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THE IMPLEMENTATION OF GEOGEBRA-ASSISTED DISCOVERY LEARNING APPROACH TOWARDS MATHEMATICAL COMMUNICATION ABILITY OF VOCATIONAL STUDENTS

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ABSTRACT

Mathematicals communication ability is one of essential mathematical abilities that every person, who learns mathematics, needs to have. However, many facts found in many studies has shown us that students' achievements on this ability are still low. Factors that may cause it spread from teacher factors, tools, approaches, learning media to students themselves. To overcome these issues, many efforts are made to select and implement learning approaches that can improve students' mathematical communication ability as well as their activities in instructional process. Thus, the purpose of this study is to examine whether the implementation of GeoGebra-assisted discovery learning approach is effective in improving vocational school students' mathematicals communication ability or not. This quasi experimental research design involved 60 students of Gema Karya Bahana Vocational School as samples. The samples were divided into two groups in which 30 students of Accounting-1 class as the experimental group and 30 students of Accounting-2 as the control group. The data collected through a description test consisted of 3 questions on a linear program. The data collected through the test, both in pre-test and post-test, then analyzed using inferential statistics. The results of this analysis showed that the implementation of the discovery Learning approach assisted by GeoGebra was effective in improving vocational school students' mathematicals communication ability. Thus, the discovery learning approach assisted by GeoGebra can be implemented on instructional processes as one of instructional approach alternatives.

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INTRODUCTION

Among students' abilities required in facing the progress of the times is communication ability, which are found in 21st century abilities namely collaboration, communication, critical and creative thinking (Scott, 2015; Nganga, 2019). Apart from that, communication ability is one among the requirements stated in curriculum 13 that abstract mathematicals material must be presented concretely thus students can either think creatively or to communicate appropriately and correctly (Majid, 2015). Mathematics is a language in the form of notations, terms and symbols so students' communication ability is required in studying mathematics. This ability is important to make students understand abstract concepts in mathematics during instructional activities at school (Purnama & Aldila, 2016). Communication is a very essential part of mathematics and mathematics education, because communicating in mathematics lessons can guide and stimulate thinking and reasoning about mathematics (Fatmasuci, 2017; Habsah, 2017). Apart from that, communication ability is also needed to complete and perfect every other process in mathematics that without it, students will have difficulties in solving many mathematicals issues (Hartati, Abdullah, & Haji, 2017; Junita, 2016; Sukoco & Mahmudi, 2016).

However, the facts found in many previous researchs showed that Indonesian students' communication ability is low (Luritawaty, 2016; Wijayanto, Fajriah, & Anita, 2018; Sumartini, 2019; Putri & Sundayana, 2021). Those facts is in accordance with the 2011 TIMSS report which states that Indonesian students have weaknesses in answering questions that require students to argue and communicate (Delyana, 2014).

Factors that may cause those poor mathematicals communication ability spread from teacher factors, tools, approaches, learning media to students themselves (Purnamasari & Afriansyah, 2021; Dewi & Nuraeni, 2022). However, the main factor is the teacher's ability to creatively vary the delivery of material which results in students quickly feeling bored and having difficulty understanding mathematicals problems. Currently, conventional learning still dominates mathematics education. Teachers mostly rely on verbal communication during classroom instruction (Anggraeni & Sundayana, 2021). When learning with this conventional approach, students usually uses most of learning time to listen and do assignments arranged by the teacher, so that students' activities with their classmates are reduced. Besides teacher factor mentioned above, another factor that causes students' low mathematicals communication ability is the poor students' skill in communicating ideas during the mathematics learning process (Ariawan & Nufus, 2017).

To overcome these problems, many efforts are made to select and implement learning approach that can improve students' mathematicals communication ability as well as their activities in instructional process. One of learning approaches that is suited to this problem is the discovery learning approach because this approach emphasizes on students' activities in learning (Simamora & Saragih, 2019). In this approach, activities are prepared in a way where students are trained how to discover concept or principle independently through their mental abilities (Asmara & Afriansyah, 2018; Putri, Roza, & Maimunah, 2020). Apart from that, when learning using this approach, students are required to practice observing, making guesses, grouping, measuring and drawing conclusions (Jainuri, Rais & Sutiana, 2019). Giving problems to the students since the beginning of learning process will force them to be proactive since they get new things that they discover themselves.

To give it more interesting to the students, GeoGebra software is also used to assist in this discovery learning approach. GeoGebra is a dynamic software commonly used in mathematics learning which combines geometry, algebra and calculus (Arbain & Shukor, 2015). GeoGebra is software which mostly uses to make presentations and illustrate concepts

in mathematics to students (Sari, Ardana, & Suweken, 2021). GeoGebra uses dynamic visualization to clarify many concepts in mathematics for students thus they can understand those concepts and ideas more easily and clearly.

Several studies regarding the use of the discovery learning approach for high-level mathematicals communication abilities have been carried out. Among them were studies conducted by: Aziz, Budiyono, & Subanti, (2015), using discovery learning to measure communication skills and learning achievement in elementary school students; Gusmania & Marlita, (2016), to measure abilities mathematicals problem solving in high school students; Muhamad (2017), measuring representation abilities; Danial, Gani & Husnaeni, (2017), to measure critical thinking and understanding abilities in high school students; Nurrahmi, Utaya, & Utomo (2017), to measure critical thinking abilities in college students; Istiqomah & Nurulhaq (2021), to measure connection abilities; Zubainur, Jannah, Syahjuzar, & Veloo (2020) to measure mathematicals reasoning abilities. However, none of the those initial studies results had examined about implementation of discovery learning approach assisted by GeoGebra towards mathematicalss communication ability of vocational school students.

Thus, this research emphasizes on the implementation of GeoGebra-assisted discovery learning approach as an effort to improve vocational school students' mathematicals communication ability. Purpose of this research is to examine whether the implementation of GeoGebra-assisted discovery learning approach is effective in improving vocational school students' mathematicals communication ability or not. The result of this research is really important in which it can provide an overview of the effectiveness of implementing the GeoGebra-assisted discovery learning approach especially in improving mathematicals communication ability. Besides that, the result of this research also can provide alternative learning approach for teachers to be implemented in classrooms as an effort to enhance mathematicals communication ability of students.

METHODS

Quasi-experiment method is the method used in this research. This method was used because the sample selection was carried out randomly in the class, not randomly in the students. This research requires two groups of students each consists of 30 students. One group, called experimental group, was treated by discovery learning approach assisted by GeoGebra and another one, namely control group, was treated on conventional teaching approach. Before and after the treatment both classes are given tests. The design of this research described as follows:

E	O	X	O
K	O		O

Notes :

E	:	experimental group
K	:	control group
O	:	Pretest/Posttest
X	:	The treatment is provided in the form of a Discovery Learning model with the help of GeoGebra

Samples of this research were 60 students of Gema Karya Bahana Vocational School which is located in Bekasi. Those samples divided into two groups in which 30 students of Accounting-1 class as the experimental group and 30 students of Accounting-2 as the control

group. Data used to measure students' communication ability on linear programming material were collected from a descriptive test of 3 questions. There are three indicators of mathematicals communication ability that will be examined in this research, such as:

MBN : Communicate mathematicals ideas in the form of real objects, pictures, diagramss

MIS : using real objects, pictures, graphs and algebra using both spoken and written language to explain ideas, situations and mathematicals relation

MPS : Using linguistic forms or mathematicals symbols to express everyday situations

The data analyzed using descriptive and inferential statistics technique which includes: normality test, homogenity test and t test and used SPSS application software as a tool to do it. The steps taken in this research are: (1) Carrying out a literature review regarding the Discovery learning model and mathematicals communication ability; (2) Creating learning tools that include creating RPPs and LKPD and questions used to measure communication ability; (3) Choosing classrooms that will be used as an experimental group and control one; (4) Socializing the implementation of GeoGebra in discovery learning approach; (5) Carrying out a pre-test to measure the initial result of abilities of both experimentaland control groups; (6) Conducting instructionals process that takes six meetings of 3 x 45 minutes for each groups; (7) Carrying out a posttest to examine final result of students' ability after treatment; (8) Scoring students' test; (9) Conducting analysis of hypotheses following inferential statistics step; and (10) Making research reasoning and conclusion.

RESULTS AND DISCUSSION

Results

The results of pre-test, post-test and the grade of n-gain scores are shown in Table 1 as follows:

Table 1. Results of Pretest, Posttest and n-Gain

Statistics	Experimental Group			Control Group		
	Pretest	Posttest	N-Gain	Pretest	Posttest	n-Gain
$\underline{x}$	40,90	82,20	0,73	37,90	72,60	0, 53
s	6,65	6,74	0,16	7,00	5,27	0,08
n	30	30	30	30	30	30

Maximum score: 100

Based on Table 1, if you compare the averages of pre-test scores of the experimental group with the average of control group, there is a tiny difference between them. It can be presumed that there is no significant difference in mathematicals communication abilities of those two groups of students. In the post-test, the difference of averages between students in both groups showed significant differences. Thus, it can be concluded that the communication ability of students received GeoGebra-assisted discovery learning approach as learning treatment performed a better score than those who were not. Furthermore, the n-gain score also showed the difference between the average n-gain for the two groups. It showed that the increase of students' mathematicals communication ability of those who used GeoGebra-assisted discovery learning was higher than those who didn't.

The next step of data analysis is to test normality of the two groups. Normality test results are presented in Table 2.

Table 2. Summary of Normality Test

Test	Group	Kolmogorov-Smirnov		
		Stat.	df	Sign
Pretest	Experimental group	0,120	30	0,200
	Control group	0,106	30	0,200
Posttest	Experimental group	0,143	30	0,122
	Control group	0,138	30	0,14
n-Gain	Experimental group	0,175	30	0,019
	Control group	0,150	30	0,084

According to the findings in Table 2, it was observed that both groups had samples originating from a normal distribution during the pretest. Similarly, in the posttest, it was noted that both groups had samples deriving from a normal distribution. However, regarding to n-Gain, it was discovered that the experimental group that utilized discovery learning with GeoGebra assistance had samples from non-normally distributed populations, while the control group that treated conventionals method had samples from populations with a normal distribution.

For the pretest and posttest, the homogenity test is then used. Meanwhile, for n-Gain, the Mann-Whitney test is then used. From the results of data processing, summary of homogeneity tests is shown in Table 3.

Table 3. Summary of Homogenity Test

Tes	Uji Lavene	df 1	df 2	Sign
Pretest	0,049	1	58	0,83
Posttest	1,577	1	58	0,21

From Table 3 it could be seen that pretest and posttest have both homogeneous variances.

Next, hypothesis testing for pretest and posttest was carried out using the t-test. Due to condition of sample that was not normally distributed, n-gain examination was carried out using the Mann-Whitney test. Summary of hypothesis testing is shown in Table 4 below.

Table 4. Summary of Hypothesis Testing

Tes	t/z	Sign.	Interpretation
Pretest	1,70	0,94	H_o accepted
Posttest	6,15	0,00	H_o rejected
n-Gain	-4,55	0,00	H_o rejected

Table 4 showed us that the pretest scores of students whose learning using the GeoGebra-assisted discovery learning and those who using conventionals one were had no significant difference. It can be conluded that initial mathematicals communication ability of them were at the same level. However, The result of n-gain concluded that the increase in students' mathematicals communication ability using the discovery learning approach assisted by GeoGebra is better than those who treated by conventional approach.

Apart from the results above, the results of students' difficulties in solving mathematicals communication problems were also obtained. The results of students' difficulties are shown in Table 5.

Table 5. Student Difficulties in Mathematicals Communication Ability

No	Experimental group			Control group		
	Indicator	%	Category	Indicator	%	Category

1.	MBN	85,00	Not Difficult	MBN	74,22	Difficult
2.	MIS	84,22	Not Difficult	MIS	74,67	Difficult
3.	MPS	78.08	Not Difficult	MPS	69,75	Difficult

Giving the percentage of mathematicals communication ability above, based on the determined KKM of Gema Karya Bahana Vocational School which stated that If it is less than 75% is categorized as difficult and if it is more than 75% it is categorized as not difficult, students who utilized discovery learning approach with the assistance of GeoGebra experienced no impediments in their mathematicals communication ability. It was proved by their test scores which consistently surpasses 75%. On the other hand, those who utilized conventional teaching approach had difficulty on their mathematicals communication abilities proven by their test scores that never reached 75%. Those facts reaffirm the notion that the discovery learning approach trumps conventional learning approaches in terms of effectiveness.

Discussions

The result of this research proved that the implementation of GeoGebra-assisted discovery learning can significantly enhance students' comprehension of mathematicals concepts. With the help of GeoGebra, abstract concepts can be illustrated into more concrete ones that will allow students to bridge their thinking patterns to solve problems and communicate their results effectively with both teachers and peers. Thus, learning using Discovery Learning can develop abilities in mathematicals communication. This thing is in accordance to research conducted by Purnama & Aldila, (2016); Suliswa, Rosmaiyadi, & Buyung (2017); Sugandi & Bernard, (2018), which stated that the application of innovative approaches or models is effective in developing students' mathematicals communication abilities. Purnama & Aldila, (2016), uses a complete sentence type cooperative learning model and team quiz; Tanjung, (2017), uses a problem-based learning model; Suliswa, Rosmaiyadi, & Buyung, (2017), used the snowball throwing learning model.

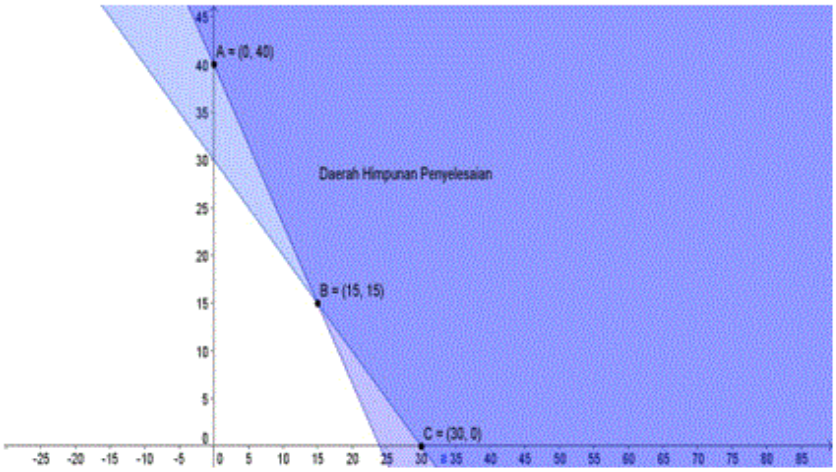
Among the reasons why students' mathematicals communication ability whose learning uses the discovery learning approach are better than ordinary learning is that the discovery learning approach can foster students' curiosity about unfamiliar mathematicals concepts. This is in line with one of the advantages of discovery learning, namely growing and increasing students' curiosity (Thorsett, 2021). The way to overcome students' curiosity is by reading books, holding discussions and exchanging ideas with their classmates. This step is contained in the steps of discovery learning, at the problem statement and data collection stages, and it is also included in the indicators of mathematicals communication in the form of reading with understanding or written mathematicals presentations, conducting discussions and exchanging ideas in presenting the results of discussions.

Apart from that, the learning atmosphere becomes more interesting because students are actively involved in learning proccess, especially when presenting the results of group discussions. There are question and answer activities between groups to gather other information that can deepen understandings of the material being studied. Another remarkable result of this research also implied that GeoGebra software is able to attract students' interest and motivation to learn because it is connected directly to students' cellphones which are commonly held and easily found on the internet (Batubara, 2017). More, this software is also able to display graphs and areas of an equation with boundaries. Certaintly, this thing makes students easier to present and discuss the results of their learning. Furthermore, using GeoGebra software can develop students' mathematicals communication ability in a way that GeoGebra can make mathematicals concepts that were originally abstract become more concrete. In linear programs, the GeoGebra is commonly used to illustrate graphics of certain

equations both equal or not, conclusion area and optimum or minimum scores. The use of GeoGebra in linear programs as used in this study is shown in the picture below.

Masalah
Salah satu sekolah SMA di Kabupaten Bekasi mengadakan kegiatan perkemahan pramuka. Pada perkemahan tersebut rencananya akan menggunakan 2 jenis tenda yaitu tenda A dan tenda B. Tenda A dapat menampung 5 orang dan tenda B dapat menampung 3 orang. Jumlah peserta perkemahan sebanyak 120 orang. tenda yang dibutuhkan tidak kurang dari 30 buah. Harga tenda A sebesar Rp 500.000 dan tenda B sebesar Rp 250.000. Berapakah tenda A dan tenda B yang dibutuhkan agar biaya yang dikeluarkan minimum.

Penyelesaian:
Menggambar grafik himpunan penyelesaian menggunakan aplikasi Geogebra



Picture 1. The use of Geogebra in Linear Program

CONCLUSIONS

The implementation of GeoGebra-assisted discovery learning is effective in improving vocational school students' mathematicals communication ability. GeoGebra-assisted discovery learning could be implement on classrooms as a bridge to develop students' abilities in mathematicals communication as well as one of efforts to present abstract mathematicals concepts and ideas into more concrete ones. For further research, you can apply the discovery learning approach to other higher level thinking abilities and different sample subjects.

REFERENCES

Anggraeni, N. S., & Sundayana, R. (2021). Kemampuan Komunikasi Matematis Siswa dengan Pembelajaran Kooperatif Tipe Group Investigation dan Team Quiz Ditinjau dari Kemandirian Belajar. Plusminus: *Jurnal Pendidikan Matematika*, 1(3), 469-480.

Arbain, N., & Shukor, N. A. (2015). The effects of GeoGebra on students achievement. *Procedia-Social and Behavioral Sciences*, *172*, 208-214.

Ariawan, R., & Nufus, H. (2017). Hubungan Kemampuan Pemecahan Masalah Matematis dengan Kemampuan Komunikasi Matematis Siswa. *Theorems: The Original Research of Mathematics*, 1 (2), 82–91.

Asmara, R., & Afriansyah, E. A. (2018). Perbedaan peningkatan kemampuan komunikasi

matematis siswa antara model eliciting activities dan discovery learning. *Suska Journal of Mathematics Education*, *4*(2), 78-87.

Aziz, A., Budiyono, & Subanti, S. (2015). Eksperimentasi Model Pembelajaran Inquiry Learning Dan Discovery Learning Terhadap Prestasi Belajar dan Kemampuan Komunikasi Matematis pada Materi Bangun Ruang Sisi Datar Ditinjau dari Kecerdasan Spasial Siswa Kelas VIII SMP Negeri Se-Kota Surakarta. *JMEE*, V(1), 11–24.

Batubara, I. H. (2017). Peningkatan Kemampuan Pemahaman Konsep Matematis Melalui Model Pembelajaran Berbasis Masalah Berbantuan Autograph Dan GeoGebra di SMA Free Methodist Medan. *MES: Journal of Mathematics Education and Science*, 3(1), 47–54. https://doi.org/https://doi.org/10.30743/mes.v3i1.219

Danial, M., Gani, T., & Husnaeni. (2017). Pengaruh Model Pembelajaran dan Kemampuan Awal Terhadap Kemampuan Berpikir Kritis dan Pemahaman Konsep Peserta Didik. *Journal of EST*, 3(1), 18–32.

Delyana, H. (2014). Peningkatan Kemampuan Komunikasi Matematis dan Disposisi Matematis Siswa SMP Melalui Penerapan Strategi the Firing Line dalam Pembelajaran Matematika(*Unpublished master's thesis*). *Universitas Pendidikan Indonesia*, Bandung.

Dewi, M. W. K., & Nuraeni, R. (2022). Kemampuan Komunikasi Matematis Siswa SMP ditinjau dari Self-Efficacy pada Materi Perbandingan di Desa Karangpawitan. *Plusminus: Jurnal Pendidikan Matematika*, 2(1), 151-164

Fatmasuci, F.W.(2017). Pengembangan perangkat pembelajaran berbasis masalah berorientasi pada kemampuan komunikasi dan prestasi belajar matematika siswa SMP. *Jurnal Riset Pendidikan Matematika*, 4(1), 32-42. doi: https://doi.org/10.21831/jrpm.v4i1.11325

Gusmania, Y., & Marlita, M. (2016). Pengaruh Metode Discovery Learning Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Kelas X SMAN 5 Batam Tahun Pelajaran 2014/2015. *Pythagoras: Jurnal Program Studi Pendidikan Matematika*, *5*(2).

Habsah, F. (2017). Developing Teaching Material Based on Realistic Mathematics and Oriented to Mathematicals Reasoning and Mathematicals Communication. *Jurnal Riset Pendidikan Matematika*, 4(1), 43-55. doi: https://doi.org/10.21831/jrpm.v4i1.10199

Hartati, S., Abdullah, I., & Haji, S. (2017). Pengaruh Kemampuan Pemahaman Konsep, Kemampuan Komunikasi dan Koneksi Terhadap Kemampuan Pemecahan Masalah. *Jurnal Pendidikan Matematika*, 11(2),41-5943–72.doi: https://doi.org/10.22342/jpm.11.2.3354.41-60

Istiqomah, Q. & Nurulhaq, C. (2021). Perbandingan Kemampuan Koneksi Matematis Siswa antara Model Pembelajaran Discovery Learning dan Ekspositori. *PLUSMINUS: Jurnal Pendidikan Matematika* Vol. 1, No. 1, Maret 2021, Hal. 135-144.

Jainuri, M., Rais, H., & Sutiana, N. (2019). Pengaruh Metode Discovery Learning Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Kelas VIII SMPN 3 Merangin. *Mat-Edukasia*, 4(2), 74–79.

Junita, R. (2016). Kemampuan Representasi dan Komunikasi Matematis Peserta Didik SMA Ditinjau dari Prestasi Belajar dan Gaya Kognitif. *Pythagoras: Jurnal Pendidikan Matematika*, 11(2), 193-206. doi: https://doi.org/10.21831/pg.v11i2.10655

Luritawaty, I. P. (2016). Upaya Meningkatkan Kemampuan Komunikasi Matematis Melalui Metode Diskusi Berbantuan Microsoft Office Excel. *Mosharafa: Jurnal Pendidikan Matematika*, 5 (3), 213-221.

Majid, A. (2015). Pendekatan Ilmiah dalam Implementasi Kurikulum 2013. Bandung: PT Remaja Rosdakarya.

Muhamad, N. (2017). Pengaruh Metode Discovery Learning untuk Meningkatkan Representasi Matematis dan Percaya Diri Siswa. *Jurnal Pendidikan UNIGA, 10*(1), 9-22.

Nganga, L. (2019). Preservice teachers' perceptions and preparedness to teach for global mindedness and social justice using collaboration, critical thinking, creativity and communication (4cs). *Journal of Social Studies Education Research*, 10(4), 26–57.

Nurrahmi, Y., Utaya, S., & Utomo, D. H. (2017). Pengaruh Model Pembelajaran Discovery Learning Terhadap Kemampuan Berpikir Kritis Mahasiswa. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, 2(10), 1308–1314.

Purnama, I. L., & Aldila, E. (2016). Kemampuan Komunikasi Matematis Siswa Ditinjau Melalui Model Pembelajaran Kooperatif Tipe Complete Sentence dan Team Quiz. Jurnal Pendidikan Matematika, 10(1), 27–43.

Purnamasari, A., & Afriansyah, E. A. (2021). Kemampuan Komunikasi Matematis Siswa SMP pada Topik Penyajian Data di Pondok Pesantren. *Plusminus: Jurnal Pendidikan Matematika*, 1(2), 207-222.

Putri, N. I. P., & Sundayana, R. (2021). Perbandingan Kemampuan Komunikasi Matematis Siswa antara Problem Based Learning dan Inquiry Learning. *PLUSMINUS: Jurnal Pendidikan Matematika*, 1(1), 157-168.

Putri, A., Roza, Y., & Maimunah, M. (2020). Development of learning tools with the discovery learning model to improve the critical thinking ability of mathematics. *Journal of Educational Sciences*, 4(1), 83-92.

Sari, R. M. V. N., Ardana, I. M., & Suweken, G. (2021). Pengaruh Model Pembelajaran CPS Berbantuan GeoGebra terhadap Kemampuan Berpikir Kreatif dan Pemecahan Masalah Matematika. *Jurnal Ilmiah Pendidikan Matematika*, 9(2), 2021, 99-113.

Scott, C. L. (2015). What kind of learning for the 21st century? Education Research and Foresight, United Nations Educational, Scientific and Cultural Organization (UNESCO).

Simamora, R. E., & Saragih, S. (2019). Improving Students' Mathematicals Problem-Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. International Electronic. *Journal of Mathematics Education*, 14(1), 61-72.

Sugandi, A.I. & Bernard, M. (2018). Penerapan Pendekatan Kontekstual Terhadap Kemampuan Pemahaman dan Komunikasi Matematis Siswa SMP. *Jurnal Analisa*. 4 (1) (2018) 16-23.

Sukoco, H., & Mahmudi, A. (2016). Pengaruh Pendekatan Brain-Based Learning Terhadap Kemampuan Komunikasi Matematis dan Self-Efficacy Siswa SMA. *Pythagoras: Jurnal Pendidikan Matematika*, 11(1), 11-24. doi: https://doi.org/10.21831/pg.v11i1.9678

Suliswa, Rosmaiyadi, & Buyung. (2017). Pengaruh Model Pembelajaran Snowball Throwing

Terhadap Kemampuan Komunikasi Matematis Siswa. *Jurnal Pendidikan Matematika Indonesia*, 2(1), 37–41.

Sumartini, T. S. (2019). Kemampuan Komunikasi Matematis Mahasiswa melalui Pembelajaran Think Talk Write. *Mosharafa: Jurnal Pendidikan Matematika*, 8(3), 377-388.

Tanjung, H.S. (2017). Peningkatan Kemampuan Komunikasi dan Matematis Siswa SMA melalui Model Pembelajaran Berbasis Masalah. Jurnal Maju, Volume 4 No. 2, September 2017 , Page : 42-54.

Thorsett, P. (2021). Discovery Learning Theory A Primer for Discussion. http://limfabweb.weebly.com/uploads/1/4/2/3/14230608/bruner_and_discovery_learning.pdf

Wijayanto, A. D., Fajriah, S. N.,& Anita, I. W. (2018). Analisis Kemampuan Komunikasi Matematis Siswa SMP pada Materi Segitiga dan Segiempat. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 2(1), 97–104. doi: https://doi.org/10.31004/cendekia.v2i1.36

Zubainur, C. M., Jannah, R., Syahjuzar, S., & Veloo, A. (2020). Kemampuan Penalaran Matematis Siswa Melalui Model Discovery Learning di Sekolah Menengah Aceh. *Jurnal Serambi Ilmu, 21*(1), 148-170.