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Application of the Discovery Learning Model to Improve Mathematics Learning Outcomes of Class XI Social Sciences

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ABSTRACT

This study aims to improve the learning process to improve the mathematics learning outcomes of students in class XI IPS SMA Persada Pebenaan for the 2020/2021 academic year through the application of the Discovery Learning learning model. Collecting data involves observing the activities of teachers and students in action. This classroom action research consists of two cycles, each consisting of 3 meetings and one repetition. By applying the Discovery Learning model with a scientific approach, students must be more active in discovering concepts and materials to increase student learning activities. It was proven that the number of students who achieved KKM increased from cycle I to cycle II. In cycles I and II, students who pass the KKM have a success rate of 20% and 70%, respectively. Based on the research findings, the mathematics learning outcomes of class XI SMA Persada Pebenaan can be increased in the material for sequences and series using the Discovery Learning model.

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INTRODUCTION

Learning mathematics is one of the most important lessons because it supports other sciences [1]. Education develops learners' cognitive abilities, disciplines the mind, and trains positive character traits [2]. The aim of studying mathematics is that students are expected to be able to understand mathematical concepts, be able to make generalizations based on existing phenomena or data and be able to perform mathematical manipulations, which include the ability to understand problems and solve problems in everyday life, be able to communicate ideas and be able to compile mathematical proofs, have respect and have attitudes and behaviours that are in accordance with values in mathematics and can carry out motor activities using mathematical knowledge [3]. The achievement of mathematics learning objectives can be seen from the success and completeness of mathematics learning outcomes obtained by students. With regard to learning mastery, each learner is required to achieve the assessment standard set by the educational unit, which is called the minimum mastery criterion.

Many learning models can be used to improve learning outcomes. One model that can be used is Discovery Learning. Jerome Bruner first put forward the Discovery learning model. He argued that discovery learning is in accordance with humans' active search for knowledge. Students learn best through discovery, so they try to find solutions to problems and the knowledge that accompanies them, producing significant knowledge [4].

The Discovery Learning Model has several advantages, namely helping students improve

cognitive skills and processes, improving students' ability to solve problems (problem-solving); learners understand the basic concepts and ideas better, assist and develop memory, and transfer to learning process situations [5]. Therefore, Discovery Learning is the learning model that must be used to improve student learning outcomes.

Based on observations made by researchers in class XI IPS SMA Persada Pebenaan, no students could answer the questions given by the teacher. Students easily forget the formulas/concepts the teacher gave them in previous learning. The learning method used by the teacher is the expository method. During the learning process, most students did not focus on listening to the teacher explain the learning material. Most of the students also talked to their friends.

Students are said to be active if they can find out for themselves and investigate independently. Then, the results will be loyal, last a long time in memory, and not be easily forgotten. Based on the problems described, it is necessary to improve the learning process to improve student mathematics learning outcomes. Overcoming this requires a learning model that engages students in the learning process. The Discovery Learning model is one learning model that can help students learn actively and construct concepts. Applying the Discovery Learning model with a scientific approach can increase student learning activities, improving student learning outcomes [6]. The Discovery Learning model has several stages: stimulation, problem statement, data collection, processing, verification, and generalization [7].

Learning is a mental or psychological activity that occurs in active interaction with the environment and produces changes in attitudes in knowledge and understanding, skills and values, and attitudes [8]. Learning outcomes are certain competencies or abilities, both cognitive, affective, and psychomotor, that are achieved or mastered by students after participating in the learning process [9]. The results of learning mathematics referred to in this study are the abilities possessed by students of class XI SMA Persada Pebenaan or the level of completeness in learning mathematics based on daily test scores after participating in the learning process by applying the Discovery Learning model.

Based on this description, the researcher conducted classroom action research by applying the Discovery Learning model to improve the learning process and the mathematics learning outcomes of class XI IPS SMA Persada Pebenaan on sequences and series.

METHODS

The research was conducted in the form of Classroom Action Research. Classroom action research was conducted in two cycles, consisting of 3 meetings and one daily test. Each cycle consists of 4 stages; namely, at the planning stage, researchers prepare learning tools such as syllabus, lesson plans, and worksheets. At the planning stage, the researcher acted as a class XI social studies teacher at Persada Pebenaan High School, and the math teacher acted as an observer. Classroom action research is research conducted by teachers in their classes through self-reflection to improve their performance as teachers so that student learning outcomes increase [10]. The teacher's actions in implementing learning in class use the Discovery Learning model, which is guided by the lesson plans that have been made. The research subjects consisted of 10 students who had heterogeneous abilities.

RESULTS AND DISCUSSION

The research results were obtained based on the PTK stages, which were divided into four stages. Below is the description of each cycle.

1. Cycle

Cycle I consisted of four meetings with details of three learning process meetings and one UH I meeting at the end of the cycle. At the action planning stage, researchers developed research instruments consisting of learning tools and data collection instruments. The learning tools include a syllabus, Learning Implementation Plan (RPP), and Student Worksheets (LKPD) for the first to sixth meetings. The learning process is carried out daily using lesson hours from other subjects. Because the school only allowed researchers to conduct research for two weeks.

a. The First Meeting (Monday, January 18, 2021)

In the first meeting, learning lasted 60 minutes, starting at 07.30 WIB and continuing until 08.30 WIB. In the preliminary activities, the researcher instructed the class leader to prepare his classmates and pray together so that all students were ready to start learning. The researcher checked the presence of students who participated in the learning process by calling students individually. The researcher continued by conveying the title of the learning material. The researcher conveys apperception by giving numbers like natural numbers. Researchers motivate students by communicating the benefits of the material studied in everyday life. The researcher conveys the learning objectives to be achieved. Furthermore, the researcher directly organized students into study groups and directed them to sit in predetermined groups. The researcher distributed LKPD-1 to each group and gave instructions on how to work on LKPD-1 in groups.

In the core activities, starting with the stimulation stage, students are given problems to observe. At the problem identification stage, several groups experienced difficulties. Group representatives asked what they should write in designing the steps for solving and writing temporary answers to the problems found in the LKPD to researchers. The researcher directs students to relate the apperception given by developing the steps for completion. At the data collection stage, the researcher directed students to find the formula for an arithmetic sequence according to the steps given in LKPD-1 to solve the problem. At the data processing stage, the researcher directs students to the arithmetic sequence formula that has been discussed previously. Some students have completed this stage because the steps are clear enough. At the data processing stage, students and their groups write down solutions to problems based on the steps designed at the problem identification stage. At this stage, students process the information they have obtained from the previous stage. In the final stage, namely concluding, the researcher directed students to make group conclusions and continued with group representatives presenting the results of group discussions.

This first meeting still had many weaknesses and deficiencies in the learning process. The researcher did not explain in detail the sequence of learning activities to be carried out, so many students were still confused about working on the LKPD. Researchers do not manage time properly when implementing activities that do not meet a predetermined time. Researchers gave formative tests at the last minute, so few students finished on time.

b. Second Meeting (Tuesday, January 19, 2021)

This meeting lasted 60 minutes. Lessons are held from 07.30-08.30 WIB. Before starting the learning process, the researcher asked the class leader to lead the prayer and prepare the class so that students were ready to carry out learning activities. The researcher checked the attendance of students who participated in the learning process by calling student attendance individually. The researcher continued the activity by conveying the title of the learning material and writing down the title to be discussed.

Furthermore, the researcher conveyed apperception by reminding the reader again about the pattern of arithmetic sequences. And relate previous material to the material to be learned. Researchers motivated students by conveying the benefits of arithmetic series material in everyday life. Researchers describe the learning objectives to be achieved. Researchers direct students to sit in predetermined groups. After students sat down based on predetermined groups, the researcher distributed LKPD-2 to each student and gave instructions to work on LKPD-2 in groups.

Core Activities: At the stimulation stage, the researcher asks students to observe and understand the problems. At the problem identification stage, the researcher directed students to write down what was known and what was asked and to write down temporary answers to the problem. At the data collection stage, students are required to find the concept of an arithmetic series. At the data processing stage, all groups could complete the task using the arithmetic series formula obtained at the data collection stage. At the proving stage, students are asked to examine to prove whether or not the hypothesis they made is correct. At the generalization stage, each group wrote conclusions from the results of group discussions about discovering the concept of arithmetic sequences in LKPD-2. Researchers asked students to present their group results in front of the class.

The researcher asked students to conclude today's learning material in the closing activity. Researchers guide students in summarizing the conclusions obtained and show appreciation to these students by inviting other students to applaud them. The researcher re-explains the findings obtained from the material studied today. The researcher gave a formative test to determine the extent of students' understanding of the material. After the time to do the formative test is over, the researcher gives homework. Then, the researcher conveyed the material to be studied at the next meeting, namely geometric sequences. Finally, the researcher closed the lesson today by greeting.

c. Third Meeting (Wednesday, January 20, 2021)

This third meeting lasted for 1 lesson hour (60 minutes), starting at 10.30 - 11.30 WIB. The researcher entered the class and then asked the class leader to prepare the class and pray. After answering greetings and praying, the researcher asked how they were doing, about students' readiness to start learning, and took attendance for all students. The researcher said that the material to be studied today was geometric sequences, then continued by writing the title of the material to be discussed. Furthermore, the researcher conveyed apperception by reminding students again about the arithmetic sequences and series that had been studied previously by asking them to write the formula on the blackboard. The researcher conveys motivation regarding the benefits of geometric sequences in everyday life. Researchers describe the learning objectives to be achieved. Researchers organize students into groups. The researcher distributed LKPD -3 to each group.

Core Activity: At the stimulation stage, students read discourses and observe problems found in LKPD-3 with their groups. All groups have been able to understand the problem well through group discussions. At the problem identification stage, students can write down what is known and asked and provide provisional answers. At the data processing stage, all groups solved the problems found in LKPD-3 by applying the geometric sequence formula they had obtained. At the proving stage, each group re-examines the provisional answers that have been made. At the conclusion stage, students and their groups discuss to conclude the material that has been studied. Group representatives present the results of their group work in front of the class. After finishing the presentation, the researcher thanked the representatives of group three and asked them to return to

their seats. Researchers and other students gave appreciation through applause to students who dared to present their work.

The researcher asked students to conclude today's learning material in the closing activity. Researchers guide students in summarizing the conclusions obtained. The researcher re-explains the findings obtained from the material studied today. Then, the researcher distributed formative test questions to see students' understanding regarding the use of geometric sequence formulas, and the implementation of formative tests went smoothly. Then, the researcher reminded the students to study the material at meetings 1-3 regarding sequences, arithmetic series, and geometric sequences in preparation for quiz I on Thursday. The researcher also gave homework as practice questions at home, and the researcher closed the lesson by greeting.

d. Fourth Meeting (Thursday, January 21, 2021)

The researcher conducted UH I at this meeting by administering a mathematics learning test. The test questions consist of 6 questions according to the first cycle UH grid. The researcher entered the class and asked the class leader to prepare the class. The class leader instructs the class to pray and continue with greetings. The researcher answered greetings and continued by checking the presence of students, and all students were present. Researchers ask students to submit homework. All students collect homework. Researchers asked students to adjust their sitting position and save mathematics-related books. The researcher also swapped the seating positions of several students to avoid cheating and provided the seating distance for each student. Before starting the quiz, the researcher explained the assessment method that the researcher would use to examine the quiz results. Then, the researcher read the quiz questions to each student and asked students to work individually, not discuss, and be careful. The quiz starts with an allotted time of 60 minutes.

e. Cycle I Reflection

Data on teacher and student activities in cycle I were obtained from observation sheets filled in by observers. Researchers reviewed the results of observations on the observation sheet. From the results of the observations, I got better at implementing learning in the cycle. Slowly, some students began to become actively involved in the learning process. The discussion process in each group had started well, as seen by the fewer students asking the researcher when working on the LKPD. The provision of motivation from the first, second, and third meetings also increased, as indicated by students who were increasingly enthusiastic about participating in learning.

After carrying out cycle I, there are several shortcomings, including 1) The attitude of some students who tend to be silent and wait for friends looking for answers.2) At the beginning of the student cooperation meeting to complete the LKPD, it was not good; students were still not used to having discussions. This can be seen when completing the LKPD; some students did not understand what they filled in because they relied only on their friends.3) Some students do not dare to ask questions, express opinions, and convey conclusions at the end of their learning. 4) At the beginning of the implementation, the researcher lacked time management, so the researcher was hurrying to complete the learning activities. Researchers will minimize errors from the actions in the first cycle.

2. Cycle II

At the action planning stage of cycle II, the researcher no longer compiled research instruments because the researcher had already done it at the planning stage of cycle I. Based on cycle I's

reflections, the researcher only planned actions to be carried out in cycle II. Based on the reflections of cycle I, the researcher plans action improvements for cycle II, namely, (1) Researchers must motivate students more so that all of them don't just wait for their friends to find answers; (2) The researcher explains in detail the steps of the activities carried out during the learning process so that there is good cooperation between group members; (3) Researchers must motivate students to have the courage to express opinions; (4) Better time management so that all learning activities are realized according to plan.

a. Fifth Meeting (Friday, January 22, 2021)

This meeting lasts one lesson hour (60 minutes) from 08.30 – 09.30 WIB. The researcher enters the class, and then the head of the class prepares the students. The students greet the teacher and pray after answering greetings and praying. The researcher conducted an apperception by asking students to mention the geometric sequence formula learned at the third meeting. Researchers motivate students by conveying examples of the benefits or applications of geometric series material in everyday life. The researcher asked the students to sit in their respective groups, and after the students had sat in their groups, the researcher distributed LKPD-4 to each student.

Core activities: At the stage of stimulation and identification of problems, students have been able to solve them in their respective groups and at the data collection and processing stage. At the proving stage, each group re-examines the temporary answers that have been made. All groups can write down the provisional answers correctly. In the final stage, namely concluding, students and their groups discuss the material that has been studied based on the understanding of each group. Closing activities The teacher then ends the lesson by praying together, followed by greetings.

b. Sixth Meeting (Saturday, January 23, 2021)

This meeting lasts one lesson hour (60 minutes) from 07.30 – 08.30 WIB. The researcher enters the class, and then the head of the class prepares the students. The students greet the teacher and pray. After answering greetings and praying, the researcher asked about students' news and readiness to start learning activities and checked student attendance by taking student attendance individually. The researcher conducted an apperception to explore the prerequisite knowledge, namely arithmetic and geometric sequences, by asking again about the characteristics of arithmetic and geometric sequences. Researchers motivate students by conveying examples of benefits or application of growth and decay material in everyday life. The researcher asked students to sit in their respective groups, and after the students had sat in their groups, the researcher distributed LKPD-5 to each student.

Core Activities: During the learning process, the researcher surrounded the class and monitored the discussion in each group. It was seen that the students were discussing seriously working on LKPD-5 with their group mates. The students didn't ask much more of the researcher. Almost all stages in LKPD-5 can be done well by each group. In the final stage, namely concluding, students and their groups discuss the material that has been studied based on the understanding of each group. After the groups finished working on LKPD-5, the researcher instructed the students to return to their respective seats and look at the front of the class so that all students listened to their friends who were going to present. Closing activities The teacher then ends the lesson by praying together, followed by greetings.

c. Seventh Meeting (Monday, January 25, 2021)

This meeting lasts one lesson hour (60 minutes) from 07.30 – 08.30 WIB. The researcher enters the class, and then the head of the class prepares the student. The students greet the teacher and pray. After answering greetings and praying, the researcher asked about students' news and readiness to start learning activities and checked student attendance by taking attendance individuallyly. The researcher conducted an apperception to explore prerequisite knowledge by asking again the formulas for sequences and series that had been studied previously. Researchers motivated students by conveying examples and benefits or applications of compound interest and annuity material in everyday life. The researcher asked the students to sit in their respective groups, and after the students had sat in their groups, the researcher distributed LKPD-6 to each student.

Core Activities: During the learning process, the researcher surrounded the class and monitored the discussion in each group. It was seen that the students were discussing seriously working on LKPD-6 with their group mates. The students didn't ask much more of the researcher. Almost all stages in LKPD-6 can be done well by each group. In the final stage, namely concluding, students and their groups discuss the material that has been studied based on the understanding of each group. The researcher instructed the front of the class so that all students listened to their friends who would make presentations. At the end of the lesson, the researcher gave assignments to be done at home and collected at the next meeting. Closing activities The teacher then ends the lesson by praying together, followed by greetings.

d. Eighth Meeting (Tuesday, January 26, 2021)

The quiz starts with an allotted time of 60 minutes. The researcher carried out UH II at this meeting by giving a mathematics learning achievement test. There are six test questions according to the second cycle UH question grid. The researcher entered the class and asked the class leader to prepare the class. The class leader instructed the class to pray and continued by greeting. The researcher answered greetings and continued by checking the presence of students, and all students were present. Researchers ask students to collect homework. All students collect homework. The researcher asked students to adjust their seating position and save mathematics-related books. After the time for Quiz II was up, the researcher instructed each student to stop working and immediately collect the answer sheets.

e. Cycle II Reflection

Based on the reflection results in the first cycle, the researcher has prepared the plans to be carried out in the second cycle. From the results of observations on the observation sheet, during the action three times in this second cycle, there was an increase compared to the first cycle.

The deficiencies and weaknesses the researchers overcame in this second cycle are as follows.1) Researchers have optimized learning time more effectively so that all stages of the learning process can be carried out. 2) The researcher has conditioned the seats that support the participation of all students in the discussion. 3) Researchers have carried out learning according to the stages. 4) Researchers have motivated students to dare to answer questions and convey conclusions at the end of learning.

3. Analysis of Teacher and Student Activities

Teacher and student activity data were analyzed to determine the optimal implementation of the steps of the Discovery Learning model planned for the implementation of the learning process actions. Teacher and student activity data can be seen on the observation sheet. The data obtained is then analyzed. From the results of observations on the observation sheet of teacher and student activities in cycle I, the implementation of the action was carried out well but was not optimal. At the beginning of the implementation, the students still looked less active during the learning process. Still, at the end of the implementation of the first cycle of actions, the students started to be active in the learning process.

Student activities in the learning process in the core activities are improving until the end of implementing a cycle I action. In cycle II, the researcher corrected deficiencies and weaknesses based on reflections from cycle I. From the observations of teacher and student activities on the observation sheet of cycle II, the implementation of learning was carried out optimally per the plan. Students are increasingly seen as active during the learning process. The learning process in the core activities is getting better at each meeting.

At the problem identification stage in the first cycle, at the beginning of the meeting, many students experienced difficulties because they were still not used to solving problems on their own without the teacher's help. So, some students asked several times for answers that had to be filled in at the problem identification stage. In line with the implementation of the cycle I action, some students began to understand the problems given and asked questions related to the given issues. In cycle II, almost all students could understand the problems presented. Students were able to identify problems and had active discussions in groups.

At the stage of collecting and processing data in the first cycle, some students had difficulty following the steps at this stage. At the end of the implementation of the first action cycle, students started to write answers by following the steps given in the LKPD. In cycle II, students can collect and process data to solve problems in LKPD in groups.

.At the proving stage, some students experienced difficulties because they did not understand what to do, and most students who experienced difficulties lacked the desire to learn and had no discussion with their group mates. In line with implementing the first cycle of action, group collaboration is improving. Students who initially did not cooperate with the group already wanted to have discussions with their group mates. At the end of implementing the first action cycle, students are familiar with working on the LKPD. In cycle II, the cooperation of each group in working on LKPD looks better until the end of cycle II. Students carry out the learning process facilitated by the teacher well. Students actively express their opinions in group discussions.

The activities of researchers and students in the final activities also improved until the end of the cycle I. From the beginning of the cycle I, the researchers consistently gave formative tests and reflections on the formative test questions. The deficiencies and weaknesses that occur in the learning process are getting fewer along with the implementation of the actions in cycle I and II so that the learning process is improving until the end of cycle II. Analysis of the learning steps in cycle I and cycle II showed that there was an improvement in the learning process in class XI SMA Persada Pebenaan in the subject matter of sequences and series in the even semester of the 2020/2021 school year

4. Data Analysis of Students' Mathematics Learning Outcomes

a. Frequency Distribution Analysis

Data on students' mathematics learning outcomes are presented in the form of a frequency distribution so that the distribution or distribution of the frequencies of students' scores can be seen so that it can be seen the increase in students' mathematics learning outcomes. The following is the frequency distribution of students' mathematics learning outcomes on fundamental values, UH I and UH II.

Table 1. Frequency Distribution of Students' Mathematics Learning Outcomes on Knowledge Competence

Intervals	Student Frequency		
	Basic Score	UH I	UH II
40-50	5	0	0
51-60	5	3	0
61-70	0	5	3
71-80	0	1	5
81-90	0	1	2
91-100	0	0	0

Based on Table 1, it can be seen that there was an increase in student learning outcomes from the basic score, UH I, and UH II. On the basic frequency score, ten students had not reached the KKM, eight at UH I, and three at UH II. On the other hand, the frequency of students who achieved KKM experienced an increase of 0 students on the basic score, to 2 students at UH I and seven at UH II.

The explanation of the data above shows that after the implementation of the action, there is an increase in students' mathematics learning outcomes on the knowledge indicator, which is marked by a change in the frequency of students in each value interval to a higher value interval (in a better direction). Furthermore, the frequency distribution of students' mathematics learning outcomes on skills indicators on basic values, UH I and UH II, is presented in the following table.

Table 2. Frequency Distribution of Students' Mathematics Learning Outcomes on the Skills Indicator

Interval	Student Frequency		
	Basic Score	UH I	UH II
40-50	4	1	3
51-60	3	2	1
61-70	0	4	2
71-80	2	2	3
81-90	1	1	1
91-100	0	0	0

Based on Table 2, it can be seen that there was an increase in student learning outcomes from the basic score, UH I, and UH II. Seven students had not reached the KBM on the basic frequency score, three at UH I and four at UH II. In contrast, the frequency of students who achieved KBM increased from 3 students on the basic score to 3 students on UH I and four students on UH II.

The explanation of the data above shows that after the implementation of the action, there is an increase in students' mathematics learning outcomes in competency skills, which is marked by a change in the frequency of students in each value interval to a higher value interval (in a better direction).

b. KKM Achievement Analysis

KKM achievement was analyzed by comparing the percentage of students who achieved KKM on the basic score before implementing the action and the percentage of students who achieved KKM on the mathematics learning achievement test after implementing the action. The percentage of students who achieved KKM in knowledge competence before and after the implementation of the action can be seen in the following table.

Table 3. Achievement of Students' KKM on Indicators Knowledge

Information	Student Frequency		
	Base Value	UH I	UH II
The number of students who achieve KKM	0	2	7
Percentage of students who achieve KKM	0%	20 %	70%

Table 3 shows an increase in the percentage of students who achieved KKM in knowledge competence from the basic value obtained before the UH I action (after the implementation of the first cycle action) by 20%. At UH II (after the implementation of cycle II actions), the percentage of students who achieved KKM increased by 50% from UH I. From these data, it can be concluded that the number of students who achieved KKM on knowledge competency from the basic value (before implementing the action) to UH I (after the implementation of the action) and the number of students who achieved KKM in knowledge competencies from UH I to UH II (after the implementation of the action) has increased. Furthermore, the percentage of students who achieved KKM in skill competencies before and after implementing the action can be seen in Table 4 below.

Table 4. Table of Students' KKM Achievement on Indicators Skills

Information	Student Frequency		
	Base Value	UH I	UH II
The number of students who achieve KKM	3	3	4
Percentage of students who achieve KKM	30%	30%	40%

Table 4 shows an increase in the percentage of students who achieved KKM on the skills indicator on the UH II score (after implementing cycle II actions) of 10% from UH 1. Even though the results of UH 1 did not show an increase in the basic score, from these data, it can still be concluded that the number of students who achieved KKM on the skills indicator from basic values (before implementing the action) to UH II (after implementing the action) and the number of students who achieved KKM from UH I to UH II (after implementing action) has increased.

CONCLUSIONS AND SUGGESTIONS

Based on the data analysis and discussion, it can be concluded that the application of the Discovery Learning model can improve the learning process and improve the mathematics learning outcomes of students in class XI IPS SMA Persada Pebenaan, Keritang District, Indragiri Hilir Regency, even semester of the 2020/2021 school year on the subject matter of sequences and series.

Based on the conclusions and discussion, the researchers put forward recommendations related to the application of the Discovery Learning model in learning mathematics, including: 1) Mathematics teachers or researchers can apply the Discovery Learning Model in further learning. This is because the Discovery Learning model can improve the learning process, such as students who are increasingly actively participating in the learning process and learning in student-centred classes (student-centred), to improve student learning outcomes. 2) The teacher/researcher motivates students more to be able to pay attention to explanations from other groups during presentations.

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