USE OF AUTOGRAPH LEARNING MEDIA TO IMPROVE MATHEMATIC COMMUNICATION SKILLS

1stNuraini Sri Bina

Information Engineering

Universitas Potensi Utama

Medan, Indonesia

[rainribi2701@gmail.com](mailto:rainribi2701@gmail.com)

3rdYulia Fitri

Information Engineering

Universitas Potensi Utama

Medan, Indonesia

[yulia\_usu@yahoo.co.id](mailto:yulia_usu@yahoo.co.id)

2ndSiti Fatimah Sihotang

Industrial Engineering

Universitas Potensi Utama

Medan, Indonesia

siti.fatimah.sihotang@gmail.com

4thRisna Mira Bella Saragih

Mathematics Education

Universitas Alwashliyah

Medan, Indonesia

risnamirabellasaragih@gmail.com

*Abstract*— The use of learning media is one way to support the government in socializing the era of industrial technology 4.0. Learning media as a solution to students' low mathematical communication skills. One of the learning media that is proven to be able to improve students' mathematical communication skills is Autograph. This paper describes how much influence the use of Autograph learning media has on students' mathematical communication skills. The method used in this research is experimental. Before using the Autograph learning media, a pretest was carried out and after using the Autograph learning media, a post-test was carried out to determine the increase in students' mathematical communication skills. From the results of the pretest and post-test data analysis, it was found that the Autograph learning media had a positive effect on mathematical communication skills. The average of students' mathematical communication skills taught with the help of Autograph media was higher. The use of Autograph learning media in learning makes students more active in discussions, dares to express opinions using mathematical language to express mathematical ideas correctly and can interpret mathematical data in the form of pictures or graphics.

Keywords—autograph; mathematical communication skills; learning media

# Introduction

Education plays an important role in the era of industrial technology 4.0 in Indonesia. Education is expected to be a solution for the government to produce qualified and competitive human resources in incessant technological developments. Improving the quality of education can be started from schools and teachers, improvement in the modern technological school facilities, and teachers who can use technology to transfer their knowledge to their students. Today, teachers who use technology in learning seem to be a demand in society for the advancement of education. "With the advancement of technology, educators are themselves learning to utilize and making good use of technology for the betterment of their teaching" [1], [2]. Technology is something that is still viral in the world of education. The use of technology in learning such as computer-based learning media serves to help students study subject matter programmatically under the competencies defined in the curriculum and the development of their abilities. This is supported by several researchers such as Hillmayr, et al [3] who found "The ICILS study shows that 87% of teachers across the participating countries think that ICT helps students to work at an appropriate level to their learning needs, and 78% state that ICT enables students to collaborate more effectively. Additionally, 91% of teachers agreed with the statement that information and communications technology (ICT) help students develop a greater interest in learning. The subject matter delivered with the help of technology-based learning media will be easily understood by students and will have an impact on the interest or attention of students in the lesson. Many schools are competing to equip their schools with computer laboratory facilities and provide training for teachers to be proficient in using computer technology in learning; this is all solely to assist the government in achieving educational goals in Indonesia. One of the goals of Indonesian education that has not been achieved is the problem of mathematics, namely the students' low mathematical communication skills, lack of ability to read mathematical symbols and how to convey them to others. Besides, mathematics is an abstract science, to support this in mathematics learning which has a subject that is so abstract and varied that there is a need for assistive devices such as learning media to help students learn to understand mathematical concepts [4]. Mathematical communication skills are important to improve, not only in Indonesia and even in the world. In Malaysia and also elsewhere in the world the demands for graduates who have employability skills such as the ability to think critically, solve problems and can communicate are highly sought in the workplace [5]. Kabael [6] also stated the same thing; the importance of the mathematics language in learning is independent. In the world of work, it is necessary to have the ability to think critically, solve problems and communicate well which can be obtained through learning mathematics. The concept of learning that uses technology and information in the teaching and learning process is called e-learning. Electronic-learning (e-Learning) is a form of education that utilizes information and communications technology to access online teaching and learning [7]. One of the subjects in education that is effective for learning using e-learning is mathematics. With the e-learning concept, learning mathematics will be more successful than learning with traditional concepts. In other words, in terms of developing mathematics success, teaching based on problem-based e-learning is more effective than the traditional teaching method [8]. In the concept of e-learning, it is not always done online. There are two main types, namely asynchronous type and synchronous type. E-Learning is not confined to online learning; it includes any form of digital communication used to deliver information. There are two main types of e-Learning: time-independent asynchronous type, where students study from downloadable courseware at their convenient time, and the synchronous type, where real-time online learning with the ability to interact and chat with students in live conferences is scheduled at set times [9]. In the Asynchronous type, students can use offline learning applications such as Autograph. Autographs as technology-based offline learning media can be used by students independently using the buttons on the toolbox menu to create charts or find the area of ​​a flat area. So that the Autograph learning media can improve mathematical communication skills as expressed by Linda, Syahputra & Surya [10] the development of Autograph-based learning tools is effective and able to improve mathematical communication skills. Learning media can improve the quality of mathematics learning. This is supported by Ramadhani & Dahlya [11] who said that using learning media also makes a real contribution to increasing mathematics learning quality to high school students.

Kaya's research on communication skills states that fostering mathematical communication in classroom settings is a strategy to develop students thinking skills by mathematical talk, discussion and activities. Mathematical communication skills can be improved by managing classes through discussion [12]. Dimmel & Herbst [13] said: "if mathematics teachers are to create opportunities for students to hone discipline-specific communication skills, they will need to change their existing instructional routines". The essence of these two studies is that there must be unusual strategies to improve students' communication skills. Mathematical communication skills are still far from expectations according to Triana, Zubainur & Bahrun [14] who said Students' skills in expressing mathematical ideas in various ways had not met the expectation. He found that using the Brain-Based Learning (BBL) approach with Autograph can help students develop mathematical communication skills. Then the findings of Karnasih & Sinaga [15] said using dynamic Software Autograph in teaching-learning statistics with cooperative learning Think-Pair-Share improved students' problem solving and mathematical connection abilities. Based on several findings described above, at one point, the researcher carried out an unusual strategy by combining previous studies to see an increase in mathematical communication skills. This strategy manages the class through a discussion of activities while working on student activity sheets with the help of an autograph independently, two, then four and present their findings to the class. This strategy termed a “disugraph” which stands for discussion using Autograph. In the school in which the target of this research, no similar experiment has been conducted.

From the search results to school, the researcher found that the students' mathematical communication skills in the second grade of Senior High School in Tebing Tinggi, Indonesia were still low. It is proof by the students' answers in Fig. 1 below:

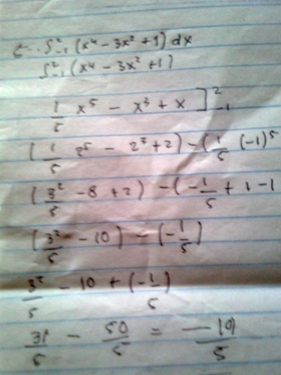


Fig. 1. Students’s Answer Sheet Before “*Disugraph*”

Based on Figure 1, it is clear that the students are not able to sketch the area of ​​a flat area that is limited by the curve. Then don't use the L symbol representing the area. This school has excellent computer laboratory facilities and technology-literate teaching staff but are not familiar with Autograph learning media and have never used Autograph learning media to improve students' mathematical communication skills. With this research, the use of Autograph learning media can be an alternative solution to the problem of students' low communication skills at the school.

# METHODOLOGY

The design of this study was to conduct a one-class pretest and posttest control group design. The pretest was carried out before using the Autograph media in learning. Posttest is done after using Autograph media in learning. Pretest data as variable X and posttest data as variable Y in regression data analysis to see the effect of Autograph learning media on mathematical communication skills. The research sample consisted of 33 people, class of Science XII-1 in SMA Negeri 1 Tebing Tinggi. The research sample was selected using a cluster random sampling technique.

This research was categorized into quasi-experimental research. The data collection procedure in this study is to prepare a mathematical communication ability test kit based on the grid. Then do a test research instrument outside the research sample. From the test results, an analysis of the validity and reliability of the items was carried out using the Statistical Package for the Social Sciences (SPSS). In SPSS, the Pearson moment product correlation test is used to test the validity of the questions. Pearson product-moment correlation was employed to determine the relationship between the independent variable and the dependent variable [16]. If the value is sig. from the total score obtained with , the items are said to be valid. Or, compare r-count with r-table at and probability 0.05 if then the item is valid. For reliability, if the value of Cronbach's Alpha Based on with means that the overall test is reliable. Invalid questions are not tested for reliability. Questions that are said to be valid and reliable are then used in the study.

The research was started by giving pretest questions to the students who were the research samples, then learning the material to determine the area of ​​the flat area using autograph media, and finally doing the postest. To analyze and select the type of the related test, firstly the data distribution normality should be investigated [17]. Before the regression test, the pretest and posttest data were tested for normality and homogeneity using SPSS. If sig. obtained , the data is normal. The group variant is said to be homogeneous if according to the Levene sig test. [18]. The final step is to perform a simple linear regression test using SPSS to see if there is an effect of Autograph learning media on mathematical communication skills. If the ANOVA table the , it can be said that the regression equation obtained is good for prediction. The R2 value in the ANOVA table shows what percentage of the Autograph learning media contribution to mathematical communication skills. If the table of the coefficient of the regression equation , then H0 is rejected, which means that there is a positive effect of Autograph learning media on mathematical communication skills.

# RESULTS AND DISCUSSION

1. *Results*

The results of the research instrument trial analysis and the results of the research data analysis using SPSS are presented below.

## Validity

If the calculated r-value using SPSS is smaller than the critical value in the table, then the correlation is not significant, meaning that the item is invalid. If the value of r is greater than the critical value in the table, then the correlation is significant or the item is valid. With n = 33, df = 33-2 = 31 at 5% significance obtained r-table= 0.355. For the results of calculating the validity of the items on the results of the instrument trial using SPSS, it is presented in table 1 below:

TABLE 1. VALIDITY OF TEST RESULT POINTS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Question details** | **r value** | **r table** | **Sig.** | **Description** |
| 1 | 0.726 | 0.355 | 0.000 | Valid |
| 2 | 0.707 | 0.355 | 0.000 | Valid |
| 3 | 0.766 | 0.355 | 0.000 | Valid |
| 4 | 0.097 | 0.355 | 0.612 | Invalid |
| 5 | 0.775 | 0.355 | 0.000 | Valid |
| 6 | 0.426 | 0.355 | 0.019 | Valid |

From table 1 above, it can be seen that 6 items were tested. After being compared with the r table, there are 5 valid items, namely the value is greater than the r table or the . And there is 1 item that is invalid, namely item number 4 because the value of is or the sig. value it is that is The five valid items were then tested for reliability.

## Reliability

After analyzing the items, the next step is to measure the reliability of the items. Reliability indicates the amount of variation to expect in the measurement from one occasion to another [19]. Reliability is done to see the consistency of a reliable question when done by anyone, anywhere and anytime. There are 5 valid items in which the reliability will be measured. For the results of the calculation of the reliability of the instrument trial results using SPSS, it is presented in table 2 below:

TABLE 2. RELIABILITY OF TEST RESULT POINTS

|  |  |  |  |
| --- | --- | --- | --- |
| **Cronbach's Alpha** | **Reliability Statistics** | | |
| ***N of Items*** | ***r table*** | ***Description*** |
| 0.747 | 5 | 0.355 | Reliable |

Of the 5 items tested based on the reliability test results in table 2 above, the Cronbach's alpha value was 0.747. So this number (0.747) is greater than the value of r table, namely 0.747> 0.355. Therefore it can be concluded that the research instrument used to measure mathematical communication skills can be said to be reliable.

After testing the validity and reliability of the items on the results of the research instrument trial, the next step is to analyze the pretest and posttest data to obtain a conclusion whether there is an effect of Autograph learning media on mathematical communication skills. Several stages of the analysis carried out are as follows: determining descriptive statistics, making graphs, testing statistical requirements, namely the normality test and homogeneity test, the last is the linear regression test using SPSS.

## Descriptive Statistics

Table 3 below shows the descriptive statistics of the pretest and posttest data consisting of the lowest, highest, average and standard deviation scores of the mathematical communication skills test.

TABLE 3. DESCRIPTIVE STATISTICS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Minimum** | **Maximum** | **Mean** | **Standar Deviasi** |
| Pretes\_X | 25 | 70 | 47.88 | 11.112 |
| Postest\_Y | 35 | 75 | 52.73 | 9.445 |

From table 3, it can be seen that the minimum value before and after using the Autograph (disugraph) learning media has increased by The maximum value increased 16.7% and the average increased by From the standard deviation, there is a decrease of which means that the pretest data is more spread out than the postest data. For more details, the graph of this increase is presented in Fig. 2 below.

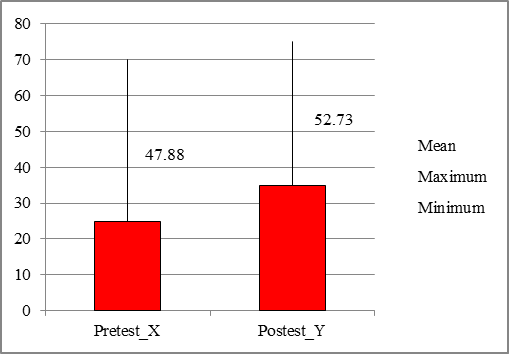


Fig 2. Descriptive Statistic Graphic Picture

From Fig. 2, it can be seen visually a graph of the increase in the average, maximum and minimum values ​​of the data on students' mathematical communication skills at pretest and posttest. The two bars have different heights indicating the difference in the maximum and minimum values ​​of the pretest and posttest data. The maximum value of the postest data is higher than the pretest data.

## Normality Test

Test data normality using SPSS with the Shapiro-Wilk test because the sample is small. With the test criteria if sig. , the data is normally distributed. The results of normality testing using SPSS are presented in table 4 below:

TABLE 4. NORMALITY TEST

| Variable | Tests of Normality | | |
| --- | --- | --- | --- |
| Statistic | Df | Sig. |
| X | 0.975 | 33 | 0.627 |
| Y | 0.961 | 33 | 0.278 |

From table 4 above, it is found that the two data on mathematical communication skills, both pretest (X) and postest (Y), are normally distributed. Because of the sig. obtained is greater than .

## Homogeneity Test

This test is used to determine whether the sample obtained comes from a population with the same variance. Test criteria, homogeneous data if sig. . From the results of the homogeneity test using SPSS, the values ​​are obtained as in table 5 below:

TABLE 5. HOMOGENEITY TEST

|  |  |  |  |
| --- | --- | --- | --- |
| **Levene Statistic** | **df1** | **df2** | **Sig.** |
| 0.403 | 7 | 23 | 0.891 |

From the results of the analysis with SPSS in table 5 above, it can be concluded that the testing of the variable mathematical communication skills after using the Autograph (disugraph) or posttest learning media based on the pretest has the same or homogeneous variants. This is because of the sig. obtained is greater than or . After performing the requirements test for linear regression and the results show that the pretest and postest data as variables X and Y are normal and homogeneous. Then a simple linear regression test is eligible to be performed.

## Linear Regression Test

Testing the effect of the Autograph learning media on students' mathematical communication skills with a simple linear regression test. The R-value obtained by the SPSS calculation is presented in table 7 below:

TABLE 6. THE R VALUE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **R** | **R Square** | **Adjusted R Square** | **Std. Error of the estimate** |
| 1 | 0.570 | 0.325 | 0.304 | 7.881 |

Table 6 shows the R-value which is a symbol of the correlation coefficient value. The correlation value obtained is or . This value can be interpreted that the relationship between the two research variables is in the moderate category. Through table 6, it is obtained the value of R2 or the coefficient of determination (KD) which shows how good the regression model is formed by the interaction of Autograph learning media and mathematical communication skills. The KD value obtained is which can be interpreted that the Autograph learning media has a contribution effect of on the variable mathematical communication ability and is influenced by other factors outside the Autograph learning media.

In table 7 below is presented the calculated F value using SPSS. This table is used to determine the level of significance or linearity of the regression, the criterion is if the value is sig. , the regression model is linear.

TABLE 7. ANOVA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Sum of Square** | **df** | **Mean Square** | **F** | **Sig.** |
| 1 Regression  Residual  Total | 928.93  1925,61  2854,55 | 1  31  32 | 928.94  62.12 | 14.96 | 0.001a |

From table 7, which means smaller than the criteria of significance , thus the regression equation model based on the research data is significant, meaning that the linear regression model meets the linearity criteria. To find out whether there is an effect of Autograph learning media on mathematical communication skills, the following hypothesis is formulated:

H0 : There is no positive effect of Autograph learning media on mathematical communication skills.

Ha : There is a positive effect of Autograph learning media on mathematical communication skills.

The test criteria are rejected H0 if and accept H0 for other conditions with a significance level of . The results of the linear regression test using SPSS are listed in the table below:

TABLE 8. LINEAR REGRESSION TEST

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Unstandardized Coefficients** | | **Standardized Coefficients** | **T** | **Sig.** |
| ***B*** | ***Std. Error*** | ***Beta*** |
| 1 (Constant)    X | 29.513  0.485 | 6.158  0.125 | 0.570 | 4.80  3.87 | 0.000  0.001 |

Table 8 informs the regression equation model obtained with the constant coefficients and variable coefficients in the unstandardized coefficients column B, namely in (1) :

(1)

With tvalue = 3.87 and sig. = 0.001, the hypothesis being tested is H0 which states that there is no influence of the Autograph learning media on students' mathematical communication skills is rejected.

1. *Discussion*

Mathematical communication skills after using the Autograph (disugraph) learning media have increased, in other words, the Autograph learning media has a positive influence on mathematical communication skills. This is supported by the findings of Triana, Zubainur & Bahrun [14] and Chasanah, Riyadi & Usodo [20], namely the study showed that mathematics learning applying BBL approach with Autograph contributes to developing students' mathematical communication skills. From the test results of mathematical communication skills between before and after using the Autograph learning media (disugraph), respectively, the maximum value is , the minimum value is , the average is , the standard deviation is and the maximum value is , the minimum value is , average -average , standard deviation . The maximum value increased by , the minimum value increased by and the average value increased by There was an increase in the average value of mathematical communication skills after using the Autograph learning media, but this increase if interpreted based on the category of acquisition of the N-gain value was at a low level because the value of g However, the findings using linear regression test in this study obtained the if interpreted according to the criteria for the R value, it was categorized as moderate correlation. This is a new finding that has not been found in other studies. Based on the value of Fvalue it is concluded that the linear equation is good. And according to tvalue, it was found that there was an influence of Autograph learning media on mathematical communication skills. From the learning results using the disugraph strategy, it can be seen that the way students answer the problem of the area of ​​a flat area is getting better with the ability to make graphics. This can be seen in Fig. 3 below:

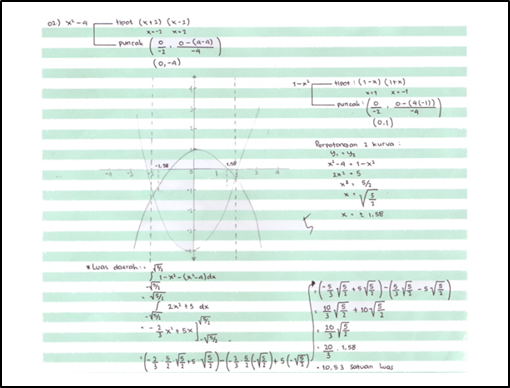


Fig 3. Students’s Answer Sheet After “*Disugraph*”

From Fig. 3 we can see students' complete answer, students can describe an area bounded by two curves, students can also interpret mathematical ideas that are seen in the way students write answers clearly or students' techniques are looking for area, and students know the mathematical terms of the problem write it down on the answer sheet, namely the area, intersection point, vertex and unit area.

# CONCLUSION

Learning with the help of Autograph media has resulted in interesting, quality, fun and different teaching and learning activities. When using Autograph learning media, students are more enthusiastic because learning is carried out in the laboratory, actively discussing, daring to express opinions to convey mathematical ideas to others. Autograph learning media helps students understand how to make charts and introduce mathematical symbols or terms that are on the display of the application. From the findings during the study and the results of statistical test data obtained during the study, other conclusions from this study are: students' mathematical communication skills are influenced by the application of the use of Autograph learning media. of students' mathematical communication skills are influenced by the Autograph learning media. In other hand, the average communication skills of students who use Autograph media in learning are higher. This is evident from the average mathematical communication ability which has increased by after learning using Autograph.

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