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# APPLICATION OF THE DISCOVERY LEARNING MODEL WITH PROCESS DIFFERENTIATION TO IMPROVE JUNIOR HIGH SCHOOL STUDENTS' MATHEMATICS LEARNING OUTCOMES

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***ABSTRACT***

The aim of this research was to improve mathematics learning outcomes of class VIII A students at SMPN 14 Denpasar through the application of discovery learning with process differentiation. This type of research was classroom action research with two cycles. The research subjects were 42 students. Student's mathematics learning outcomes data were obtained using mathematics learning outcomes tests. The collected data was analysed descriptively. The results showed that the percentage of students with mathematics learning outcomes in the complete category increased in each cycle. The success criteria were that the average student mathematics learning outcome score in each cycle increased, where the average student mathematics learning outcome was at least 80 and student's classical learning completeness was at least 75%. Subsequently, the improvement results from each cycle could be said optimal. It could be conluded that the application of the discovery learning model with process differentiation could improve junior high school students' mathematics learning outcomes.

**Keywords:** Discovery Learning, Process Differentiation, Mathematics Learning Outcomes

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## PRELIMINARY

Currently, learning that is being intensively implemented is student-centred learning, where in this learning, students are provided with the chance and resources to construct their own understanding, enabling them to attain profound knowledge. Through learning activities that provide students the opportunity to experience their own learning, it will guide them toward meaningful learning activities (Naibaho, 2021). Through this method, students will learn in a fun way and can maximise learning outcomes, especially in mathematics learning. Learning outcome can be deciphered as the most extreme comes about accomplished by a understudy after encountering the learning handle in considering certain subjects (Widana & Umam, 2023). Students who have a strong tendency due to their interest and enthusiasm for mathematics will become resilient, persistent, responsible individuals with high

achievements, and will help them reach their best outcomes (Safitri et al., 2020). So in this context, students will feel real benefits in studying mathematics.

Mathematics is a logical science regarding shapes, arrangements, concepts, sizes, and large quantities so that mathematics emphasises reasoning (Eka, 2020). Mathematics is also an important subject in human life because mathematics is a foundation and tool for understanding and developing science and technology. Apart from that, the process of studying mathematics will help sharpen students' sharpness in thinking critically and using logic (Mucholladum, 2022). However, in reality, mathematics learning is still considered difficult to understand because apart from being abstract and tends to be less interesting, students also find it difficult to understand the material so they cannot construct their understanding (Sumandya et al., 2023). In this case, the learning environment is very influential for students. Ki Hadjar Dewantara once revealed that the learning environment can be divided into three, namely the family, school and community environments (Pakaya & Hakeu, 2023). These three environments will later be called the three educational centres. Learning experiences obtained from learning environmental conditions will give rise to various variations so that derived from the impact of the educational setting, it is very possible in one class to have very diverse student characteristics (Widana et al., 2023).

Character is a factor that is related to characters and habits that are relatively fixed. According to Pratiwi (2021), student characteristics are the overall behaviour and abilities of students as a result of their nature and social environment, thus determining activity patterns in achieving their goals. From this understanding, information on student characteristics is necessary for teachers will can adapt it to learning planning so that the learning process will run effectively. Comprehending the traits of students plays a crucial role in shaping the learning outcomes they will achieve. The occurrence of obstacles in student learning outcomes due to a lack of emphasis on student characteristics, does not only occur in senior high schools, but also occurs in junior high school.

SMP Negeri 14 Denpasar is a school that faces problems with learning outcomes because the mathematics learning process is not appropriate, especially in class VIII A. The results of the researcher's interviews with several students revealed that although some students understood the subject content being discussed in class, when in home, students forgot the material. So that when the summative assessment was administered at the final’s semester, the results that they achieve were not optimal. This can be seen from the score data from the two previous tests given by the mathematics teacher, where for class VIII A the average score was 58.93 and 48. So from this data it can be said that student learning

outcomes are still relatively low because they are still below the standar score. The mathematics teacher has established a benchmark score of 80. Apart from these problems, on the other hand, students prefer flexible learning compared to learning that focuses on explaining the material alone. Various ways of learning, such as conducting investigations and the like, are also of interest to most students so that they do not make learning monotonous. Given this, educators are constantly urged to innovate in teaching methods to accommodate the conditions and traits of their students.

Innovation will later become a major driver of quality change for students and schools. Innovation in this case focuses on the efficiency of the learning process, tailored to the materials, conditions and characteristics of the students. Learning that has process efficiency will yield superior outcomes in terms of mathematics learning processes and outcomes. One innovation that can be carried out by teachers given the conditions of the material to be studied, In other words, it is the Pythagorean theorem, and by implementing a discovery learning model with process differentiation, it can accommodate the characteristics of the students.

Discovery learning is a strategy that gives students the opportunity to explore their own knowledge and take an active role in their learning so that they can fully understand concepts and develop critical thinking skills (Umayah, 2019). According to Lestari & Yudhanegara (2018), the discovery learning model is crafted to enable students to uncover concepts and principles through their own cognitive processes. According to Yuliana (2018), discovery learning is a education process where is not given in its entirety but rather involves students in organising, developing knowledge and skills for problem solving. Based on this explanation, through this model students will be actively encouraged to search, explore, and discover concepts so that they are able to develop their knowledge through investigation. Apart from that, the discovery learning model also focuses on discovering concepts and principles that were previously unknown to students (Sari, 2021). The importance of concept discovery in this model is not to focus on the form of the concept itself, but rather on how the concept is understood by students (Rasyid, 2022). Meanwhile, differentiated learning according to Faiz et al., (2022) is a teacher's endeavor to accommodate the variety of students in the classroom, considering their readiness to learn, interests, and individual profiles. According to Atikah et al., (2024), differentiated learning is an instructional approach aiming to tailor the classroom learning experience to accommodate the unique learning styles of each individual. In this case, what will be emphasised so that it can be combined with the essence of the discovery learning model lies in the differentiation of processes. Process

differentiation pertains to the type of processes students engage in during the learning process. Therefore, the student's investigation process will be adjusted to the student's learning style so this ensures that the learning process is not only more effective and meaningful but also results in the retention of acquired knowledge in long-term memory (Purnadewi & Widana, 2023).

By providing this action, knowledge will be placed in students' long-term memory so that it can be a solution to the main problems experienced by class VIII A students at SMP Negeri 14 Denpasar. The main problem is that students still place their knowledge in short-term memory, where even though some students understand the subject content under discussion in the classroom, when they are at house, students will forget the material. This results in low student mathematics learning outcomes. The low results of student mathematics learning can be seen from the score's average from summative assessment results at the end of the odd and even semesters in the mathematics subject, which is still below the score set by the mathematics teacher, namely 80. The following is a recap of the results of the end-of-semester summative assessment results for class VII mathematics at SMPN 14 Denpasar.

**Table 1. Mathematics Summative Assessment Results**

| Aspect | Semester | |
|---|---|---|
| | **Odd** | **Even** |
| Number of Students | 40 students | 42 students |
| Succeeding Students | 5 students (12,5%) | 7 students (16,67%) |
| Failing Students | 35 students (87,5%) | 35 students (83,33%) |
| Highest Score | 100 | 100 |
| Lowest Score | 10 | 25 |
| Total Score | 1.920 | 2.475 |
| Average | 48 | 58,93 |

Regarding implementing the discovery learning model with process differentiation to improve student mathematics learning outcomes, there is several relevant research as follows. Ermawati et al., (2023) pointed out that implementing the discovery learning model has the potential to enhance student learning outcomes. This was because when the discovery learning model was implemented, learning became more active because the model chosen was appropriate to the material and able to attract students' attention. Then, Yuvita (2021) found out that the implementation of discovery learning could enhance the learning outcomes and activeness of students in class V SDK Maumere 2. This was because students learnt to think critically with the problems posed by the discovery learning model. Learning focused on experiments so that later students could apply critical thinking skills, thus outcomes improved. Lukitawanti et al., (2023) showed that learning using the discovery

learning model integrated with differentiated learning succeeded in maximising the problem solving ability of class X students at SMAN 8 Malang on Vector material. This could be seen from the implementation of learning in cycles I to III. When viewed from the achievement of learning objectives, students who were analysed as a whole and also each indicator for each cycle also experienced an increase. Meanwhile, Wedekaningsih et al., (2019) showed that the implementation of the discovery learning was successful to enhance critical thinking skills and student learning outcomes in mathematics lesson content through the steps. This was because the researcher had taken action in the last cycle, namely providing contextual problems, conditioning the class to be more conducive, and in guiding group investigations, the researcher made students more participative in presenting the product results of their work.

Based on this presentation, the researcher hypothesizes that utilizing the discovery learning model with process differentiation could lead to enhancements in mathematics learning outcomes for students. Because this research focuses on students discovering mathematical concepts on their own, where students utilize their own learning styles to seek out the necessary information, and then in group discussions, the knowledge they have acquired is combined with knowledge from other students with different learning styles, thereby achieving an accurate understanding of mathematical concepts.

## METHODS

This classroom action research was conducted at SMP Negeri 14 Denpasar with all students in class VIII A as the subjects during the second semester of the 2023/2024 academic year, totaling 42 students, consisting of 18 boys and 24 girls. The object studied is related to the application of the Discovery Learning Model with Process Differentiation to improving student mathematics learning outcomes in class VIII A. This research is divided into two activities, namely initial reflection and research implementation. The model for this research procedure is the model by Kemmis & Mc Taggart (Triandi et al., 2020), where the research is carried out in two cycles. Each cycle includes four stages, namely action planning, action implementation, observation, as well as reflection. The design for implementing this research is as follows.

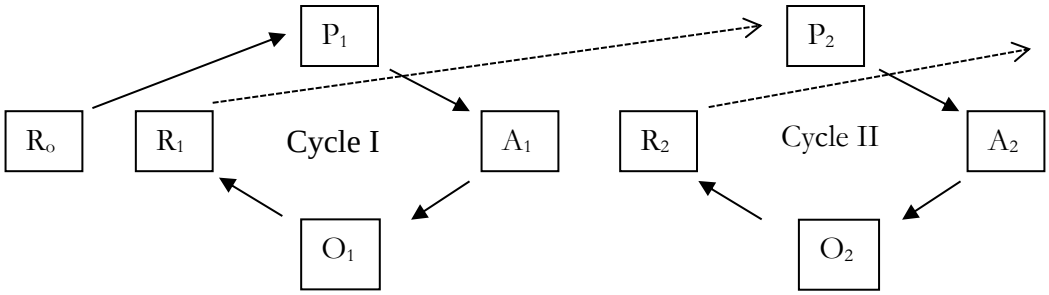


**Figure 1. Research Implementation Design**

Note:

$R_0$ = Initial Reflections

$P_i$ = Action Planning in Cycle I

$A_i$ = Implementation of Actions in Cycle I

$O_i$ = Observation in Cycle I

$R_i$ = Cycle Reflection in Cycle I

The initial reflection activities in this research consisted of classroom observations and interviews with the mathematics teacher and several students in class VIII A. During initial observations, learning was a little active because it was seen that only a few students were able to respond to questions from the teacher. And only these students asked questions during the studying process. So it could be view that the level of material absorption by most students was still not optimal. Apart from initial observation activities, in interviews attended by several students, information could be found that when in class, students said they understood the content being taught, but when they came house from school and when they got house, these students would immediately forget the material discussed at school.

From this identification process, the researchers and mathematics teachers collaborate to provide action on the studying process in the classroom. The action given is implementing a learning model that can overcome students' difficulties in the learning process and can enhance the mathematics learning outcomes of students. So that the appropriate learning model is used to improve the mathematics learning outcomes of class VIII A students, namely by applying the discovery learning model with process differentiation. The flowchart below depicts the stages involved in every cycle of classroom action research.

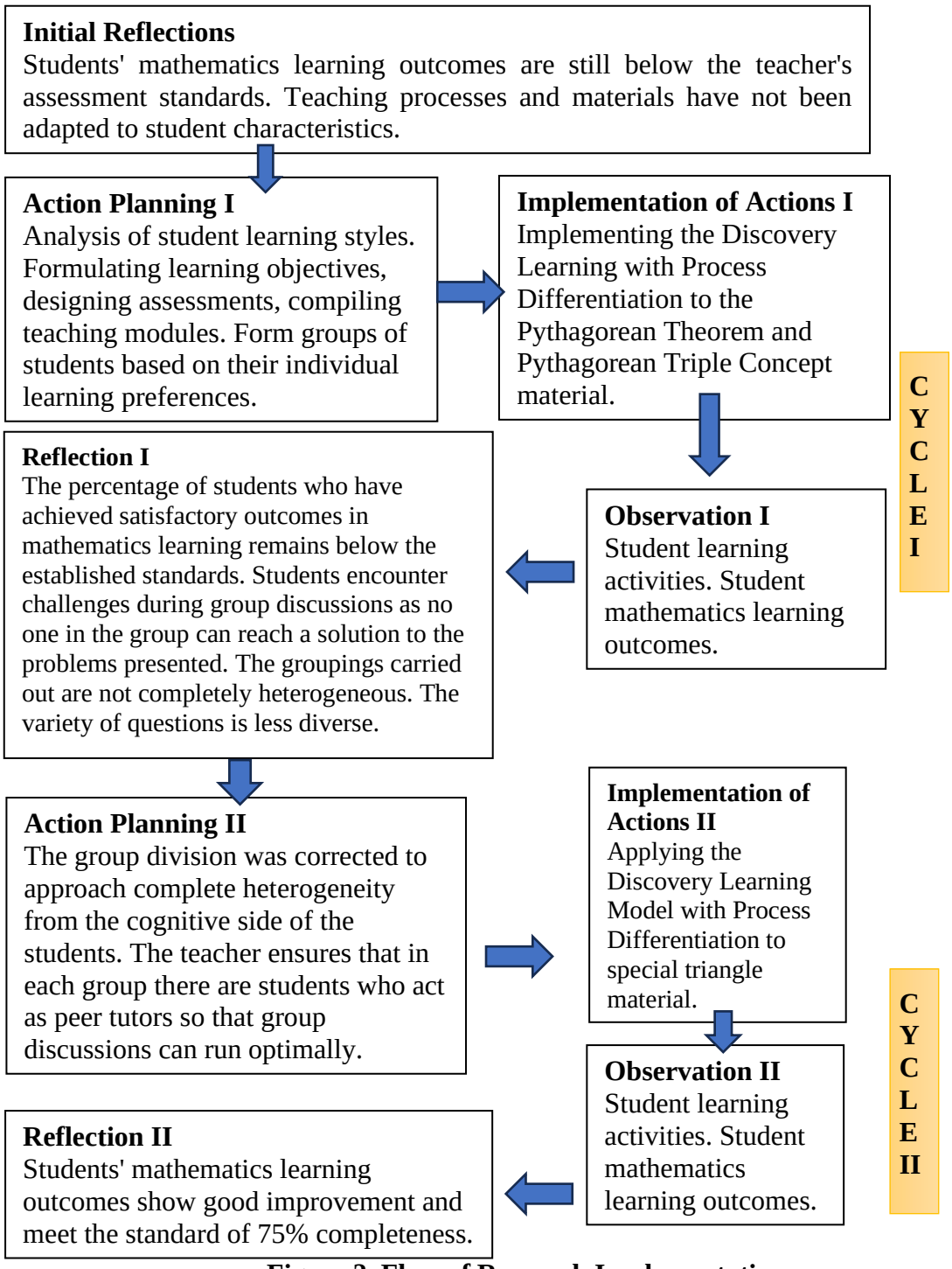


**Figure 2. Flow of Research Implementation**

The data for the research were gathered through a combination of observation and testing methods. These data were acquired through a learning observation process that applied the discovery learning model with process differentiation and test evaluation results at the final of each cycle's learning. The instruments utilized included observation sheets, interviews, and tests assessing student learning outcomes. For test instruments, student learning outcomes were prepared based on previously formulated learning objectives. The following is a calculation of student mathematics learning outcomes.

$$\text{Mathematics learning outcome scores} = \frac{\text{total score}}{\text{total maximum score}} \times 100$$

Note:

Total score : the total score obtained by the students

Total maximum score : maximum score for all questions

Data on students' mathematics learning outcomes were analysed using the formula for the average value of students' overall mathematics learning outcomes.

$$\bar{M} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Note:

$\bar{M}$ = the mathematics learning outcome's average value for all students

$x_i$ = mathematics learning outcome's student scores

n = the total number of students

The data obtained was then qualified based on the standard score determined by the mathematics subject teacher for class VIII A of SMP Negeri 14 Denpasar, namely 80. The following are the completeness of mathematics learning outcomes category.

**Table 2. Completeness of Mathematics Learning Outcomes Category**

| Mathematics Learning Outcomes | Category |
|---|---|
| $80 \leq \bar{M} \leq 100$ | Pass |
| $0 \leq \bar{M} < 80$ | Fail |

The research is considered successful if the mathematics learning outcome average score can at least reach or exceed 80 and in each cycle it increases. This research not only looks at the average mathematics learning outcome scores, but also learning completeness (KB) which uses the standard score of 80 as a reference in determining learning completeness so that it can be formulated as follows.

$$KB = \frac{\text{Number of students who get the standard scores} \geq 80}{\text{the total number of students}} \times 100\%$$

In each cycle, The enhancement in outcomes of students' mathematics learning from the initial assessment to cycle I and cycle I to cycle II is determined. Students' mathematics learning outcomes are said to have increased if learning completeness from first cycle to second cycle shows an increase.

The discovery learning model implementation with process differentiation is said to be successful if it meets the following two success criteria. (1) There is a rise in the average score of students' mathematics learning outcomes with each cycle and the minimum is in the complete category, where the complete category means the average student's mathematics

learning results reach a minimum of 80. (2) Minimum classical learning completeness of students reaches 75% of the total number of students in class VIII A so that the number of students who must be in the complete category at the final cycle reaches a minimum of 32 students.

## RESULT AND DISCUSSION

The research began by carrying out initial reflection activities with the aim of analysing problems with student learning outcomes in mathematics subjects. Based on the initial reflection activities, it was observed that the students' mathematics learning outcomes remained below the standard score set by the mathematics teacher, which is 80. There were 32 students out of 42 students or 76.19% of students in class VIII A who were categorised as incomplete in achieving the standard score. Through observations, it was noted that the learning process did not align with the characteristics of the students, which was the primary factor contributing to the suboptimal nature of the learning process, it would greatly affect students' mathematics learning outcomes. Apart from that, it was also seen that during the implementation of the learning process in class, there were several students who showed active learning, although it was still not evenly distributed among all students. There were also students who were always active in class when responding to the teacher's questions or asking questions. When a mathematics test was held, the results these students got were less than satisfactory. All of these findings served as guidelines for devising the learning plan in First Cycle.

Implementation of first cycle began with preparing a plan based on the problem findings. The planning stage began with an analysis of Learning Achievements (CP) on the Phyragoras Theorem material. The findings of the CP analysis were subsequently distilled into Learning Objectives (TP) that students must attain in the Pythagorean Theorem material. Apart from CP analysis, cycle I also carried out an analysis of student characteristics which focused on student learning styles. Learning style analysis was conducted by administering a learning style questionnaire to map students according to their preferred learning styles. The results of mapping each student's learning style was used as a guide for forming student discussion groups when the learning process began. In order to gauge students' attainment of mathematics learning outcomes, the researcher devised learning assessments including tests and observation sheets. Designing an assessment at the beginning of the activity aimed to provide an overview in later arranging the flow of learning activities. Apart from that, designing this assessment also helped provide a clear picture of the learning objectives that

students must achieve. After determining the learning objectives and assessment, the final step was to arrange the steps of the learning process and make them suit each student's learning style. The steps in the learning process were created so that learning shifted to a student-centered approach, allowing students the freedom to construct their own understanding. Following the completion of planning, the next stage involved implementing learning activities in First Cycle.

The Implementation phase of first cycle was held on Tuesday, 31 October 2023 and Wednesday, 1 November 2023. In the implementation phase, the mathematics learning process regarding the Pythagorean Theorem material was carried out. The Pythagorean Theorem sub-material in cycle I was the Pythagorean Concept and Pythagorean Triples, where each of these sub-materials was conducted within a single session. During classroom learning sessions, the researcher assumed the role of a teacher, aided by one observer, to conduct observations and document student activities throughout the learning process utilizing the discovery learning model with process differentiation. During the initial learning session, it was observed that all students were still unable to actively engage in the learning process because all students were still focused on discussions in each group regarding Student Worksheets. When working on the Student Worksheets, each group of students was asked to carry out an investigation related to the sub-material being discussed based on the guidelines provided on the Student Worksheets. In this case, the differentiation of processes carried out by students based on learning styles was focused on searching for different materials and investigations. There were several students who investigated by looking for material in various sources, books, learning videos, articles on the internet, and there were also students who carried out direct practice to investigate the Pythagorean theorem by making squares of various sizes and then pairing them together so that they could find and construct an understanding related to the concept about Pythagoras and Pythagorean Triples. As time went by, there were several students who interacted with the teacher regarding clarification of the investigative activities they had carried out. Apart from that, there were also complaints about the school's internet connection not being strong enough to find teaching resources. So the teacher turned on a personal hotspot to overcome this problem. At the second meeting, the interaction between the teacher and students increased. This showed that students began to familiarise themselves with the learning process that was being followed. The discussion was quite progressing even though there were still several groups who were still hampered in working on the Student Worksheets. At the conclusion

of First Cycle, students were administered a Mathematics Learning Outcomes Test I and participated in interviews regarding the learning process they had directly experienced.

In first cycle, there were 23 out of 42 students in class VIII A who reached the complete category based on the mathematics learning outcomes test I, so the calculated percentage of those who had completed was 54.76%. Based on this data, it could be viewed that there had been a fairly good enhance in mathematics learning outcomes from the initial reflection to cycle I. This improvement was driven by the development of Student Worksheets which served as the foundation for conducting investigations, aiding students in building and constructing their own understanding. Additionally, students were assisted in searching for materials on the internet tailored to their preferred learning styles. Consequently, students had the opportunity to reinforce the understanding they had constructed through discussions with the teacher, thereby solidifying this understanding in their long-term memory. The following is the learning outcome of one student in cycle I.

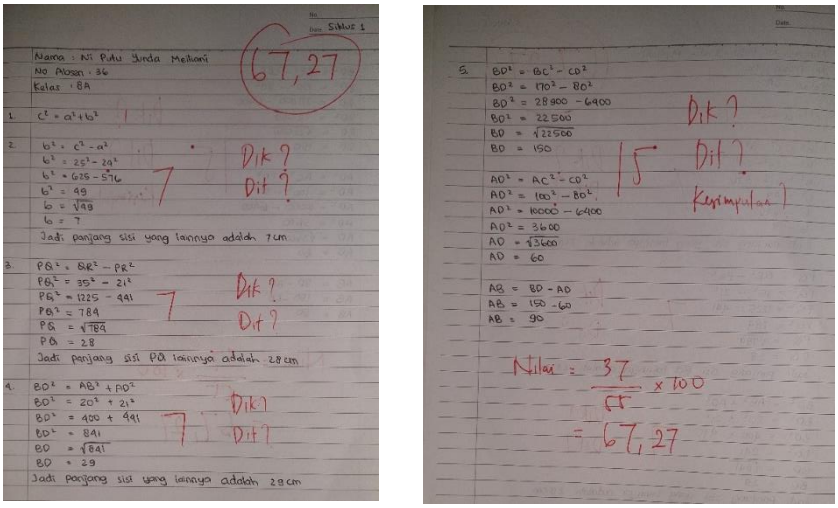


**Figure 3. The learning outcome of one student in cycle I**

Even though students' mathematics learning outcomes had increased, in terms of percentage, student learning outcomes still fell short of the predefined criterion for classical completeness, namely 75%. The absence of classical completeness in Cycle I was influenced by the group formation not being entirely heterogeneous from a cognitive perspective among students. This resulted in obstacles related to discussions in student groups because no one was able to find ideas for solving problems provided on the Student Worksheets. Derived from the outcomes of the interviews, input was obtained from students who wanted to learn to work on various practice questions, because students wanted to familiarise themselves with the existing question models. It was quite easy for them to understand the material discussed, but sometimes there were still obstacles in applying their understanding in solving the problems given. Based on these findings, it was evident that improvements were

necessary to address the issues encountered during Cycle I, thus prompting the continuation of the research into Cycle II.

The implementation of second cycle began with planning for second cycle was informed by the reflection outcomes from first cycle . The formed groups in cycle II was revised so that it would be heterogeneous from a student's cognitive perspective. Furthermore, to maximise the sharing process, one representative from each group was appointed to act as a peer tutor. Peer tutors in each group had an important role in leading the discussion so that the discussion would be well directed. Apart from that, peer tutors also had a role as a liaison between the teacher and the group when all group members experienced obstacles in carrying out investigations and discussions so that the learning process would be more focused and had clear objectives. This method saved time for group discussions so that each group would have enough time to construct their understanding, especially during group presentations.

The implementation phase of Cycle II was held on Wednesday, 8 November 2023 and Tuesday, 14 November 2023. The learning process carried out in cycle II discussed the Pythagorean Theorem with sub-material about Special Triangles (triangles with angles $45^o$ – $45^o$ – $90^o$ and $30^o$ – $60^o$ – $90^o$) where each sub-material was held in single session. During classroom instruction, the researcher assumed the role of a teacher, supported by one observer, to conduct observations and document student activities throughout the learning process employing the discovery learning model with process differentiation. The studying process in cycle II looked better in implementation compared to cycle I. By having peer tutors in each group, it was possible to facilitate group members to be able to carry out discussions well. Apart from that, the time remaining after investigations and group discussions was used effectively to practice various model questions related to the sub-material discussed.

At the final of second cycle, students were once again instructed to complete Mathematics Learning Outcomes Test II and participate in interviews to evaluate the learning process. Following data analysis, Cycle II revealed another improvement in students' mathematics learning outcomes. The increase could be seen from the quantity of students who completed the test, from 23 students in first cycle to 34 students from 42 students so that the calculated percentage who completed was 80.95%. This percentage of completeness had reached the previously determined classical completeness of 75% so because of that the research was completed in second cycle. The following is the learning outcome of one student in cycle II.

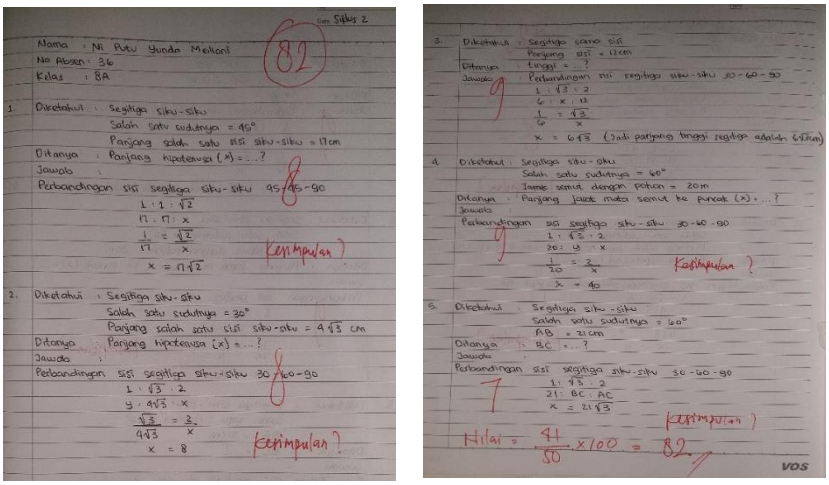

**Figure 4. The learning outcome of one student in cycle II**

The success observed in Cycle II was closely linked to enhancements in group composition, which became increasingly heterogeneous. This improvement was complemented by appointing one member in each group as a peer tutor, facilitating effective discussion guidance. This condition aligns with the theory stating that peer tutoring essentially involves tasks that allow students to help and support each other in completing assignments, thereby facilitating communication among students and encouraging each other to make maximum efforts (Arnawa, 2021). Thus, in the learning process, when combined with process differentiation, each student with different learning styles can complement one another. With discussions becoming more efficient, the remaining time was utilized effectively by practicing various model questions related to the sub-material discussed, as per student requests.

Based on this explanation, the selected learning was able to improve the outcome of students' mathematics learning in each cycle. The research result were in accordance with the existing success criteria. Thus, this research was said to be successful and the application of the discovery learning model with process differentiation could be an alternative learning in an effort to improve the outcome of student mathematics learning.

This is in line with the research conducted by Ermawati dkk. (2023) on the effect of the discovery learning model on mathematics learning outcomes of fourth grade students at SD 1 Dersalam. The research showed that the application of the discovery learning model can improve student learning outcomes. This is because, after the implementation of the discovery learning model, the learning process became more active as the chosen model matched the material and was able to attract students' attention. The research by Yuvita (2021) on the implementation of the discovery learning model to improve activeness and learning outcomes in mathematics for fifth grade students at SDK Maumere 2 found that the

application of discovery learning can enhance students' learning outcomes and activeness in the classroom. This is because students learn to think critically about problems presented through the discovery learning model. Learning that focuses on experimentation allows students to apply critical thinking skills, thereby improving learning outcomes. Research by Lukitawanti et al., (2023) on maximizing problem-solving abilities of tenth grade students on vector material by applying the discovery learning model integrated with differentiated learning showed that the integration of the discovery learning model with differentiated learning successfully maximized the problem-solving abilities of tenth grade students at SMAN 8 Malang on vector material. This was evident from the learning implementation from cycle I to III. When viewed from the achievement of learning objectives, students analyzed overall and also each indicator in each cycle showed improvement. Research by Atikah et al., (2024) on the application of content and process differentiation strategies in learning styles based on the problem based learning model found that the content and process differentiation strategy in tenth grade using the problem based learning model showed an increase in student learning activities. This was evident from the activeness in answering teachers' questions related to the presented problems and conducting presentations. The learning activities with process differentiation were the first experience for students, giving them the opportunity to choose the learning process based on their learning styles.

Based on the findings from the research and relevant studies, it can be concluded that the application of the discovery learning model with process differentiation can improve students' mathematics learning outcomes. The implementation of the discovery learning model with process differentiation has several implications, including that this model encourages students to be more actively involved in the teaching and learning process. With the discovery learning model, students are invited to explore and discover mathematical concepts independently or in small groups, which can enhance their engagement and motivation to learn. Secondly, process differentiation allows teachers to tailor teaching methods to the individual learning styles of students, so that each student can learn in the way that is most effective for them. Additionally, the combination of discovery learning and process differentiation can help bridge the ability gaps within the classroom. Students who grasp the material more quickly can be given additional challenges, while students who need more time can be supported through simpler tasks and further guidance. This can create a more inclusive and supportive learning environment, where all students feel supported and empowered to reach their full potential. In discovery learning, students are presented with real-world problems that require analytical thinking and creativity to solve. With process

differentiation, students are given the opportunity to explore various approaches to solving problems, which can enrich their understanding of mathematical concepts. Thus, this learning model not only enhances students' learning outcomes in terms of mathematical knowledge but also equips them with skills useful for everyday life and their future academic endeavors.

These implications certainly have limitations given the constraints in this research. The limitations of this research include, first, the limited implementation time. Implementing the discovery learning model with process differentiation requires a considerable amount of time for preparation and execution, which is often difficult to accommodate within an already packed school curriculum. Students and teachers need time to adapt to this new method, which can affect the short-term effectiveness of this learning model. Second, there are resource and facility limitations. Discovery learning with process differentiation requires adequate teaching aids, technology, and learning materials. However, not all middle schools have sufficient access to these resources, especially in remote areas or with limited educational budgets. This can be a significant obstacle to the optimal implementation of this model. Lastly, the diversity in students' abilities and motivation. Students have different backgrounds, abilities, and levels of motivation. Although process differentiation aims to tailor learning to individual needs, in practice, adapting strategies for each student can be very challenging and requires extra effort from teachers. These limitations can affect the effectiveness of the discovery learning model with process differentiation in improving students' mathematics learning outcomes.

## CONCLUSION

Based on the research results presented previously, In conclusion, the implementation of the Discovery Learning Model with Differentiated Process has led to significant improvements in the mathematics learning outcomes of Class VIII A students at SMP Negeri 14 Denpasar from initial reflection to first cycle and second cycle. This optimal increase was due to various actions provided by teachers, including searching for teaching materials from the internet so that students could review the construction of understanding formed at school, improving the formation of groups that were increasingly heterogeneous in terms of students' learning and cognitive styles, and appointing one member from each group to become a peer tutor so that they could organise a clear and effective discussion and add practice questions of various types to familiarise students with working on existing problem models.

The suggestions that can be provided for future research include the implementation of the Discovery Learning Model with Differentiated Process, which requires various preparations both in terms of material and technology, as well as addressing the challenges faced by researchers during the learning process so that students can learn and achieve better results.

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