Discovery learning rise student’s activeness and understanding compound figure area

J Subagis
SD Negeri Wonokerto, Jl. Sukoharjo Km. 03 Kecamatan Leksono, Wonosobo

E-mail: jabalsubagis@gmail.com

Abstract. In elementary school, activeness and understanding is prime factor to learn mathematic joyfully and successfully. Both has strong relationship factor to master mathematic well. Low student interest in mathematics affect in activeness in participating in the learning process. Understanding mathematics is not easy for sixth-grade student of Lipursari elementary school due to its complexity. This is caused by improperly of instructional media and approaches with the material being studied. It is a descriptive qualitative action research. This study aims to determine the increase in student activeness and understanding using a discovery learning approach and manipulatives media. This research was conducted in class VI SD Negeri Lipursari, Leksono District, 2019/2020 academic year. The research subjects were 19 students consisting of 9 male and 10 females. First lesson was carried out using manipulative media in large groups (4 students) and second one in small groups (2-3 students). Data collection techniques using test, interview and observation. The observation sheet is used to determine the increase in activity. Meanwhile, the understanding of the combined plane area material is known through tests. The data analysis technique used a comparative descriptive method. The results showed that discovery learning can increase the activeness of the sixth-grade students of SD Negeri Lipursari in the first semester of the 2019/2020 academic year. Student's activeness rate increased from 2.57 to 3.04. Their understanding score of compound figure increased from 64.9 to 68.6. The \( r_p \) correlation coefficient shows 0.546200 in the first lesson and 0.507962 in the second lesson. Base on this study, the researcher define Discovery learning is a method that becomes a solution for teachers and students to be able to present learning that is friendly, flexible, student-oriented and able to show how to think and how to solve math problems logically and creatively. The results of the study showed that students' activity and understanding of the broad materials of the compound figure area increased using the discovery learning approach.

1. Introduction

Many students prefer to play than pay attention to teacher’s explanation in mathematics. Student dislike mathematics because of its abstractive and complexities using formulas as well[1]. Teacher often use speech and memorization method in mathematics learning. The weakness of the memorization method is the emergence of verbalism [2-3] students know to mention words, definitions, formulas and so on but they do not understand them [4-5], students have a difficulty pouring ideas [6] and they do not dare to argue according to their own understanding[7]. Mathematics learning conducted by teachers tends to seem monotonous [8-9] so that it has not been able to improve student mathematics learning outcomes instead [10]. Learning is the heart of educational activities, so
the learning process occupies a very important position and role. Student learning outcomes can be improved if students’ learning interest in the subject also increases [11].

There are many difficult materials in mathematics for elementary students. For example, two-dimensional area. Lehrer [12] define that area measurement, which involves relating numerical quantity to a geometric attribute, is an important domain of school mathematics. Moreover, constructing and applying area formulas for measuring areas is an essential goal for learning area measurement for children in elementary school. There are phenomena students’ performances of solving area measurement problems in the context of area measurement. First, they demonstrated good memorization of an area formula, but were less able to determine the areas of given configurations successfully [13]. Second, they prefer using the counting-and-addition strategy [14]. Shape identification, which represents geometric knowledge, lays the foundation for the development of area formulas of basic shapes [14]. In particular, a good understanding of area formulas requires acquisition of the basic shapes and their properties, which in turn helps thinking about the logical relationships that exist between the formulas [14].

Geometry, whose content area is shapes and objects, has an essential place in human life [15]. In science, art, architecture, engineering, in short in every element that humans created geometry makes itself evident and nested with the daily life [16]. Geometry gives students opportunity to stimulate their minds, make mind exercises and problem solving, comparing, generalizing and summarizing skills’ development. In general, geometry is a significant tool for a student to give meaning to his/her surroundings [17]. Geometry provides a natural setting for the development of their deduction, proving skills. Mathematics, particularly geometry, is a subject that students’ approach with bias. To eliminate this bias and to provide a positive attitude for geometry can only be possible with the education to be given to them [18]. Geometric thinking structure is closely related to the geometry education given in primary school era. Teacher is an important factor during learning process. The Indonesian curriculum uses geometry materials that focus on calculating the area and circumference with development up to the compound figure area. This topic is quite weighty for students and teachers to have difficulty in order to improve their understanding and application in daily life. Teachers’ should be given change to test their knowledge and to develop skills.

There is a process of transmission and transformation of learning experiences to students according to the curricula. To improve the quality of learning that is adapted to the demands of the 21st century development. Learning approach must be able to improve students to think at high levels (high order thinking skills/ HOTs). One of the learning models that can increase HOTs is discovery learning [19-21] Discovery learning focuses on the problem-solving process; students must explore various information then define their own concept. The essential point of the learning process is every student’s active and understanding a learning concept. Student-centered learning facilitates activities that lead to collaboration, project-based learning, technology integration, and discussions between students and educators about learning. To encourage student’s activeness, it is important to design instructional flows for student rather than teacher actions. Learning activities is very important contributors to student understanding.

Discovery learning is a method based on the inquiry or discovery through a systematic thought process [22]. Knowledge is not just a set of facts of the results of remembering but the results of constructing or discovering. In other words, learning is the process of discovery activities so that students acquire knowledge and skills through their own inventions [23]. The purpose of discovery learning is to help students think analytically, boldly and creatively imagine. With imagination guided by the teacher to create something using the knowledge he gained. Discovery learning has an influence on students’ mathematical concepts mastery [24]. Discovery Learning with video media significantly affects the learning outcomes of grade IV students of SDN Gemah [25].

The result showed that learning materials based guided discovery learning with Batak Toba context improved students’ mathematical problem-solving ability and self-efficacy significantly [26]. Similar result also written by [27]. They found that the result of their study shows that there is enhancement difference of student mathematical problem-solving ability taught by guided discovery learning model (GDLM) and taught by direct learning model (DLM). N-gain of student taught by GDLM is higher than student taught by DLM.
Learning research concerning with discovery learning has shown that the learners have a high ability to follow very well, while the less ability group may increase the ability itself [3]. However, the discovery learning emphasizing the extensive search through problem solving, processing of enhancing the learners’ memory has a limitation. Concerning with this matter, it may cause less learning [28]. To pay attention is a factor which is needed for innovation in learning to improve the student’s ability [3]. Discovery learning is very useful for students who have a high ability and also can enhance his/her ability for those in the medium category.

Based on the results of [29] in her study, it can be concluded that in general students who follow the learning using the model of Discovery Learning with the sunflower context showed better results in learning mathematics when compared with students who learning conventionally. This is possible because learning using the Discovery Learning model with the sunflower context provides flexibility for students to find and express answers with the use of various open issues, because in solving the problem students are required to be more active in understanding, reviewing, and transferring knowledge gained. The researcher also found that students are more active with learning discovery learning. Application of discovery learning model is effective on students’ mathematical problem solving abilities [30]. Learning goal of the research is to increase student’s activeness and understanding in compound figure areas using discovery learning approach.

2. Method
This is descriptive quantitative research. The subject of this study is grade VI students of Lipursari Elementary School in the 2019/2020 school year which consists of 19 students, 9 male and 10 females. The criteria and indicators of success of this class action research are as follows: Student activity reaches 78% or 15 out of 19 students with moderate and good categories in the learning process. Learning achievement has reached KKM which is 61 and achieved by 78% (15 out of 19 students). The technique of collecting data on the activity of students using observational intrusion.

The five aspects of activeness observed in this study are based on the theory put forward by [31], they are (1) students actively asking teachers and to group friends; (2) students actively express opinions; (3) students actively contribute to irrelevant or incorrect student responses; (4) students are active in solving problems given by teachers; and (5) students are actively and independently doing the tasks given by the teachers. The technique of collecting data on the activity of students using observational intrusion. The five aspects of activeness observed in this study are based on the theory above. Scoring criteria as follows (1) less, (2) enough, (3) good and (4) very good.

While the technique of data collection of learning achievement (understanding) material broadly builds flat combined using tests. Material understanding measuring tests are given to students in the form of pre-test and post-test. Pre-test is given before the learning model treatment is given to students while post-test is given after using discovery learning. Pre-test and post-test are based on competency achievement indicators. The results of observations of activeness and learning achievement are analysed using product moment correlation formula through the correlation coefficient value interpretation table. Pearson’s r measures the strength, direction and probability of the linear association between two interval or ratio variables [32]. Product moment correlation coefficients can be calculated using formulas:

\[ r_{XY} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{(N \sum X^2 - (\sum X)^2)(N \sum Y^2 - (\sum Y)^2)}} \]  

| Interval Coefisient | Relationship level |
|---------------------|--------------------|
| 0.800-1.000         | High               |
| 0.600-0.800         | Strong             |
| 0.400-0.600         | Enough             |
After the correlation coefficient was obtained then tested the significance using statistical t test formula with hypothesis acceptance and rejection criteria at a rate of significance of 5% (α=0.05) with a degree of freedom df = (N-2) is accepted if $t_{hitung} > t_{table}$ and $H_0$ are rejected if $t_{hitung} < t_{table}$.

3. Result and Discussion

3.1. Result

The average activity of the 5 aspects observed in first lesson was 2.57 and the second one was 3.04. And understanding of the area of the combined plane area increases from 50.6 before using discovery learning then increase to 64.9 at first lesson and 68.6 in final lesson. The correlation coefficient at the first lesson: $r_{xy} = 0.546200$ indicates sufficient correlation. While at the second lesson the correlation coefficient showed a score of $r_{xy} = 0.50796228$.

3.1.1 Discovery Learning Approach. Teacher implementing discovery learning approach to increase the activeness and understanding compound figure area. It begins with the teacher showing simple compound figure then explaining how to find the area. Next steps are teacher gives two sheets of paper containing compound figure. Teacher asks students to find areas in their own way. Students use the material that has been prepared. Students work individually. At end of this session, teacher have student to explain and argue their way to answer the problem. The teacher facilitated brainstorming among them. Mathematics tends to abstract, so mathematics must be concretized using real objects. During teaching of mathematics, the concrete or real materials will help the increase of the students’ success. Math activities that supported with concrete materials will increase the student attention and understanding. Learning activities using discovery learning shown as follows:

![Image of discovery learning approach](image)

**Figure 1.** Discovery learning approach engages student’s activeness effectively.

At the next lesson, the teacher changed the way of learning, students work in pairs and the teacher gave papers that had been attached to various 2-dimensional figure (triangle, rectangular,
parallelogram, etc.). Teacher have students to combine them into compound shapes creatively and independently.

Teachers guide students to solve their own math cases (compound figure areas). Students are given the opportunity to make assumptions, predict how to solve math problems, the advantages are discussions and differences of opinion on solving math problems. This means that the question of mathematics is open to several options or ways of working but logically sequenced and correct. The creativity of students is aroused and triggered naturally. And even they do not feel compelled to solve math problems in their own way.

In guided discovery learning, the students will be involved actively in experience and reflect the experience. The students learn by building experience based on what they have known and through guidance in the learning process, the students have many ways in learning and the students learn through social interaction with others and the students learn through guidance and experience which is suitable to their cognitive development [27].

![Figure 2. Student enthusiast to involve in second lesson.](image)

### 3.2. Discussion

#### 3.2.1. Student's activity and understanding in learning compound figure area(s).

Discovery learning used by teacher makes students more active in learning. Students are able to discover their own concepts of what they learn during experiments. In addition, with the media to experiment, it can build students' motivation to follow the learning well and explore knowledge, mathematical reasoning naturally.

In the manual of the preparation of the curriculum at the level of elementary school education unit is listed the purpose of the mathematics curriculum, namely first, understand the concept of mathematics and apply the concept in a flexible, accurate, efficient and precise in problem solving [33]. The results of the research that has been carried out show the development of students who are able to understand the concept of mathematics that has been considered difficult by students. Another achievement obtained in this learning is that students are able to create and use reasoning and manipulate mathematics. Even students can explain the idea of solving the math problem. The learning process is meaningful and involves the hands-on activity and other senses. Students are able to explain the process of solving math problems using their own language. Students' ability in accordance with
the objectives of the mathematics curriculum is that students must be able to understand problems, complete models and interpret the solutions obtained.

![Student creates compound figure by themselves.](image)

Figure 3. Student creates compound figure by themselves.

The figure above shows the creativity of students making compound figures. It is consisting of two or three shapes. Based on the image, no limitation compound figure may be formed. This is what researchers mean as turning conventional learning that begins with assignment into discovery ones. The results of interviews show that they are happy with the learning activities carried out. They are more relaxed, active and increase according to their level of understanding and problem-solving capabilities. They learning while playing. In fact, the student’s activeness in learning reaches 100%. None of the students passively, waited and stayed silent. All of them actively make compound figure according to their own will. Freedom and activeness in learning are fulfilled through discovery learning. The active learning provides more opportunities to learn beyond the classroom teaching. Effectiveness of these activities is assessed through academic performance [34].

The research using colored paper. Paper functions as a medium. Media is communication tools. Media is used as an intermediary, among the source of messages with the recipient of the message. This medium is used to clarify the message so as not to be too verbalistic, arouse the passion of learning, allow students to learn independently and provide stimuli, experiences and perceptions [35].

The colored paper differences of the compound figure help them identify the original shape, the formula to be used and the way it works. Learning is usually done by most teachers, build the existing combination is already formed and only one color. For students with weak geometry skills and poor identification abilities, building a combination becomes complicated and weakens their motivation. Conditions will be very different when students know the origin of the combined build. Not only because students remember the shapes and formulas, but also the creative aspects of students to identify and manipulate the combined build into a way of solving math problems. This result congruent to Yunianto’s research [36]. He recorded students’ activities in working with the applet. Students were enthusiastic to try when they could not solve the problems. After the session with the applet, students worked on similar problems on paper. They successfully dealt with the problems. It reveals that students prefer to use the applet because they can easily try again when they fail. It shows that students could understand how to measure areas of irregular figures. Based on the previous research we can say that media also serves to clarify and accelerate the delivery of materials, as well as make learning more communicative and productive. However important the media is but the role of the media will not be seen if its use is not in line with the learning objectives formulated. The media also cannot shift the role of teachers because the media is only a tool that facilitates teachers.

3.2.2. Discovery Learning in mathematics. Through well-planned and quality learning, this learning method has significant advantages. The following aspects are: First, the activeness and mobility of students in learning increases and stimulates the interest in learning. Students' explosiveness in
learning is triggered automatically even without the student's own awareness. This has the effect that they want to exploit the ability to solve problems creatively. Second, learning is able to trigger the willingness and ability of students to work together. When they find a way to solve every math problem, students need analysis. The analysis includes the form of a compound figure, then separate it into two or three shapes. Students will use the easiest and fastest way according to the student's understanding to achieve the result. It all depends on the ability and understanding to solve math problems. Constructing student’s problem-solving ability is not easy, but it has to. Knowledge, experiment, curiosity and motivation to learn and solving mathematic problem are the keys. White conclude that the process of meaning construction involves connected knowledge, and a student’s ability with mathematics is plastic and not fixed, and depends upon the experiences and stimulus to the brain [37].

![Figure 4. Various way solving compound figure area.](image)

Based on figure above, we can see various student’s way to solve the compound figure area. Students geometric thinking framework built well. Although some students need assistance, but overall, they could rise understanding and logical thinking as well. The way students think logically according to their level of understanding is a very significant progress of the learning process. Students' perseverance and confidence to solve their math problems is awakened naturally.

In solving math problems, communication, collaboration and cooperation between students are very important. As we understand, in the real world, none of the aspects of life are free from cooperation with others. Therefore, training and developing interpersonal skills and cooperation is part of the main purpose of education in the 21st century. Although this learning process using discovery learning is not perfect and there are limitations but it can provide significant differences and changes in the system and learning process.

4. Conclusion
Mathematics that is considered complicated and difficult by students becomes easy, flexible and fun based on the learning that has been done by researchers. Discovery learning becomes a gateway for students to start becoming math companions. No more poor performance in solving math problems. According to the theory of constructivism, the most important thing is the learning process, students should get emphasis [38]. They should actively develop their knowledge, not teachers or others. Students' creativity and activeness will help them to stand on their own in the cognitive life of the student. With the experience being a cognitive stimulus, there will be accommodation in the student's mind. Teachers must provide a learning experience that allows students to process. Teachers also play a role in providing activities that stimulate students' curiosity and help them express ideas and communicate their scientific ideas. Students should be able to visualize their mathematical understanding [39] then pouring ideas, communicating and solving problems.
Discovery learning is a method that becomes a solution for teachers and students to be able to present learning that is friendly, flexible, student-oriented and able to show how to think and how to solve math problems logically and creatively. The results of the study showed that students' activity and understanding of the broad materials of the compound figure area increased using the discovery learning approach.

5. References
   [1] Shofulrah M 2016 J. BK UNESA 6 2 1–10
   [2] Elita M 2018 Layakkah Metode Menghafal dalam Pembelajaran? (Jawa Tengah: Jateng Pos) Retrieved from http://jatengpos.co.id/layakkah-metode-menghafal-dalam-pembelajaran-2/ accessed May 24, 2021.
   [3] Alex A M and Olubusuyi M F 2013 J. of Educ. and Practice 4 82-90
   [4] Browning C Edson A J, Kimani P M and Aslan-Tutak F 2014 Math. Enthus. 11 2 333–383
   [5] Gazali R Y 2016 Jurnal Pendidikan Matematika 2 181-90
   [6] Battista M T and Clements D H 2020 Math. Teach. 88 48–54
   [7] Heryadi D 2017 Menumbuhkan J. Pendidik. dan Kebud. 1 317
   [8] Trinova Z 2012 Hakikat belajar dan bermain menyenangkan bagi peserta didik Al-Ta Lim Jurnal 19 209-15
   [9] Daconceicao A P, Amsikan S and Nahak S 2019 MATH-EDU: Jurnal Ilmu Pendidikan Matematika 4 3 73-80
   [10] Surya Y F 2017 Jurnal Cendekia: Jurnal Pendidikan Matematika 1 38-53
   [11] Setiawaty S, Fatni N, Rahmi A, Unaida R, Hadiya I, Muhammad I and Sari R P 2018 Proc. of MICoMS (Emerald Publishing Limited) pp 575–81
   [12] Lehrer R 1998 Developing Understanding of Geometry and Space in the Primary Grades pp 169–200
   [13] Backhouse J K and Pirie S E B 2021 J. Educ. Stud. 32 3 280–82
   [14] Daro P, Mosher F and Corcoran T 2011 Learning trajectories in mathematics: a foundation for standards, curriculum, assessment, and instruction CPRE Research Report p 86
   [15] Yeni E M 2011 Utilization of manipulative objects to improve understanding of geometry concepts and observation ability of class V elementary school students Ed. Khusus 1 63–75
   [16] Van de Walle J A 2013 Elementary and Middle School Mathematics: Teaching Developmentally. Eighth edition (Boston: Pearson)
   [17] W. Is, “Pssm,” J. Equine Vet. Sci., vol. 18, no. 11, p. 719, 1998, doi: 10.1016/s0737-0806(98)80482-6.
   [18] Pusey E L 2003 The van hiele model of reasoning in geometry: a literature review Unpublished Master Theses (North Carolina: North Carolina State University) p 87
   [19] Indah P 2020 Int. J. Chem. Educ. Res. 3 3
   [20] Hidayati N E 2020 Penerapan Discovery Learning Berorientasi Hots Sebagai Upaya Peningkatan Keterampilan Berfikir Kritis Pada Peserta Didik Kelas 7c Smpn 1 Mataram Tahun Pelajaran 2019/2020 Jurnal Ilmiah IKIP Mataram 7 1 100-9
   [21] Suryamiati W, Kahar A P and Setiadi A E 2019 J. Pendidik. Biologi Indonesia 5 2 245–52
   [22] Kemidikbud 2015 Modul Manajemen Implementasi Kurikulum 2013 (Indonesia: Kemidikbud)
   [23] Afduillah N 2013 J. Chem. Inf. Model. 53 9 1689–99
   [24] Sihombing H, Sinaba B and Mukhtar 2017 The effect of discovery learning model to students’ mathematical concept mastery IOSR J. Res. Method Educ. 7 5 18–23
   [25] Puspitasari Y and Nurhayati S 2019 Pengaruh model pembelajaran discovery learning terhadap hasil belajar siswa J. Pendidik. dan Kewirausahaan 7 1 93–108
   [26] Simanora R E, Saragih S and Hasratuddin H 2018 Improving students’ mathematical problem solving ability and self-efficacy through guided discovery learning in local culture context Int. Electron. J. Math. Educ. 14 1 61–72
   [27] Simonjuntak D, Napitupulu E, Manullang M, Manalu R and Sinambela L 2018 The enhancement difference of student mathematical problem solving ability between guided discovery learning model and direct learning model J. Educ. Res. 6 12 1688–92
[28] Rittle-Johnson B 2006 Child Dev. 77 1 1–15
[29] Putriani D and Rahayu C 2018 Int. J. Trends Math. Educ. Res. 1 22
[30] Herdiana Y, Wahyudin and Sispiyati R 2017 Effectiveness of discovery learning model on mathematical problem solving AIP Conf. Proc. vol 1868 pp 125–39
[31] Syah D 2009 Strategi Belajar Mengajar (Jakarta: Diadit Media)
[32] Chee J D and Queen T 2018 , “Pearson's Product-Moment Correlation: Sample Analysis (University of Hawaii at Mānoa School of Nursing)
[33] BSNP 2008 Pedoman Penyusunan Kurikulum Tingkat Satuan Pendidikan Jenjang Sekolah Dasar (Jakarta: Departemen Pendidikan Nasional) p. 44
[34] Patil U, Budhal S V, Siddamal S V and Mudena U K 2016 J. Eng. Educ. Transform
[35] Rudi C R and Susilana 2009 Media Pembelajaran, Hakikat, Pengembangan, Pemanfaatan dan Penilaian (Bandung: CV Wacana Prima)
[36] Yunianto W 2015 Southeast Asian Math. Educ. J. 5 1 73–82
[37] White A L 2012 Southeast Asian Math. Educ. J. 2 1 75–87
[38] Rosalin E 2008 Gagasan Merancang Pembelajaran Kontekstual (Bandung: PT Karsa Mandiri Persada)
[39] Laksono K and Retnaningdyah P 2017 Strategi Literasi dalam Pembelajaran (Jakarta: Kementerian Pendidikan dan Kebudayaan)