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The Use of Differentiated Instruction Strategies To Achieve Mastery Of Mathematical Communication Skills on Circular Material

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ABSTRACT. This study aims to determine the completeness of students' mathematical communication skills by using differentiated instruction strategies. This research is a type of pre-experimental research with a one-shot case study research design. This research was conducted on students in grade VIII of SMP Negeri 3 Adiwerna in the academic year 2023/2024. With a population of 320 students in class VIII, class 8-E was chosen as the experimental class with a sample size of 32 students. The results of hypothesis testing with the T-test and Proportion Test show that learning with differentiated instruction strategies has achieved mastery.

Keywords: Differentiated Instruction, Learning Style, Mathematical Communication Skills

INTRODUCTION

Mathematics plays an important role in the development of human thinking skills to be sharper even now mathematics is the basis of the development of modern technology and will continue to underlie the development of modern technology in the future (Riyadi et al., 2020). Based on this statement, mathematics is very important to master. Therefore, mathematics must be taught from elementary level education to the final secondary level.

In learning mathematics, a guide is needed regarding what students should know and the actions that students should take, or a learning standard is needed. One of the standards that must be mastered according to NCTM (2000) is communication skills.

This means that a student is not considered complete in learning mathematics if they do not have good mathematical communication skills. This is also supported by the statement of Sultoni et al. (2020) which states that the abilities that must be possessed in learning mathematics are not only numeracy skills, but it is also important to have communication skills.

According to Hodiyanto (2017), mathematical communication skills refer to students' skills in expressing mathematical ideas and concepts both verbally and in writing. From Hodiyanto's statement, it can be concluded that the mathematical communication skills that students must have consist of oral and written communication.

The results of interviews and observations conducted with grade 8 students at SMP Negeri 3 Adiwerna show that most grade 8 students still have difficulty communicating mathematical ideas in writing when answering questions. This means that most students have difficulty in achieving one of the indicators of communication skills.

According to Riyadi (2020), learning styles can be a solution to the problem of students' low mathematical communication skills. Learning style according to Deporter and Hernacki (2007) is an individual's way to receive, absorb, and process

the information they get. Deporter and Hernacki explained that there are three different learning styles among students, namely auditory, visual, and kinesthetic. From this statement, it can be concluded that one way to overcome the problems of mathematical communication skills that occur in grade 8 students of SMP Negeri 3 Adiwerna is by paying attention to students' learning styles in learning. Learning that pays attention to students' learning styles is called differentiated learning. Differentiated learning itself has begun to be applied to the independent curriculum that is currently in effect.

However, based on the results of the interview, there has never been any data collection regarding students' learning styles at SMPN 3 Adiwerna. This shortcoming hinders teachers from implementing learning optimally.

From the various descriptions of the problems regarding the communication skills of grade 8 students at SMPN 3 Adiwerna. So the purpose of this study is to determine the completeness of students' mathematical communication skills by using differentiated learning strategies.

METHODS

This research is a type of pre-experiment research where research involves 1 experimental class to know the completeness of students' mathematical communication skills by using differentiated learning strategies for 8th-grade students at SMP Negeri 3 Adiwerna.

The research design used was a one-shot case study, with the research sample being class 8-E with a sample of 32 students. The instruments used in this study include questionnaires and test instruments.

RESULT AND DISCUSSION

The research results presented include the results of learning style classification, lesson planning, lesson implementation, assessment, and completion tests. Further explanation is presented as follows.

Planning

Lesson planning begins with classifying learning styles by giving a

student learning style questionnaire to find out the learning style tendencies of students in classes VIII-E. This activity was carried out during the first meeting which was held on Saturday, March 16, 2024, during math class. There were only 29 students who filled out the learning style questionnaire because there were 3 students who did not attend math lessons. Before giving the questionnaire to students, the teacher first gave directions for filling out the learning style questionnaire. The teacher accompanies students during the process of filling out the learning style questionnaire and collects the completed learning style questionnaire. The following is a recapitulation of the results of the learning style questionnaire.

Table 1. Result of learning style questionnaire

Learning Style	Number of Students
Visual	7
Auditory	12
Kinesthetic	4
Visual/Auditory	2
Visual/Kinesthetic	1
Auditory/Kinesthetic	2
Visual/Auditory/Kinesthetic	1
No Filling	3
Total	32

Based on Table 1, the data shows that 7 students have visual learning styles, 12 students have auditory learning styles, 4 students have kinesthetic learning styles, 2 students obtained the same questionnaire results in the visual and auditory learning styles questionnaires, 1 student obtained the same questionnaire results in the visual and kinesthetic learning styles questionnaires, 2 students obtained the same questionnaire results in the auditory and kinesthetic learning styles questionnaires, 1 student obtained the same questionnaire results in all learning style questionnaires, and 3 students did not fill in the learning style questionnaire.

The results of the learning style questionnaire were used to determine the learning model used and the formation of student groups. The learning model used is the problem-based learning model and each group consists of 4 students with the same learning style.

Learning Implementation

Learning implementation is carried out for 1 week with the

implementation schedule can be seen in the following table.

Table 2. Research schedule

Date	Meeting	Description
March 19, 2024	Meeting 2	Circumference of a circle material
March 23, 2024	Meeting 3	Circlmateriale area

Differentiated learning used during the learning process in the classroom is differentiated based on students' learning styles. Where 2 things are differentiated, namely content and process. Content differentiation is done by presenting teaching materials that have interesting pictures and illustrations to facilitate students with visual learning styles, reading and explaining clearly about the material being studied to facilitate students with auditory learning styles, and learning media that can be practiced directly by students to facilitate students with kinesthetic learning styles. Process differentiation, is done by dividing groups according to their respective learning styles with details of groups 1, 2, and 3 are auditory groups, group 4 is a kinesthetic group, group 5 is a visual group, and groups 6, 7, and 8 are mixed groups. Visual groups are more directed to pay attention to the illustrations presented to better understand the material being studied, auditory groups are more given oral explanations and directions to better understand the material being studied, and kinesthetic groups are more directed to practice with props to better understand the material being studied.

Assessment

The assessment was carried out to determine students' mathematical communication skills by giving description questions. The assessment was conducted individually for 50 minutes and was attended by all students of class VIII-E as many as 32 students. Before the implementation of the test, the teacher first conveyed the petuntuk working on the test. The following is a brief description of the results of the mathematical communication ability test.

Table 3. Mathematical communication skill test results

Data	
Number of Students	32
Average	71,9
Highest Score	97
Lowest Score	20
Number of Students Who Completed	22
Many Students Who Have Not Completed	10

From the data obtained, the outlier test is then carried out. The outlier test needs to be done on the mathematical communication ability test score data to ensure that there are no outliers or outliers from the mathematical communication ability test score data that can affect the overall results. The outlier test used is the Grubbs Test. The results of the outlier test can be seen in the following table.

Table 4. Results of the outlier test

Score	Average	Standard Deviation	Pg_{count}	Pg_{table}	Conclution
20	71,90625	17,473223	2,9706169	2,94	*Outlier*
97	71,90625	17,473223	1,436126	2,94	Not an *Outlier*

From Table 4, it is found that the data with the lowest value of 20 is an outlier. Then based on the test results, it was decided that the data with a value of 20 was removed from the mathematical communication ability test score data. The latest mathematical communication ability test results data can be seen in the following table.

Table 5. Latest mathematical communication skill test results

Data	
Number of Students	31
Number of Scores	2281
Average	73,58
Highest Score	97
Lowest Score	46
Number of Students Who Completed	22
Number of Students Who Have Not Completed	9
Standard of Classical Completion	75%

Test of completeness

From the data on the mathematical communication skills test scores, it is important to conduct testing to answer whether the experimental class reaches completeness or not. According to Trianto (2018), a class is said to be complete if it achieves individual completeness and classical completeness.

Individual completeness

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Do not use abbreviations in the title or heads unless they are unavoidable.

It is said to be individually complete if the average class score has reached the minimum score. The minimum value used refers to the criteria used at school, namely, students are said to be complete if the score obtained is more or equal to 66.

Because $t_{count} = 2{,}8277 \geq -t_{table} = -1{,}609$, This means that the mean score of the experimental class reached the minimum score.

Classical completeness test

It is said to be classically complete if the number of students who obtain completeness is at least 75%. Then to test the classical completeness, the left-party proportion test was conducted.

Because $z_{count} = 0{,}518 \geq -z_{table} = -1{,}64$, This means that the number of students who reached the minimum score ≥ 75% or the differentiated learning conducted achieved classical completeness.

The individual completeness test that has been carried out shows that the average value of students' mathematical communication skills exceeds the minimum value of

completeness set by the school. This means that the mathematical communication skills of students taught with differentiated learning have exceeded the minimum score set by the school which is 66. Meanwhile, the proportion test shows that the number of students who have reached the minimum score reaches 75%. It can be interpreted that the class taught with differentiated learning achieved classical completeness. From the results of these tests, the experimental class is said to have achieved completeness.

The achieved completeness shows that learning through differentiated learning can be used to develop students' mathematical communication skills. This is also reinforced by the statement of Laili Ayu Novitasari & Suryanti (2023) who said that differentiated learning can improve students' mathematical communication skills. One of the factors that influence the completeness of differentiated learning used is the existence of various methods that can facilitate each student in receiving material. Where differentiated learning that is carried out includes direct practice of finding formulas, explained through visual illustrations and clarified by oral explanation.

CONCLUSIONS

The results of hypothesis testing with the T-test and Proportion Test show that learning with differentiated instruction strategies has achieved mastery.

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