this type is because the class is still considered to need improvement in terms of student activity, so that learning becomes more engaging and less monotonous. In this planning phase, the teacher also used card media for group formation and colorful paper to paste answers, aiming to make the classroom atmosphere more enjoyable. The model teacher also consulted with the mathematics subject teacher when preparing the lesson plan and gathered various learning resources as inspiration for the planning process.

In addition, the model teacher made adjustments to the lesson scenario to better accommodate students' needs by integrating more interactive and fun activities. The use of competitive yet cooperative elements in TGT is expected to increase student participation, build teamwork, and boost motivation. The teacher also carefully arranged the time allocation for each activity and prepared formative assessment tools to monitor students' understanding during the learning process. These efforts are intended to create a dynamic classroom atmosphere and support the achievement of learning objectives more effectively.

Do

The learning activities were implemented by the model teacher based on the plan previously prepared during the planning stage. The core activities began with the teacher displaying the learning media designed for a math game. This game included material and practice questions on compound interest, presented in an engaging and interactive format. During the group division process, students appeared enthusiastic as they grouped with peers who had received the same illustrated card. These cards contained images of flat shapes (plane geometry) and were used as a fun and efficient method for forming groups. This approach not only simplified the group formation process but also created a more enjoyable and less formal classroom atmosphere.

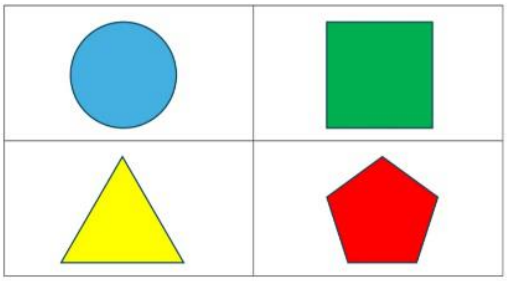

Figure 2. Group Division Card

Figure 3. Classroom learning

Following the group division, the lesson progressed to the implementation of the game-based learning activity. At this stage, students worked collaboratively to find answers to the questions presented on the board or other teaching media. Once an answer was found, they posted it on a designated answer sheet. This activity was designed not only to reinforce understanding of compound interest but also to foster group collaboration and boost students' self-confidence. Throughout the session, the teacher was able to monitor student progress more easily and provide support or encouragement when necessary. The learning activity concluded with a scoring session, where each group's answers were evaluated, and points were awarded based on accuracy and completion speed. The points ranged from 7, 5, 2, to 0.

See

As in cycle 1, cycle 2 also carried out a reflection stage using the observer sheet and also discussions with the math teacher. Based on this reflection activity, several problems were encountered. Students in this case do tend to be more active, but the division of groups is still less heterogeneous. This can be seen from the total points obtained. Then some students answer with inaccurate results. Students' problem solving literacy level tends to be low. This argument is strengthened by the answers of students who should be able to read the flow of the problem well but there are still many answer errors.

The application of lesson study in mathematics learning, especially on single flower and compound flower material, showed a significant increase in students' activeness and understanding. In the first cycle, the teacher used the Think Pair Share (TPS) cooperative model designed to encourage students' active participation. Observations during the implementation showed that students showed high interest when engaging in group discussions, although some obstacles such as students chatting and lack of focus remained. This indicates that although the TPS method provides space for students to interact, additional strategies are needed to maintain their concentration during the learning process.

Entering the second cycle, the model teacher adapted by using the Team Games Tournament (TGT) model to increase student activeness. This change proved effective, as students showed greater enthusiasm during learning activities. Game-based learning not only made the classroom atmosphere more enjoyable but also increased student engagement in solving math problems. Students were more active in finding answers and collaborating with their group mates. Nevertheless, reflection from the second cycle revealed that the division of groups still needs to be improved to be more heterogeneous, as well as the level of students' problem-solving literacy needs to be improved.

Reflections from both cycles show the importance of continuous evaluation in lesson study. Discussions between model teachers and subject teachers helped identify strengths and weaknesses in the

lesson implementation. Despite progress in student engagement, challenges such as differences in mathematical literacy among students remain a major concern. Therefore, further development of the lesson planning and teaching techniques used is necessary to achieve optimal results.

Overall, lesson study not only improves the effectiveness of mathematics learning but also provides opportunities for teachers to collaborate and learn from each other's experiences. By continuing to apply and evaluate this method, it is hoped that the quality of mathematics learning can continue to improve in the future.

CONCLUSION

Based on the implementation of lesson study-based mathematics learning using cooperative learning models at Colombo High School, it can be concluded that this approach has had a positive impact on improving students' engagement, conceptual understanding, and motivation, particularly in learning about simple and compound interest. The application of the Think Pair Share (TPS) model in the first cycle successfully laid the foundation for collaborative learning by encouraging students to think independently and engage in peer discussions. However, challenges such as students' lack of focus due to the long duration of learning sessions and the less heterogeneous composition of student groups were identified as areas requiring improvement.

In response to these reflections, the second cycle implemented the Team Games Tournament (TGT) model. This approach proved to be more effective in enhancing student enthusiasm and involvement, as it introduced a game-based and competitive atmosphere in the classroom. Students became more active in group work and showed increased interest in solving mathematical problems. The interactive nature of the TGT model also created a more dynamic learning environment, which helped sustain students' attention and participation throughout the lesson.

Despite the progress achieved, the reflection stage revealed that there were still areas in need of further development. These included improving group composition to ensure greater heterogeneity and strengthening students' mathematical literacy, especially in terms of problem-solving skills. Such improvements are crucial in ensuring that all students—regardless of ability level—have equitable opportunities to engage meaningfully with the learning material and collaborate effectively within their groups.

The continuous evaluation and reflection made possible through the lesson study process—facilitated by collaborative discussions between model teachers, subject teachers, and observers—play a vital role in identifying both strengths and weaknesses in the teaching and learning process. These reflections allow for targeted and sustainable improvements in instructional practice. Therefore, lesson study not only contributes to enhancing the effectiveness of mathematics learning but also serves as a platform for teachers' professional development through reflective practice and peer collaboration.

In conclusion, the implementation of lesson study with cooperative learning models such as TPS and TGT has proven to be an effective alternative for improving student learning outcomes in mathematics, particularly in the topic of simple and compound interest. This success is closely linked to careful planning, flexible yet structured implementation, and consistent reflection on practice. Hence, this approach is highly recommended for further development and replication in other mathematical contexts to continuously improve the quality of learning in schools.

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