

## **Application of Discovery Learning Model in Mathematics Learning to Determine Students' Mathematical Communication Ability**

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### **Abstract**

This research aimed to describe the application of the discovery learning model in mathematics learning and to describe students' mathematical communication skills both orally and in writing. The approach to this research is a qualitative approach, while the type of research used is descriptive. This research was conducted with the subject of class VIII C students in the 2019/2020 school year. The data collection techniques used in this study were observation to determine students' mathematical communication skills orally and tests to determine students' written communication skills. The instruments used in this study were the observation sheet of students' communication skills and the test in the form of description questions. Based on the results obtained, it shows that the application of the discovery learning model in this study can be said to be quite good but the results are less than optimal and there are several obstacles experienced during learning activities using the discovery learning model. Meanwhile, the level of students' mathematical communication skills is quite good with a percentage of 56% for oral and 59.48% for written.

**Keywords:** Discovery Learning; students' mathematical communication

## **INTRODUCTION**

Study is a process where someone who initially didn't know to be know about a problem or problems. Study is an activity to develop yourself or behavior both in the cognitive, attitude or psychomotor aspects (Mufidah, Effendi, & Purwanti, 2013). So that by learning someone will experience development and progress in his life. Learning activities can be interpreted as an individual interaction with their environment (Pane & Dasopang, 2017). The environment in question is the objects that make individuals gain experience or knowledge (Pane & Dasopang, 2017). Learning can be carried out anywhere, one of which is at school. School is a place where a person can study where the teacher becomes a facilitator in the learning process in the classroom.

Learning is the interaction between students and teachers as well as learning resources in a learning environment (Nurdyansyah & Fahyuni, 2016). Based on this statement, there are three main elements in learning that is students, teachers and learning resources. Students and teachers must have a relationship with each other, so there needs to be cooperation between the two so that the objectives of learning can be achieved. Ideal learning places the teacher as a facilitator (companion) of students, motivates students, guides students in exploring information, becomes a learning resource, asks questions well, creates a learning atmosphere to be student-

centered (Hartono, 2013; Hunaepi, Samsuri, & Afrilyana, 2014) . Teachers must also be able to develop teaching materials and determine learning models according to classroom conditions.

The learning model is an activity carried out by the teacher in the learning process in order to improve learning achievement and achieve learning objectives. The learning model is a form of learning that is described from beginning to end and is described by the teacher in a typical manner (Helmiati, 2013). Many learning models can be selected such as Discovery Learning. Discovery Learning is a model where the teacher acts as a facilitator in learning activities, where students are guided by questions from the teacher, LKK or LKS to find knowledge they do not yet know (Mawaddah & Maryanti, 2016). On the other hand, Discovery Learning is a learning process in which students are asked to learn on their own to find a concept (Nurgazali, 2018). This learning model can be applied in groups or individually (Mawaddah & Maryanti, 2016).

Mathematical communication is a process in learning that uses mathematical language both orally and in writing in delivering information (Siregar, 2016). Through mathematical communication, teachers can find out students' abilities when interpreting and expressing understanding regarding the material being studied (Widiatmika, Suharta, & Suryawan, 2019).

The 2018 PISA shows Indonesia ranks 70 out of 77 countries with a score of 379. This shows that Indonesia's math ability can be said to be low. In addition, based on experience when participating in the apprenticeship program, researchers conducted learning activities using several models, namely Two Stay Two Stray and the Team Games Tournament. During the internship, the researcher only delivered material and ran the model according to the steps, where out of 30 students only 5% of students were active in conveying or communicating opinions or ideas. This shows that there are still many students with not optimal mathematical communication skills in expressing or communicating their opinions or ideas orally or in writing.

Based on Sari, Noer, & Bharata's (2016) research, it is shown that Discovery Learning affects mathematical communication skills and does not affect self-confidence. The results of this study are inversely proportional to the results of research conducted by Prestika, Saragih, & Yuanita (2018) showing that Discovery Learning can improve mathematical communication skills and self-confidence compared to conventional learning. In Qodariyah & Hendriana's research (2015) it shows that the mathematical communication skills of students who take learning with Discovery Learning are higher than conventional learning. On the other hand, in Nazikha's (2016) research, it was shown that the communication skills of grade VII students in learning using the Discovery Learning model reached 90.625% classical completeness.

Through the description above, the researchers took the problem about Application of the Discovery Learning Model in Mathematics Learning to Determine Students' Mathematical Communication Ability, so that the purpose of this research was to describe the implementation of learning using the Discovery Learning model and the level of students' mathematical communication skills both verbal and writing on implementation Discovery Learning Model.

## **RESEARCH METHOD**

The approach to this research is a qualitative approach while the type of research used is descriptive. This research was conducted at SMP Muhammadiyah 06 Dau with the subjects is class VIII C which means 30 students consisting of 16 female students and 14 male students. This procedure has four stages that is the planning stage which is the stage for determining the place of research and making a permit to conduct initial observations. The second stage is the preparation stage which is the drafting of the RPP. The third stage is the implementation in which this research was conducted in four meetings. In the fourth stage is the final stage leads to the analysis of data collected to be processed descriptively and described in accordance with the facts during the learning activities.

Data collection techniques used in this research were observation and test. The observation will be carried out at the 1st to 3rd meeting and these observations are used to determine the verbal communication of students' mathematical communication. The test is used to determine students' mathematical communication verbal and this test consists of 4 items that will be given to students at the 4th meeting. The research instruments used by researchers were the observation sheet and the test sheet. Data analysis of mathematical communication skills and the test consists of data that has been presented on the observation sheet and analyzed using qualitative data analysis.

## **RESULTS AND DISCUSSION**

This research was conducted at SMP Muhammadiyah 06 Dau class VIII B with a total of 30 students consisting of 14 male students and 16 female students. The research data were obtained based on the observation sheet and questions on mathematical communication skills. This research was conducted on February 24, 2020 to March 3, 2020.

### **1. Application of the Discovery Learning Model in Mathematics Learning**

Implementation of learning during the research at SMP Muhammadiyah 06 Dau was carried out in three meetings. There are several steps in applying the Discovery Learning Model including:

#### **a. Provide problems to be discussed**

At the first meeting, the problem at the first meeting were many students who talked with their friends, and some even kept going to the bathroom for fear of not being able to explain, many students were not ready. The solution is that the researcher provides directions to students so that they know what they should do next and gives a warning to several students who are busy or chatting with friends and ask students to study at home related to the material to be discussed at the next meeting.

At the second meeting, the problem was that there were still many students who had not focused during the initial learning because they were still confused about the assignments in the previous lesson. The solution given is that the researcher asks students to collect their assignment books forward and asks students to focus so that learning is completed quickly. At the third meeting, students sat in accordance with their respective groups so that learning could be carried out immediately. But there are still some students who enter late by reason of the bathroom

b. Identification of peroblems

At the first meeting, many students asked questions and were still confused about the problems in the LKPD and the solution was that the researcher explained the problems that existed in the LKPD and told students what they should look for then the researcher went around to each group giving each group the opportunity to ask questions. which they are still confused about. At the second meeting, students were not yet focused because they were still thinking about their previous lesson assignments so that students asked a lot about the problems that existed in the LKPD. Then the researcher explained the problem in the LKPD and asked students to listen to the explanation and focus because the researcher only explained it once and asked the students that in addition to the mathematics textbook, notebooks and LKPD were put in the bag. At the third meeting, many students already understood the problems that had to be resolved

c. Gather information

At this stage, many students only depend on students who they think are smart in the group so that many other students chat with their group members and their reasons are not bringing textbooks. The solution made by the researcher was that the researcher asked several students to borrow textbooks from the library so that each member of the group had resources to collect information and give warnings to busy students or chatting with friends

At the second meeting, there were several students who asked other groups for answers to the LKPD about the surface area of the blocks, which made the class conditions crowded and not conducive. Then the researcher reprimands students who take a walk to another group and threatens to give a zero score and asks students to finish the discussion as soon as possible because there will be reciting activities. At the third meeting, students began to understand the LKPD provided and students who did not bring textbooks borrowed directly from the school library. In gathering information, only a few students still asked other groups.

d. Processing data to answer problems

At the first meeting, many students thought that only group representatives were working on the LKPD. The solution made by the researcher is to provide threats where even if they do not do it, if they are appointed they must be able to explain and if they cannot, then they will be given punishment. Researchers also reprimanded students who were busy and chatting with their friends. At the second meeting, the activity was a little late because previously there was a recitation activity so to overcome this, the researcher gave about 10 minutes for the students to solve the problems at the LKPD. At the third meeting, there were still many who were not confident in their own answers, so many students asked one of the students who were considered smart in the class

e. Proving the truth of the problem identification that has been done

At the first meeting, the researcher appointed several other students to explain but they did not want to because they had not studied so they were not ready, afraid of making mistakes and afraid of being scolded. The solution is the researcher asks students to study the material that will be discussed at the next meeting. At the second meeting, the researcher immediately appointed students who were usually advanced and also pointed to busy students. At the third meeting,

many students wanted to explain the solution because they had already asked the answer to one of the students so that they became confident to explain in front.

f. Summing up the results

At the first meeting, the researcher appointed several students to conclude the results of the learning that had been done. At the second meeting, students were appointed by the researcher to explain in advance and at the same time provide conclusions obtained from the learning that had been carried out because the lesson time was almost up. At the third meeting, students who explained the immediate solution were asked to conclude the learning that had been carried out was the same as the second meeting.

2. Students' verbal mathematical communication skills

The results of the research for students' verbal mathematical communication skills were obtained from observation sheets during learning activities using the discovery learning model on the material of building space filled by two observers as well as peers. The values on the observation sheet that had been filled in by the observer were then analyzed to calculate the average student's communication skills for each indicator. The following is the analysis result of students' mathematical communication skills orally through learning with the discovery learning model as follows:

Table 1. Results of the Verbal Analysis of Students' Mathematical Communication Skills

Aspect	Indicator	Meeting		
		I	II	III
Express opinions related to the issues being discussed	Describe of solutions	35.8%	58.3%	74.2%
	Express opinions	35.8%	57.5%	79.2%
	Average per meeting	35.8%	57.9%	76.7%
	Average	56.8%		
Using terms and mentioning mathematical notation	Say math terms	37.5%	57.5%	75%
	Using mathematical notation	35%	55.8%	75.8%
	Average per meeting	36.3%	56.7%	75.4%
	Average	52.26%		
Give questions related to things that are not yet understood asking question	Asking question	38.3%	55.8%	70.8%
	Average	55%		
Overall average		56%		

Based on the table above, the results of the verbal analysis of students' mathematical communication skills can be explained as follows:

a. Describe of solutions

At the first meeting, students who explained a solution were 35.8%. The percentage of students in explaining a solution is very low. The obstacle is that many students do not explain for several reasons, namely not learning yet, fear of making mistakes, and asking that only one member explain each group. The solution is to ask students to study the next material. At the second meeting it increased to 58.3%. Many students explained that the solution was still wrong, there were some who were not right, but there were also students who explained the

solution correctly. At the third meeting the percentage of students explaining a solution increased again to 74.2%. At this meeting, most students still had to be appointed or a little coerced so that they would explain the solution.

b. Express opinions

At the first meeting, the percentage of students who expressed their opinions was 35.8%. Constraints at the first meeting of students were not yet brave or not confident in their opinions so that more students were silent, only a few students were willing to express their opinions even though they were not in accordance with the issue being discussed. At the second meeting the percentage of students in expressing their opinions was 57.5%. At this meeting there were still many things that were not true, but this had raised self-confidence and courage in expressing opinions. At the third meeting, the percentage of students in expressing their opinions was 79.2%. The obstacle was the condition of the class being crowded because almost all students wanted to express their opinions.

c. Say math terms

At the first meeting, the percentage of students who mentioned math terms was 37.5%. The obstacle is that there are still many students who do not mention the mathematical terms that are being discussed because many students are silent and only listen to the opinions of other students who are asking, explaining solutions or expressing opinions. At the second meeting, the percentage of students in mentioning mathematical terms was 57.5%. There are still many students who chat with their friends and make class conditions less conducive. At the third meeting, the percentage of students in using mathematical terms was 75%. At this meeting, the researcher appointed students to express opinions or ask questions so that students had to be ready when appointed.

d. Using mathematical notation

At the first meeting, the percentage of students using mathematical notation was 35%. Because many students are silent during the lesson, students rarely use mathematical notation so that the percentage of students who use mathematical notation is very low. At the second meeting, the percentage of students using mathematical notation was 55.8%. Researchers appoint students to express opinions or ask questions. At the third meeting, the percentage of students using mathematical notation was 75.8%. Researchers designate students and if there are students who are chatting, the researcher immediately asks the student to express their opinions or ask questions.

e. Asking question

At the first meeting, the percentage of students who asked questions was 38.3%. When students are asked to ask questions related to things that have been discussed or something that has not been understood, students just keep quiet. There are also students who do not ask directly to the teacher but through their peers. At the second meeting, the percentage of students asking questions was 55.8%. At this meeting, many students asked questions even though their questions were not in accordance with the problem being discussed. At the third meeting, the percentage of students asking questions was 70.8%. At this third meeting, many students asked about the previous material because at the next meeting there would be tests related to the material starting from the first to the third meeting. So that students who were

at the previous meeting were still confused and did not want to ask about the material, they asked at the third meeting.

### 3. Written mathematical communication skills

To determine students' written mathematical communication skills in mathematics learning using the discovery learning model at SMP Muhammadiyah 06 Dau, a test was conducted. The test is given in the form of a description with a number of questions, namely 4 items covering the surface area of the cube, the surface area of the block, the volume of the cube and the block. The test results will be analyzed to determine the level of students' mathematical communication skills in writing, both individually and as a whole. The following are the results of the written analysis of students' mathematical communication skills through the following tests.

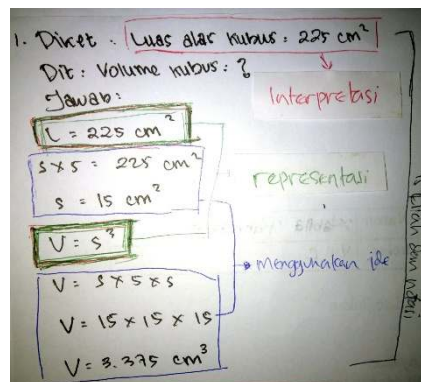
Table 2. Result of Analysis of Students' Mathematical Communication Ability in Written

Aspect	Indicator	Question Number			
		I	II	III	IV
Interpret mathematical ideas in the form of images and algebra	Interpret mathematical ideas in the form of images and algebra	67.5%	70.83%	70%	55%
	Using representations in the form of images and algebra	74.17%	77.5%	80%	48.3%
	Average of each question	70.83%	74.17%	75%	51.67%
Average		67.92%			
Explain mathematical ideas, situations and relations in writing	Use and write down ideas in solving problems	81.67%	70%	75.83%	36.67%
	Summing up the solution through writing	25%	25%	25%	25%
	Average of each question	53.33%	47.50%	50.42%	30.83%
Average		45.52%			
Use proper mathematical terms and notations	Write down solutions using proper mathematical terms and notations	78.83%	69.17%	74.17%	40.83%
	Average	65%			
Overall average		59.48%			

Based on the results of the analysis of students' mathematical communication skills in writing, it can be explained as follows:

#### a. Interpret mathematical ideas in the form of images and algebra

In question number 1, the percentage of students interpreting ideas in the form of pictures and algebra is 67.5%, in question number 2, the percentage is 70.83%, in question number 3, the percentage is 70% and in question number 4, the percentage is 55%.



**Picture 1: Students' answers to question number 1**

In the picture above, students have used and written down ideas to solve a problem appropriately, interpreted ideas only in algebraic form, used representations in expressing concepts appropriately, and used appropriate mathematical terms and notations. However, students have not concluded the results that have been found.

- b. Using representations in expressing a mathematical concept in writing

In question number 1, the percentage of students using representations in expressing a mathematical concept in writing is 74.17%, in question number 2, the percentage is 77.5%, in question number 3, the percentage is 80% and in question number 4, the percentage is namely 48.3%.

- c. Use and write down ideas in solving a problem

In question number 1, the percentage of students using and writing ideas in solving a problem is 81.67%, in question number 2, the percentage is 70%, in question number 3, the percentage is 75.83% and in question number 4, the percentage is 36.67%.

- d. Summing up the solution through writing

In questions 1, 2, 3 and 4, the percentage of students in concluding solutions through writing was 25%. All students did not conclude the solutions they had found.

- e. Write down solutions using proper mathematical terms and notations

In question number 1, the percentage of students writing solutions using appropriate mathematical terms and notations is 75.83%, in question number 2, the percentage is 69.17%, in question number 3, the percentage is 74.17% and in question number 4, the percentage is 40.83%.

Based on research that has been carried out at SMP Muhammadiyah 06 Dau, it can be concluded that the application of the discovery learning model in mathematics learning that has been carried out for three meetings is quite good even though the results are not optimal. The constraints in this study are in accordance with the research conducted by Apriandinata (2016) where the constraints on group learning are not optimal because most students still depend on one member who is considered smart and discovery learning model learning takes a long time. The same problem was experienced by Kodirun, Busnawir, & Viktor (2016) in their research, namely that most students expect answers from group leaders or other members because they are still not confident. Supriyanto (2014) also experienced several obstacles, namely during learning there were some students who were busy so that the class was not conducive, there were still many students who were



ashamed and afraid of presenting the results of their discussions, and students' oral activity was still low.

Based on the results of the above analysis, the level of oral mathematical communication skills of students at SMP Muhammadiyah 06 Dau class VIII C is quite good with a percentage of 56%. Meanwhile, the written level of students' mathematical communication skills was quite good with a percentage of 59.48%. These results are in accordance with research conducted by Halimatussadiah & Halimah (2017) which shows students' mathematical communication skills both verbally and in writing, namely 55.58% and 67.55%. The results obtained are also in accordance with the research of Heryani & Setialesmana (2017) showing that the mathematical communication abilities of students who take learning using discovery learning provide positive changes, meaning that their communication skills increase. Research conducted by Widyasmoro (2015) was in accordance with the results obtained by researchers where the level of students' mathematical communication skills verbally was 57.19% and 66.67% for students' written mathematical communication skills.

## CONCLUSION

Based on the results presented, it can be concluded that the application of discovery learning conducted at SMP Muhammadiyah 06 Dau class VIII C is quite good. In the discovery learning model step, students were formed into 5 groups and each student was given a student worksheet related to the volume and surface area of cubes and blocks. Then the researcher went around to each group and gave the opportunity to ask questions that were not understood. Then students discuss looking for information from textbooks or exchange opinions with group members. From the results of the discussion the students were asked to answer the problems in the LKPD. After that, several students were appointed to explain their answers and then the problems were discussed together. At the end of the lesson, students are asked to conclude the results that have been presented.

The students' mathematical communication skills after learning discovery learning model showed quite good with a percentage of 56% for oral and 59.48% for written. This is because students are not confident in expressing opinions or asking questions so that students do not dare to communicate during learning. However, with a little coercion it makes students have the courage to express their opinions by pointing students so that they become accustomed. Meanwhile, written mathematical communication skills make the percentage low, namely in concluding solutions through writing.

## REFERENCES

- Apriandinata, I. (2016). *Penerapan Metode Discovery Learning untuk Meningkatkan Kemampuan Pemecahan Masalah Dan Komunikasi Matematik serta Dampaknya Terhadap Kemandirian Belajar Siswa SMA*. Universitas

Pasundan.

- Halimatussadiyah, A., & Halimah, L. (2017). *Efektivitas Pembelajaran Metode Discovery Learning Terhadap Kemampuan Kounikasi Matematis*. 5(1), 35–43.
- Hartono, R. (2013). *Ragam Model Mengajar yang Mudah Diterima Murid*. Yogyakarta: DIVA Press.
- Helmiati. (2013). *Model Pembelajaran*. Yogyakarta: Aswaja Pressindo.
- Heryani, Y., & Setialesmana, D. (2017). Penggunaan Model Discovery Learning terhadap Peningkatkan Kemampuan Koneksi dan Komunikasi Matematik. *Jurnal Pendidikan Matematika*, 8, 43–52.
- Hunaepi, Samsuri, T., & Afrilyana, M. (2014). *Model Pembelajaran Langsung Teori dan Praktik*. Mataram: Duta Pustaka Ilmu.
- Kodirun, Busnawir, & Viktor, E. B. (2016). *Penerapan Model Pembelajaran Discovery Learning Berbasis Lesson Study Dalam Upaya Peningkatan Kemampuan Komunikasi Matematik Siswa Kelas X Mipa-3 Sma Negeri 5 Kendari*. 7, 93–104.
- Mawaddah, S., & Maryanti, R. (2016). Kemampuan Pemahaman Konsep Matematis Siswa SMP dalam Pembelajaran Menggunakan Model Penemuan Terbimbing (Discovery Learning). *EDU-MAT: Jurnal Pendidikan Matematika*, 4(1), 76–85. <https://doi.org/10.20527/edumat.v4i1.2292>
- Mufidah, L., Effendi, D., & Purwanti, T. T. (2013). Penerapan Model Pembelajaran Kooperatif Tipe Tps Untuk Meningkatkan Aktivitas Belajar Siswa Pada Pokok Bahasan Matriks. *Jurnal Pendidikan Matematika*, 1(1), 117–125.
- Nazikha, F. N. (2016). *Analisis Kemampuan Komunikasi Matematis Berdasarkan Self - Esteem Siswa Kelas Vii Pada Pembelajaran Matematika*. Universitas Negeri Semarang.
- Nurdyansyah, & Fahyuni, E. F. (2016). *Inovasi Model*. Sidoarjo: Nizamial Learning Center.
- Nurgazali, F. (2018). Model Discovery Learning Dalam Pembelajaran Matematika. *Model Discovery Learning Dalam Pembelajaran Biologi*, (September), 18–20.
- Pane, A., & Dasopang, M. D. (2017). Belajar Dan Pembelajaran. *FITRAH: Jurnal Kajian Ilmu-Ilmu Keislaman*, 3(2), 333. <https://doi.org/10.24952/fitrah.v3i2.945>
- Prestika, I., Saragih, S., & Yuanita, P. (2018). Self Confidence Dalam Pembelajaran. *Seminar Nasional Pendidikan Matematika FKIP UIR*, (2), 29–30.
- Qodariyah, L., & Hendriana, H. (2015). Mengembangkan Kemampuan Komunikasi Dan Disposisi Matematik Siswa Smp Melalui Discovery Learning. *Edusentris*, 2(3), 241. <https://doi.org/10.17509/edusentris.v2i3.177>

- Sari, L. K., Noer, S. H., & Bharata, H. (2016). Pengaruh Model Pembelajaran Discovery Terhadap Peningkatan Kemampuan Komunikasi Matematis Dan Self Confidence. *Jurnal Pendidikan Matematika Universitas Lampung*.
- Siregar, N. F. (2016). Pemahaman Dan Komunikasi Matematis Dalam Pembelajaran Matematika Realistik. *Jurnal Logaritma, IV(01)*, 17–36.
- Supriyanto, B. (2014). Penerapan Discovery Learning untuk Meningkatkan Hasil Belajar Siswa Kelas VI B Mata Pelajaran Matematika Pokok Bahasan Keliling dan Luas Lingkaran Di SDN Tanggul Wetan 02 Kecamatan Tanggul Kabupaten Jember. 3, 165–174.
- Widiatmika, I. M., Suharta, I. G. P., & Suryawan, I. P. P. (2019). Meningkatkan Kemampuan Komunikasi Matematis Siswa Melalui Penerapan Creative Problem Solving. *Jurnal Pendidikan Matematika Undiksha, 10(2)*, 1. <https://doi.org/10.23887/jjpm.v10i2.19905>
- Widyasmoro, K. N. (2015). Peningkatan Komunikasi Matematis Siswa Melalui Strategi Discovery Learning Pada Siswa Kelas VII A Semester Gasal SMP Pancasila 13 Paranggupito Tahun 2015/2016. Universitas Muhammadiyah Surakarta.