

Use of Autograph Learning Media to Improve Mathematic Communication Skills

Nuraini Sri Bina*, Yulia Fitri

Information Engineering
Universitas Potensi Utama
Medan, Indonesia

*rainribi2701@gmail.com, yulia_usu@yahoo.co.id

Siti Fatimah Sihotang

Industrial Engineering
Universitas Potensi Utama
Medan, Indonesia

siti.fatimah.sihotang@gmail.com

Risna 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 pre-test 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 pre-test 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*

I. 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

variable X and post-test 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 <0.05 with $\alpha = 0.05$, the items are said to be valid. Or compare r-count with r-table at $df = n - 2$ and probability 0.05 if $r_{count} > r_{table}$ then the item is valid. For reliability, if the value of Cronbach's Alpha Based on Standardized Items $> r_{tabel}$ with $df = n - 2$ 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 pre-test questions to the students who the research samples were, then learning the material to determine the area of the flat area using autograph media, and finally doing the post-test. To analyse and select the type of the related test, firstly the data distribution normality should be investigated [17]. Before the regression test, the pre-test and post-test data were tested for normality and homogeneity using SPSS. If sig. obtained >0.05 , the data is normal. The group variant is said to be homogeneous if according to the Levene sig test. >0.05 [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 sig. <0.05 , 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 sig. <0.05 , then H0 is rejected, which means that there is a positive effect of Autograph learning media on mathematical communication skills.

III. RESULTS AND DISCUSSION

A. Results

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

1) *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 I. 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 r_{xy} value is greater than the r table or the sig value. <0.05 . And there is 1 item that is invalid, namely item number 4 because the value of $r_{xy} < r_{table}$ is $0.097 < 0.0355$ or the sig. value it is >0.05 that is $0.612 > 0.05$. The five valid items were then tested for reliability.

2) *Reliability*: After analysing 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 II. 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 analyse the pre-test and post-test 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.

3) *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 III. DESCRIPTIVE STATISTICS

	Minimum	Maximum	Mean	Standard Deviation
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 13.33% The maximum value increased 16.7% and the average increased by 9.3% From the standard deviation, there is a decrease of 1.8% which means that the pre-test data is more spread out than the pos-test data. For more details, the graph of this increase is presented in Fig. 2 below.

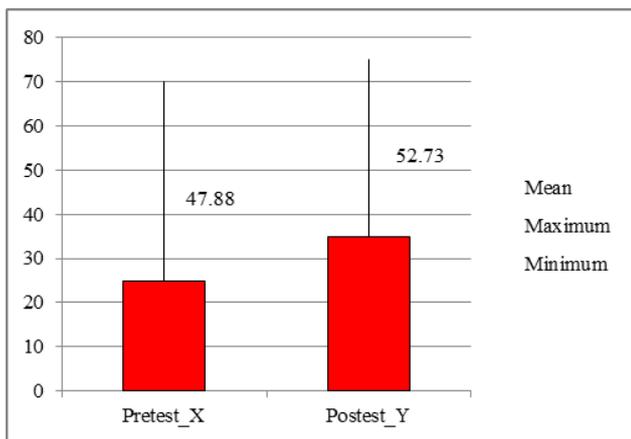


Fig. 2. Descriptive statistic graphic picture.

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 pre-test and post-test. The two bars have different heights indicating the difference in the maximum and minimum values of the pre-test and post-test data. The maximum value of the post-test data is higher than the pre-test data.

4) *Normality test:* Test data normality using SPSS with the Shapiro-Wilk test because the sample is small. With the test criteria if sig. >0.05, the data is normally distributed. The results of normality testing using SPSS are presented in table 4 below:

TABLE IV. 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 pre-test (X) and post-

test (Y), are normally distributed. Because of the sig. obtained is greater than 0.05.

5) *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.>0.05. From the results of the homogeneity test using SPSS, the values are obtained as in table 5 below:

TABLE V. 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 post-test learning media based on the pre-test has the same or homogeneous variants. This is because of the sig. obtained is greater than 0.05 or 0.891 > 0.05. After performing the requirements test for linear regression and the results show that the pre-test and post-test data as variables X and Y are normal and homogeneous. Then a simple linear regression test is eligible to be performed.

6) *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 VI. 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 0.570 or 0.6. 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 32.5% which can be interpreted that the Autograph learning media has a contribution effect of 32.5% on the variable mathematical communication ability and 67.5% 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.<0.05, the regression model is linear.

TABLE VII. ANOVA

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

From table 7, the sig value is obtained = 0.001 which means smaller than the criteria of significance (0.05), 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:

- H_0 : There is no positive effect of Autograph learning media on mathematical communication skills.
- H_a : There is a positive effect of Autograph learning media on mathematical communication skills.

The test criteria are rejected H_0 if sig (2-tailed) < 0.05 and accept H_0 for other conditions with a significance level of 0.05. The results of the linear regression test using SPSS are listed in the table below:

TABLE VIII. LINEAR REGRESSION TEST

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

$$Y = 29.513 + 0.485X \quad (1)$$

With $t_{value} = 3.87$ and $sig. = 0.001$, the hypothesis being tested is H_0 which states that there is no influence of the Autograph learning media on students' mathematical communication skills is rejected.

B. 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 70, the minimum value is 25, the average is 47.88, the standard deviation is 11.112 and the maximum value is 75, the minimum value is 35, average 52.73, standard

deviation 9.445. The maximum value increased by 16.7%, the minimum value increased by 13.33% and the average value increased by 9.3% 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 $g < 30\%$ However, the findings using linear regression test in this study obtained the value of $R = 0.570$ 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 $Y = 29.513 + 0.485X$ is good. And according to t_{value} , 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:

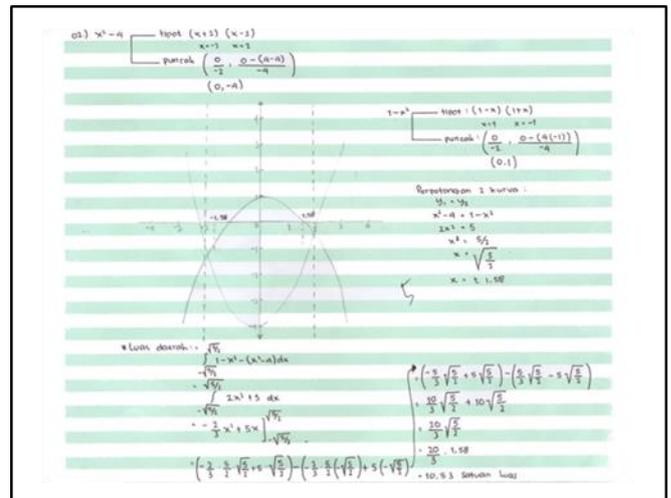


Fig. 3. Students's answer sheet after "Disugraph".

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.

IV. 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. 32.5% 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 9.3% after learning using Autograph.

REFERENCES

- [1] H. Hassan et al., "Evaluating Mathematics e-Learning Materials: Do evaluators agree with distance learners?," *Procedia-Social Behav. Sci.*, vol. 67, pp. 189–195, 2012, doi: 10.1016/j.sbspro.2012.11.320.
- [2] R. Ramadhani and Y. Fitri, "A Project-Based Learning into Flipped Classroom for ePUB3 Electronic Mathematics Learning Module (eMLM)-based on Course Design and Implementation," *Univers. J. Educ. Res.*, vol. 8, no. 7, pp. 3119–3135, Jul. 2020, doi: 10.13189/ujer.2020.080740.
- [3] D. Hillmayr, L. Zierwald, F. Reinhold, S.I. Hofer, and K.M. Reiss, "The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis," *Comput. Educ.*, vol. 153, p. 103897, Aug. 2020, doi: 10.1016/j.compedu.2020.103897.
- [4] S. Huda, R.A. Sholikhakh, N.S. Bina, F. Lestari, B. Habibi, and P. Suharto, "Effect of Application Smart Circuit Learning Media to Mathematics Learning Outcomes: A Case Study of Junior High School Students," *J. Educ. Gift. Young Sci.*, vol. 7, no. 3, pp. 745–761, Sep. 2019, doi: 10.17478/jegys.597053.
- [5] R.A. Rahman, Y.M. Yusof, H. Kashefi, and S. Baharun, "Developing mathematical communication skills of engineering students," in *Procedia - Social and Behavioral Sciences* 46, 2012, pp. 5541–5547, doi: 10.1016/j.sbspro.2012.06.472.
- [6] T. Kabaal, "Graduate Student Middle School Mathematics Teachers' Communication Abilities in the Language of Mathematics," *Procedia - Soc. Behav. Sci.*, vol. 55, pp. 809–815, Oct. 2012, doi: 10.1016/j.sbspro.2012.09.567.
- [7] N.M. Alqudah, H.M. Jammal, O. Saleh, Y. Khader, N. Obeidat, and J. Alqudah, "Perception and experience of academic Jordanian ophthalmologists with E-Learning for undergraduate course during the COVID-19 pandemic," *Ann. Med. Surg.*, vol. 59, pp. 44–47, Nov. 2020, doi: 10.1016/j.amsu.2020.09.014.
- [8] D. Üzela and E. Özdemira, "The Effects of Problem-Based E-Learning on Prospective Teachers' Achievements and Attitudes towards Learning Mathematics," in *Procedia - Social and Behavioral Sciences* 55, 2012, pp. 1154–1158, doi: 10.1016/j.sbspro.2012.09.609.
- [9] A. Merzouk, P. Kurosinski, and K. Kostikas, "e-Learning for the medical team: The present and future of ERS Learning Resources," *Breathe*, vol. 10, no. 4. European Respiratory Society, pp. 296–304, Dec. 2014, doi: 10.1183/20734735.008814.
- [10] L. Sari, E. Syahputra, and E. Surya, "Development of Autograph-Based Learning Tools to Improve Mathematical Communication Skills Students in vocational high school," *Int. J. Multicult. Multireligious Underst.*, vol. 7, no. 8, p. 326, Sep. 2020, doi: 10.18415/ijmmu.v7i8.1880.
- [11] R. Ramadhani and S.D. Narpila, "Problem based learning method with geogebra in mathematical learning," *International Journal of Engineering and Technology(UAE)*, 2018.
- [12] D. Kaya and H. Aydin, "Elementary mathematics teachers' perceptions and lived experiences on mathematical communication," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 12, no. 6, pp. 1619–1629, Jun. 2016, doi: 10.12973/eurasia.2014.1203a.
- [13] J.K. Dimmel and P.G. Herbst, "Secondary mathematics teachers' attitudes toward alternative communication practices when doing proofs in geometry," *Teach. Teach. Educ.*, vol. 68, pp. 151–160, Nov. 2017, doi: 10.1016/j.tate.2017.08.018.
- [14] M. Triana, C.M. Zubainur, and Bahrun, "Students' Mathematical Communication Ability through the Brain-Based Learning Approach using Autograph," *Journal of Research and Advances in Mathematics Education*, 2019.
- [15] I. Karnasih and M. Sinaga, "Integration of Autograph in Improving Mathematical Problem Solving and Mathematical Connection Ability Using Cooperative Learning Think-Pair-Share," *Southeast Asian Math. Educ. J.*, vol. 5, no. 1, pp. 83–95, 2015.
- [16] M. Rezaul Islam, H.A. Wahab, and L. ak Anggum, "The influence of leadership quality towards community cohesion in Iban community in Malaysia," *Heliyon*, vol. 6, no. 2, p. e03370, Feb. 2020, doi: 10.1016/j.heliyon.2020.e03370.
- [17] H.R.R. Kelidbari, M. Fadaei, and P. Ebrahimi, "The role of ethical leadership on employee performance in Guilan University of medical sciences," in *Procedia - Social and Behavioral Sciences* 230, 2016, pp. 463–470, doi: 10.1016/j.sbspro.2016.09.058.
- [18] G.B. Karadumana, N. Güdera, Z. Özsoy-Güneşb, and F.G. Kirbaşlarb, "Investigation of the relationship between study approaches and self-regulated learning skills of teacher candidates," in *Procedia - Social and Behavioral Sciences* 174, 2015, pp. 251–258, doi: 10.1016/j.sbspro.2015.01.655.
- [19] S.B. Gerber and K. Voelkl Finn, *Using SPSS For Windows*. Springer-Verlag, 2005.
- [20] C. Chasanah, Riyadi, and B. Usodo, "The effectiveness of learning models on written mathematical communication skills viewed from students' cognitive styles," *Eur. J. Educ. Res.*, vol. 9, no. 3, pp. 979–994, 2020, doi: 10.12973/EU-JER.9.3.979.