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Research article

The Effect of Video-assisted Discovery Learning Model on Junior High School Students' Mathematical Communication

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Abstract.
This study determines the effect of video-assisted Discovery Learning on the mathematical communication skills of junior high school students. The research sample was determined by cluster random sampling of the seventh-grade students of SMP Negeri 29 Semarang, Indonesia. The research data were analyzed using a two-way analysis of variance (ANOVA), continued with the Scheffe test. The results showed that: (i) the Discovery Learning model assisted by video learning had a significant effect on the mathematical communication abilities of students (F = 11,926; P = 0.05); (ii) there were differences in the mathematical communication ability between students using the Discovery model and those using conventional models (F = 9,729; P = 0.05); and (iii) there were differences in the mathematical communication skills of students watching instructional videos and those who did not (F = 8,592; P = 0.05). The authors conclude that the Discovery Learning model assisted by instructional videos is more effective and has a significant effect on the mathematical communication abilities of secondary high school students.

Keywords: instructional video, Discovery Learning effectiveness, mathematical communication

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1. Introduction

Communication skill in Mathematics is one of the important skills that must be mastered by secondary high school students in the mathematics learning process, because this skill is an activity between students and students and students and teachers to communicate in the mathematics learning process both verbally and in writing. Mathematical communication for students is a manner of transference mathematical concepts and understanding through oral, visual, written, numbers, symbols, pictures, graphs, diagrams, and words. According to [1] mathematical communication is a way for students to convey ideas, strategies and solutions in solving problems both orally and in writing. The National Council of Teachers of Mathematics states that there are 5 primary talents college students need to have, namely: Reasoning, Representation, Communication,

Problem Solving, and Connections. The cause of the Ministry of Education is in step with the ones formulated through NCTM [2]. *But there are still some teachers who have not paid attention to the ability of this mathematical communication to students*.

Mathematical conversation capacity are the capacity of college students to deliver mathematical thoughts each orally and in writing. Mathematical conversation capacity of college students may be evolved via the mastering manner at school, one in all that is the manner of mastering mathematics. Mathematical conversation is the manner of expressing mathematical thoughts and knowledge verbally, visually, and in writing, the use of numbers, symbols, images, graphs, diagrams, and words [3]

Investigate conducted by [4] states that mathematical communication can see the difficulties, responses, and future images of teachers in connecting tasks that have different forms of communication in a visual context. The tasks given by the teacher during the learning process are focused on seeing information directly or observing information indirectly. The results of his research revealed that most of the students gave a positive response to the given task, although some students still had difficulties in communicating.

Once the importance of mathematical communication skills in the process of learning math in junior high school, then teachers should try to create learning scenarios that can improve students' mathematical communication skills. Some of the efforts that need to be made by teachers include: (1) choosing an innovative learning model and high student activity and (2) creating learning media that can attract and interest students in the mathematics learning process at school. One of the learn media that can be developed is learn video, because with this media students are more interested and happy to learn mathematics. With the learning video, the teacher has the opportunity to insert material that will be given to students [5]. Video learning is one of the e-learning learning systems. By using learning videos, teachers can be more creative to create an interesting display of the learning process, because it is supported by video displays that are easier for students to understand.

In addition, engaging in video-enabled assignments spurs students to anticipate extra obligations in their learning while providing a rich, memorable and real learning experience [6]. Among numerous technological equipment on the disposal of instructors and learners, virtual video has been diagnosed as particularly useful for selling lively and innovative learning [7,8].

Learning video media is one of the audio-visual media that displays images and sounds. When compared to image media, the use of instructional video media further enhances students' mathematical communication skills. Videos can also feature objects

that are too small, too big, or even those that students cannot find in person. So that the learning video can explain abstract material and is very good for explaining a process of understanding certain concepts [9]. Learning videos, have a message that the concepts conveyed are more interesting and fun in the mathematics learning process, it encourages and increases student motivation so that students remember more about the material [10]. Thus the application of video media in the learning process makes students more motivated and interested in learning mathematics and in the end can improve mathematical communication skills.

Another factor that affects mathematical communication skills is an innovative model. Discovery learning is a learning model designed with the aim of helping students develop thinking skills and develop skills in solving problems of everyday life, which emphasizes the importance of helping students to understand the structure or key ideas of a discipline, the need for active student involvement. In the learning process, and the belief that true learning occurs through personal discovery [11]. [12] stated that the Discovery Learning model is designed so that students can find concepts and principles through their mental processes. The application of the Discovery Learning model requires support from a number of other methods and procedures that must be carried out by the teacher, namely providing stimulus, providing problem focus, data collection, data processing, and proof [13].

So the Discovery Learning model is one of the learning models that directs students to be able to find certain concepts or formulas through the learning process carried out by students. Through discovery, students learn intensively by following the scientific investigation method under the guidance of the teacher. The steps carried out in Discovery learning are: stimulation, problem statement, data collection, data processing, verification and generalization.

2. Method

This study uses a quasi-experimental method with a 2x2 factorial design where the first factor is two learning models, namely the Discovery learning model and the conventional model. While the second factor is the video learning mathematics and conventional media. The dependent variable is the mathematical communication ability of SMP students. The design of this research can be seen in table 1 below:

The population in this research were all 7th grade students of SMP Negeri 29 Semarang. Sampling used cluster random sampling technique to determine the experimental and control class. The experimental class in the learning process uses the

Table 1: Treatment by Level 2x2 Design.

Instructional Media	Learning Model	
	Discovery Learning (A_1)	Conventional Model(A2)
Instructional Video (B_1)	A_1B_1	A_2B_1
Convetional Media(B_2)	A_1B_2	A_2B_2

Discovery Learning model with the help of mathematics learning video media, while the control class uses a conventional model without learning videos.

In this study, data collection on mathematical communication skills used tests made by researchers and validated by specialists. The conditional test analysis technique used is the normality test with the Lilliefors test and the homogeneity test with the Bartlett test. [14]. To test the research hypothesis, two-way analysis of variance (Anova) was used with a significant level of =0.05. After knowing the interaction between the two research factors on the dependent variable, then proceed with the Scheffe test.

3. Result and Discussion

The data obtained from this study are the mathematical communication skills of junior high school students who study using the Discovery learning model with the help of learning videos (A_1B_1) and students who learn the conventional model without the help of learning videos (A_2B_2).

Before testing the hypothesis, the data from the research must first be tested for prerequisites, namely the normality test and homogeneity test. The two prerequisite tests were carried out using the help of Statistical Packages for Social Sciences (SPSS). Following are the results of the normality test in table 2 and the results of the homogeneity test in table 3 below:

Table 2: Mathematical Communication Abbilities Normality Test Results.

Variable	Lillifors L_{hitung}	L_{tabel} α=0,05	Explanation
A_1 B_1	0,117	0,242	Normal
A_1 B_2	0,109	0,242	Normal
A_2 B_1	0,179	0,242	Normal
A_2 B_2	0,162	0,242	Normal

Based on table 2 above, the results of the analysis of the normality test show that the overall value of L_{count} is smaller than $L_{table}$with a significant level of 0.05. This means that data on the mathematical communication capabilities of junior high school students come from all populations that are normally distributed.

Table 3: Results of Homogeneity Test of Mathematical Communication Skills.

Variable	χ^2_{hitung}	χ^2_{tabel}	Explanation
Mathematical Communication Skills	0,98	5,99	Varians Homogen

Based on the results of the homogeneity test in table 3 above, it shows that χ^2_{total} = 0.98 less than χ^2 table = 5.99 with a significant level of 0.05. This means that the data on the mathematical communication skills of junior high school students have a homogeneous population variance.

Then, the hypothesis was tested using two-way analysis of variance (Anova) with a significance level of alpha 0.05, the calculation process used Statistical Packages for Social Sciences (SPSS). The results of the calculation of the analysis of variance (Anava) are in table 4 below.

Table 4: Anova Testing Mathematical Communication Skills.

Variation Source	JK	db	RK	F_{hitung}	$F_{tabel\ \alpha=0,05}$
Among A	2,909	1	2,909	9,729	4,13
Among B	5,138	2	2,569	8,592	3,28
Interaction of A and B	7,132	2	3,566	11,926	3,14
Inside	19,734	66	0,299		
Total	34,913	71			

3.1. Interaction of Learning Models and Instructional VideosAnalysis

Based on analysis results in table 4, it is obtained F(AB)total = 11,926 > Ftable = **3,**14 for significant degrees α = 0,05, means Ho rejected. It means that there is a very significant interaction effect between factor A (learning model) and factor B (learning media) on the mathematical communication skills of junior high school students. These results indicate that there is a very significant interaction between the learning model and mathematics learning video on the mathematical communication capabilities of junior high school students. These results are reinforced by the results of research from [15] and [11] that the mathematical communication skill using the Discovery learning model is better than using the conventional learning model

Related to learning videos, Physical media and power point factor is the media maximum regularly utilized by teachers, as it is straightforward to broaden and searched from

numerous sources. However, maximum of the media used is fairly depending on verbal symbols (words) which might be very abstract, so it calls for a completely excessive abstraction talents of learners, it's miles this that may complicate the student [16]. In line with that, Video conversation additionally gives record switch and manipulation of documents, permitting the person to generate content [17]. Video verbal exchange equipment allow naturalistic oral conversations; supplement verbal modes; can act as stimuli for interaction; assist socio-affective interaction; and allow using gesture in verbal [18].

3.2. Learning Model Analysis

From table 4 above, F(A) total = 9,729> Ftable = 4,13 for significant degrees α = 0,05. The results of the analysis are also strengthened by the results of the test *Scheffe* analysis which is obtained Ftotal = 6,478 > Ftable = 4,30. From these two analyzes, Ho rejected. This means that there is a difference in the mathematical communication ability between students in classes that apply the Discovery learning model and the conventional model. This result shows that Discovery learning has a very significant effect on mathematical communication skills compared to students in classes using conventional models. It is supported by [19] that students in the class with the Discovery learning model achieved classical completeness of 88.46% and mathematical communication skills of 86.52%., [20] also said that students in the class with the Discovery Learning model achieved classical mastery and improved mathematical communication.

From these results, the application of innovative and varied learning models appropriately according to the material being taught can make students happy to learn mathematics. This has a good impact in improving mathematical communication skills and in the end can improve mathematics learning outcomes.

3.3. Learning Video Analysis

From table 4, F(B)total = 8,592> Ftable = 4,13 for significant degrees α = 0,05. The results of the analysis are also strengthened by the results of the Scheffe test analysis, which is obtained Fcount = 5,475> Ftable = 4,84. From the two analyzes, H_o is rejected. This means that there are differences in mathematical communication skills between students who are taught with mathematics learning videos and conventional media. These results indicate that mathematics learning videos have a very significant effect on mathematical communication skills compared to students who are taught using

conventional media. It is supported [21] shows that online math learning videos provide students with a safe, personal, comfortable and thought-provoking experience. So that in the end students can experience good moments, where students believe they can understand mathematical concepts in depth. Also agree with [22] shows that learning mathematics through the help of online resources such as videos, animations of relevant and challenging mathematical concepts can increase students' curiosity, although statistical data does not significantly show mathematical communication skills that are different from ordinary face-to-face learning classes.

4. Conclussion

In general, the results of this study can be concluded that there is a significant effect between the Discovery learning model and mathematics learning videos on the mathematical communication skills of junior high school students. In particular, based on the research objectives and the results of the research data analysis and discussion presented, the following finding can be drawn: (1) there is an influence between the Discovery learning and learning videos on the mathematical communication abbilities of junior high school students, (2) there are differences in communication skills Mathematics of secondary high school students whose learning uses the Discovery Learning model and conventional models, and (3) there are differences in the mathematical communication abbilities of secondary high school students whose learning uses mathematics learning videos and conventional media.

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