

Improving critical thinking skills and responsibility through discovery learning assisted by student worksheets

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Abstract

We conducted classroom action research including preparation, action observation, and reflection to measure the improvement of students' critical thinking skills and responsibilities in mathematics subjects using the Discovery Learning learning model. The sample in this study were students of SMA Negeri 1 Sleman class X MIPA 2, totaling 36 students. The success criteria are 70% in the good category. The results of the study indicate that: (1) the Discovery Learning learning model can improve students' critical thinking skills and attitudes towards responsibility. This can be seen from the students' critical thinking skills tests in cycles 1 and 2. The test results of students' critical thinking skills in cycle 1 were 33% and 56%, and in cycle 2 were 75%. (2) The ability to think critically affects learning outcomes, this can be seen from the increase in the mastery value of student learning outcomes which reached 56% in cycle 1 and 75% in cycle 2, while the results of the responsibility questionnaire filling test were 59% to 74%. From the results of these studies, the Discovery Learning learning model can improve critical thinking skills and attitudes of responsibility that have an impact on the mathematics learning process of students in class X MIPA 2 SMA Negeri 1 Sleman.

Keywords: critical thinking skills, mathematics learning, discovery learning, students' responsibility

How to cite: Hayat, N., & Setyawan, F. (2022). Improving critical thinking skills and responsibility through discovery learning assisted by student worksheets. *Proceedings of the International Conference on Education, 1*, 289-296.

INTRODUCTION

Education is one of the parameters of a nation's progress, and the better the quality of education in a country, the better the quality of that country. Wijaya, et al. (2016) explains that the 21st century is about learning that integrates knowledge, skills, and attitudes, as well as learning that relies on mastery of technology, information, and communication. In the 21st century, learning provides space for students to learn contextually related to real life so that they can apply the material in school. This learning paradigm is a fluctuating change as well as a challenge for students to keep abreast of the times. This is in line with the use of the 2013 curriculum as a learning outcome in Indonesia, as it follows the development of 21st-century learning.

The 2013 curriculum is a national curriculum that emphasizes student-centered learning to participate actively according to their abilities, as well as their physical and psychological development (Richardo, 2016). According to the 2013 curriculum, one of the compulsory subjects at the high school level in mathematics. The importance of mathematics is that students can improve their ability to understand mathematical concepts and solve mathematical problems.

The 21st-century skills that must be possessed are critical thinking skills in overcoming problems. According to Christina (2016:222), critical thinking skills are very important for students about the ability to overcome problems that exist in the real world. Critical thinking is a person's skill to get information and solve a problem by asking himself to dig up information about the problem at hand.

Participation in the Program for International Student Assessment (PISA) in Indonesia also confirms the progress of Indonesia's education compared to other countries in the world. PISA is

an international standard study supported by the Organization for Economic Cooperation and Development (OECD) which examines the thinking ability of 15-year-old students who were attended by several participating countries.

The OECD (2018) reveals that the survey results of Indonesian students are below the OECD average in terms of reading, mathematics, and science. Approximately 28% of Indonesian students in mathematics have grades of 2 or higher (OECD average: 76%). Students in this case can at least interpret and can find out the problem or problem such as comparing the distance from two different routes or changing the price of currency with the price of a different currency. Percentage of students aged 15 years achieving the lowest math level at level 2 or higher than 98% in China and up to 2% in Zambia, on average participating in the PISA assessment for development in 2017. Across the OECD, 76% of students achieve at least level 2 proficiency in mathematics.

Through the results of observations made at SMA Negeri 1 Sleman in December 2021, the mathematics achievement index at SMA Negeri 1 Sleman was good, as evidenced by about 15% of students who did not complete the KKM, with a KKM of 78. However, when the researcher did a test to measure thinking skills and critical thinking about the material, the results obtained by the average student's critical thinking ability were still low. The test was attended by 36 students of class X MIPA 2. The results obtained based on indicators of critical thinking skills were only 22% with high criteria. The second observation, made through interviews with tutors, revealed that blended learning affected students' responsibility in participating in school-based learning activities. The third observation is that in the learning process, students usually use the Student Worksheet (LKPD) from the tutor teacher.

Rachmantika and Wardono (2019) stated that one of the fields of science that can develop critical, systematic, logical, and creative thinking skills in mathematics. Through these observations, students' critical thinking skills should be encouraged to improve. Students' critical thinking skills can increase if they use the right learning model. The Discovery Learning learning model is a learning model that emphasizes a series of learning activities to understand the meaning, patterns, concepts, meanings, and experiences through an intuitive process to finally conclude. The Discovery learning model according to Brunner in Suherti and Siti (2017:53), is "learning that aims to acquire knowledge in a way that allows students to show their intellectual abilities, stimulate curiosity, and motivate students' skills. According to Saifuddin (2014:108), the discovery learning model is a learning strategy that tends to require students to make experimental observations or scientific actions to conclude the scientific action.

One form of attitude that must be owned by a student is an attitude of responsibility. Responsibility is the basis of universal values (Wibowo, 2016). The nature of responsibility is so important that it must be taught to students. In online learning, students need to actively and independently design and implement learning activities (Widyanti, 2020). Sobri (2020) explains that students are responsible for conducting independent learning, diagnosing learning needs, and assessing learning outcomes to improve the quality of the online learning process. In addition, the attitude of responsibility also plays an important role in face-to-face learning. Because the attitude of responsibility is important, it has something to do with students' critical thinking skills.

Research conducted by Elfina and Sylvia (2020) states that educators need to make changes during the learning process so that students' critical thinking skills can be improved, one of which is by using learning media such as Student Worksheets (LKPD). The LKPD used by educators adjusts to the needs of students so that the LKPD that has been created can achieve learning objectives. Ariani and Meutiawati (2020) LKPD is a sheet of paper for making problem-solving schemes, compiling, and recording observational data, and consists of discussion sheets or exercises for students. The objectives of preparing LKPD include teaching materials that can

help students understand the content of the material provided; help improve mastery of the material through the assigned tasks; train students' responsible attitude (Prastowo, 2011).

From the description above, critical thinking skills are needed by students to deal with mathematical problems. Educators as facilitators in schools have an important task, especially in the teaching process. The ability of educators to use learning models in schools is needed. The Discovery Learning learning model is one of the appropriate learning models used by educators in growing critical thinking skills. Through this topic, researchers are interested in implementing and studying further the application of the Discovery Learning learning model with the help of LKPD to improve critical thinking skills and attitudes of responsibility so that students are expected to have a better influence.

According to Adi in Suprihatiningrum and Jamil (2013), the learning model is a systematic procedure for managing the learning experience to achieve the desired learning objectives. According to Saifuddin and Kristin (2014:108), Discovery Learning is a learning procedure that puts students on observation, trials, or scientific actions to get a conclusion.

Suherti (2017:55) explained that in using the Discovery Learning model, it is hoped that it can bring a change from passive learning to active learning using student-centered learning. Changing from students who usually receive material from the teacher orally to students finding information on their own.

Through this model, students are invited to find information independently and build their knowledge by understanding it. The role of the teacher in this model is as a facilitator only. The Discovery Learning learning model allows students to learn according to their interests and talents to achieve competence through their curiosity.

Based on the Ministry of Education and Culture (2013), there are 6 stages of the Discover Learning learning model as presented in Table 1.

Table 1. Discovery learning syntax

Stage	Students and Teacher Behavior
Stage-1 Stimulation	The teacher stimulates students with a question or is given a problem in the form of pictures, writing, or videos then students are asked to observe.
Stage-2 Identification of problems	Students identify the existing problems. Students choose the problem that they feel is the most interesting and easy to solve. After selecting the problem, the students formulate the problem in the form of a hypothesis in the form of a statement.
Stage-3 Data Collection	To answer statements that have been made previously, students can collect various relevant sources to help prove the truth of the statement.
Stage-4 Data Processing	All information obtained is then processed to a certain level of confidence
Stage-5 Verification	Based on the data processing carried out, it is then examined whether the results obtained are correct or not
Stage-6 Generalizations	Students draw conclusions based on the results of the previous proof stage

One of the important characteristics that students must have is the character of responsibility. Responsibility is the basis of universal values (Wibowo, 2016). The character of important responsibility is taught to students. Virtual face-to-face learning that is currently taking place requires students to be responsible for designing and implementing learning activities actively and independently (Widyanti, 2020). Sobri (2020) explains that students have the responsibility to organize learning independently, diagnose learning needs, and evaluate learning outcomes so that the virtual face-to-face learning process can improve. In addition, the affective

attitude of responsibility will also be very important in online learning. Because the attitude of responsibility is very important for students, perhaps affective attitudes have something to do with students' critical thinking skills. According to Lickona, T (2015), the indicators of responsibility can be seen in Table 2.

Table 2. Responsibility indicator

No.	Observed Aspects
1	Understanding the rights and obligations of self as a student <ol style="list-style-type: none"> a. Comply with school rules that have been well established b. Respect the teacher both inside and outside the classroom
2	Take an active role in learning activities <ol style="list-style-type: none"> a. Actively ask when someone doesn't understand b. Take part in every learning activity c. Responding to the teacher when asked
3	Have the initiative to solve problems <ol style="list-style-type: none"> a. Helping friends who have difficulty understanding learning b. Helping the teacher when help is needed c. help smooth learning activities in class
4	Doing assignments given by the teacher <ol style="list-style-type: none"> a. Students do the assignments given by the teacher on time b. Work honestly when judging every day c. Do all the assigned tasks

Based on the description above, critical thinking skills are needed by students to deal with mathematical problems. The role of educators is so important in the teaching process. Apart from being a facilitator, educators also have an important role, especially in the teaching process. The need for educators to have the ability to use learning models in schools. One of the appropriate learning models used for educators to improve critical thinking skills is Discovery Learning. Through this topic, researchers are interested in exploring deeper and applying the Discovery Learning learning model to improve critical thinking skills and responsibility so that students are expected to have a better influence.

RESEARCH METHOD

The research was conducted at SMA Negeri 1 Sleman in May 2022. The subjects studied were students of class X MIPA 2 in semester 2, totaling 36 students in mathematics with the material being trigonometric comparisons of angles in right triangles and special angles; trigonometric ratios of an angle in various quadrants and related angles.

This research is called classroom action research, research is based on problems that exist in the classroom and it is hoped that this research will be able to improve learning outcomes (Widayanti, 2008: 87). This study uses Kennis and MacTaggart. In each cycle, there are 3 stages, namely: (1) planning is a research design that is adapted to the objects and problems that will be corrected in a class; (2) action-observation is the implementation of the design that has been prepared to achieve the desired learning objectives; and (3) reflection is the stage of looking back at the learning process carried out and seeing deficiencies or obstacles that will be used as material for improvement in the next cycle (Pujiono, 2008: 3).

The technique used in this research is the collection of data from the results of the written test. The percentage of students' learning completeness scores by applying Discovery Learning The average score range is shown in Table 3.

Table 3. Cycle I category level of critical thinking skills

Interval	Category
$x > 12$	High
$6 < x \leq 12$	Medium
$x \leq 6$	Low

Table 4. Cycle II category level of critical thinking ability

Interval	Category
$x > 12$	High
$6 < x \leq 12$	Medium
$x \leq 6$	Low

Table 5. Responsibility attitude

Interval	Category
$x > 60$	High
$40 < x \leq 60$	Medium
$x \leq 40$	Low

RESULTS AND DISCUSSION

Results

The description of the data presented below is obtained from field data on increasing students' critical thinking skills, taken from student observations, and then seeing the impact of learning outcomes that are influenced by students' thinking skills in class X, MIPA 2, using the Discovery Learning model from cycle 1 and cycle 2. Observation of students includes the implementation of critical thinking indicators by students in mathematics subjects, which consists of 6 indicators. According to Ennis (2011), there are 6 indicators of critical thinking ability which can be seen in Table 6.

Cycle 1

Observation of the learning process in mathematics subjects with trigonometric comparisons of an angle in a right triangle and special angles before the implementation of the action shows that there are problems that result in the learning process being less than optimal. It is evident from the results of the pretest of critical thinking skills in the first cycle that only 33% scored high, and the posttest results of critical thinking skills produced 56% with high criteria. While the results of the responsibility questionnaire filling test achieved by students in the first cycle of the first meeting resulted in 44% having high criteria, at the second meeting, 59% had high criteria. so that in the first cycle there was an increase, but it did not meet the success indicator of at least 70% with high criteria.

Cycle 2

Observation of the learning process in mathematics subjects on trigonometric comparison of an angle in various quadrants and related angles. The test results show the critical thinking ability in the second cycle which is 75% with high criteria and the responsibility questionnaire test. the results achieved by students in the second cycle resulted in 75% with high criteria. So that from cycle to cycle there is an increase and we meet the success indicators of at least 70% with high criteria. From the results of the critical thinking skills test and filling out the responsibility questionnaire in the second cycle, this research was carried out until the second cycle.

Table 6. Critical thinking indicator

No.	Observed Aspects
1	Focus <ol style="list-style-type: none"> Students write down what is known, and what is asked in the question correctly Students write down what is known and what is asked in the question incorrectly Students write down what is known and asked incorrectly Students do not write down what is known and what is asked in the question
2	Reason <ol style="list-style-type: none"> Students illustrate the problem on the question correctly Students illustrate the problem on the question incorrectly Students illustrate the problem on the question incorrectly Students do not illustrate the problem in the question
3	Inference <ol style="list-style-type: none"> Students model mathematics on the problem correctly Students model mathematics on the problem incorrectly Students model mathematics on the problem incorrectly Students do not model mathematics on the problem
4	Situations <ol style="list-style-type: none"> Students relate the answers obtained with the actual situation correctly Students associate the answers obtained with the actual situation with less accuracy Students associate the answers obtained with the actual situation incorrectly Students do not associate the answers obtained with the actual situation
5	Clarity <ol style="list-style-type: none"> Students write down the unit of measurement correctly Students write the unit of measurement incorrectly Students write the unit of measurement incorrectly Students do not write down the unit of measurement
6	Overview <ol style="list-style-type: none"> Students write conclusions on the answers to the questions given and recheck thoroughly from beginning to end correctly Students write conclusions on the answers to the questions given and recheck thoroughly from beginning to end with less accuracy Students write conclusions on the answers to the questions given and check back thoroughly from beginning to end incorrectly Students do not write conclusions on the answers to the questions given and check back thoroughly from beginning to end

Discussion

Based on the results of the study, the critical thinking ability test with the Discovery Learning learning model in cycle 1 to cycle 2 increased from 56% to 75%, so it has met the success indicator, namely 70% with high criteria. So that the research is sufficient to carry out until cycle 2. The research conducted is in line with the research of Arfika Wedekaningsih, Henny Dewi Koeswanti, and Sri Giarti in 2019 with the title Application of the Discovery Learning Model to Improve Critical Thinking Ability and Students' Mathematics Learning Outcomes. Further research should provide additional affective attitudes that can be improved. So that research can find out whether high critical thinking skills also affect students' affective attitudes.

CONCLUSION

From the results of the research that has been done and from the discussion, it can be concluded that learning mathematics using the Discovery Learning learning model is effective in improving critical thinking skills and attitudes of responsibility in students of SMA Negeri 1 Sleman class X MIPA 2. The improvement of students' critical thinking skills is shown by the fulfillment of

indicators of success and an increase in the percentage can be seen from cycle 1 to cycle 2, from 56% to 75%. Meanwhile, the student's responsibility also increased from cycle 1 to cycle 2, from 59% to 74%.

ACKNOWLEDGEMENT

The researcher would like to thank the supervising lecturers, tutor teachers, and partner school principals who have supported and assisted in providing data and information for this research.

REFERENCES

- Ariani, Desi., Meutiawati (2020). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis discovery learning pada materi kalor di SMP. *Journal Phi*: Vol. 1 No. 3, 13-19.
- Christina, L. V., & Kristin, F. (2016). Efektivitas Model Pembelajaran Tipe Group Investigation (GI) dan Cooperative Integrated Reading And Composition (CIRC) Dalam Meningkatkan Kreativitas Berpikir Kritis dan Hasil Belajar IPS Siswa Kelas 4. *Scholaria: Jurnal Pendidikan dan Kebudayaan*, 6(3), 217-230.
- Ennis, R. H. (2011). *The Nature of Critical Thinking : An Outline of Critical Thinking Dispositions and Abilities*. University of Illinois. Retrieved July 24, 2022 from (http://faculty.education.illinois.edu/rhennis/documents/TheNatureofCriticalThinking_51711_000.pdf)
- Elfina, S., Sylvia, I. (2020). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Problem Based Learning (PBL) dalam Meningkatkan Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Sosiologi di SMA Negeri 1 Payakumbuh. *Journal Sikola*. Vol. 2 No. 1, 27-34.
- Kementerian Pendidikan dan Kebudayaan. (2013). *Badan Pengembangan Sumber Daya Manusia Pendidikan dan Kebudayaan dan Penjaminan Mutu Pendidikan tentang Model Pembelajaran Penemuan (Discovery Learning)*. Jakarta: Kementerian Pendidikan Nasional.
- Lickona, T. (2015). *Educating for character mendidik untuk membentuk karakter*. (Diterjemahkan oleh Juma Abdu Wamaungo). Jakarta: Bumi Aksara.
- OECD. (2018). *Programme for International Student Assessment (PISA) Result from PISA 2018*. Retrieved Juli 18, 2022 from www.oecd.org/edu/pisa
- Pujiono, S. (2008). *Desain Penelitian Tindakan Kelas dan Teknik Pengembangan Kajian Pustaka*. Makalah dipresentasikan pada Pelatihan Menulis Karya Ilmiah untuk Guru TK Kec. Sewon Kab. Bantul Yogyakarta, Oktober 24, Yogyakarta.
- Rachmantika, A.R., Wardono. (2019). Peran Kemampuan Berpikir Kritis Siswa pada Pembelajaran Matematika dengan Pemecahan Masalah. *PRISMA*: Vol. 2, 439-443
- Prastowo, Andi. (2013). *Panduan kreatif membuat bahan ajar inovatif: Menciptakan metode pembelajaran yang menarik dan menyenangkan*. Yogyakarta: Diva Press.
- Richardo, Rino. (2016). Peran Ethnomatematika dalam Penerapan Pembelajaran Matematika pada Kurikulum 2013. *LITERASI*. Vol.2, No.2, 118-125.
- Suprihatiningrum, Jamil. (2013). *Strategi Pembelajaran*. Jogjakarta: Ar-Ruzz Media.
- Sobri, M., Nursaptini, N., & Novitasari, S. (2020). Mewujudkan Kemandirian Belajar Melalui Pembelajaran Berbasis Daring di Perguruan Tinggi pada Era Industri 4.0. *Jurnal Pendidikan Glasser*, Vol. 4 No.1, 64-71.
- Saifuddin. (2014). *Pengelolaan Pembelajaran Teoritis dan Praktis*. Yogyakarta: Deepublish.
- Suherti, E & Siti. (2017). *Pembelajaran Terpadu*. Bandung: Tidak diterbitkan.
- Wijaya, E.Y., Sudjimat, D.A., Nyoto, Amat. (2016). Transformasi Pendidikan Abad 21 Sebagai Tuntutan Pengembangan Sumber Daya Manusia di Era Global. *Prosiding Seminar Nasional Pendidikan Matematika 2016*: Vol. 1, 263-278.
- Widyanti, A., Hasudungan, S., & Park, J. (2020). E-learning readiness and perceived learning workload among students in an Indonesian university. *Knowledge Management & Elearning*, Vol 12 No.1, 18-29.

Wibowo, I. S., & Magfirotun, S. (2016). Peran guru dalam membentuk tanggung jawab peserta didik kelas V sekolah dasar. *Jurnal Gentala Pendidikan Dasar*, Vol.1 No.1, 61-72.