The Effect of Self-efficacy and Mathematical Anxiety on Students' Mathematical Communication Skills

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ABSTRACT

This study aims to identify and examine the effect of self-efficacy and mathematical anxiety on students' mathematical communication skills. This study used a quantitative method with a survey design. The population of this study was students of class X at SMA Negeri 2 Cianjur and the sample used was students of class X-D to X-G, totaling 34 students. The sampling technique was carried out by purposive sampling. Data regarding self-efficacy and mathematical anxiety using a questionnaire each amounted to 20 statements and data regarding students' mathematical communication abilities used a test which amounted to 5 description questions with quadratic function material. The data processing technique used is multiple linear regression tests, by fulfilling the prerequisite tests including the normality test, homoscedasticity test, linearity test and multicollinearity test. Based on the research results, it was found that the P value was 0.074, meaning > 0.05, then H_0 was accepted and H_1 was rejected. This means that there is no influence between self-efficacy and mathematical anxiety on students' mathematical abilities.

Keywords: *self-efficacy*, *mathematical anxiety*, *mathematical communication skills*

Introduction

The progress of a nation is marked by the advancement of opportunities to obtain a broad and quality education for its people (Takeuchi & Shinno, 2020). Education is essentially an activity that is consciously and deliberately, and full of responsibility carried out by adults to children so that interactions arise from both of them so that the child reaches the desired maturity and continues (Palomares-Ruiz et al., 2020; Septian & Maghfirah, 2021). Mathematics learning competence includes several things, namely: ownership of values and attitudes, mastery of concepts, and skills to apply them in life (Septian et al., 2022). Explains education as a process built by society to bring new generations towards progress in certain ways according to abilities that are useful for achieving the highest level of progress (Schneider & Council, 2020). High education in order to make the next generation have better intelligence (Hakim et al., 2022; Khofifah et al., 2021; Septian & Rahayu, 2021). Therefore, the progress of a nation is marked by the advancement of opportunities to obtain a broad and quality education for its people.

Communication is a process of selecting and sending symbols in such a way as to help listeners evoke meaning or responses from their minds that are similar to what the communicator intended (Hakim et al., 2022; Rahmawati et al., 2023; Soleh et al., 2020). Mathematical communication is an important skill in mathematics, namely the skills to coherently express mathematical ideas to friends, teachers, and others through spoken language and writing (Ramadhan & Minarti, 2018). Mathematical communication is an important skills for students to have in learning activities. Greenes & Shulman suggests that: mathematical communication is (1) the center of power for students in formulating concepts and strategies for solving mathematical problems, (2) capital for students to approach and solve problems in mathematical exploration and investigation, (3) a place for students to communicate with friends to get discoveries, brainstorm, assess and sharpen mathematical ideas.

Based on the research results found in Rahmawati et al. (2023) it was stated that students' mathematical communication abilities were still relatively low. One of them according to Mayestika (2016) in his research concluded that the mathematical communication abilities of the junior high school students he studied were low, as seen from the student gains, namely 77.5% of students had low mathematical communication skills and the average student communication skills was 42.44. The results of research by Saparudin & Effendi (2019), which was conducted in a school in Karawang Regency, West Java, showed that students' mathematical communication skills were classified as very low. This can be seen from the results of the mathematical communication skills description test of 29 students, a maximum score of 20 is obtained so that in terms of the categorization of students' mathematical communication abilities it is very low. Judging from the results of the students' answers, no one met every indicator of mathematical communication skills. This problem also occurred in the class studied, in previous observation data it was found that their mathematical communication skills were still low, namely having an average score of 55.29.

Besides the aspect of knowledge (cognitive), one's learning success is determined by the affective domain. Someone will achieve optimal learning outcomes if he is interested in a subject. Confidence in their abilities is a positive attitude that can trigger optimal learning outcomes, with an optimistic attitude that students will be successful in their studies (Hidayat & Sariningsih, 2018). This is in line with the opinion of Canfields & Watkins (Hendriana et al., 2017) stating that student success can be influenced by his own view of his abilities, and this view is repeated, sustainable, difficult to change, and entrenched in the student. Mathematical self-efficacy (self-skills) is one of the affective domains that influences mathematical communication skills (Hendriana & Kadarisma, 2019).

Self-efficacy can make a good contribution to mathematical communication skills. In the research conducted Sanhadi (2015) states that self-efficacy and mathematical communication can make

a positive contribution to student achievement. States that self-efficacy is a person's belief in managing and completing the action programs needed to produce the expected results. Tenacity in carrying out the action process can be formed, when experiencing difficulties to achieve success. Self-efficacy can be linked to the skills to set strategies in solving problems. Success for students can be related to the effect of the tenacity that has been done, one of which is the achievement of good learning achievement (Bandura, 2012). Self-efficacy has the notion of a person's assessment of his own skills to carry out certain behaviors or achieve certain goals. Based on the understanding and opinion above, it can be concluded that it is necessary for every student to have high self-efficacy in learning mathematics. Therefore, the higher a person's self-efficacy towards his own abilities, the stronger the enthusiasm to complete his work or problem.

The affective aspect that is thought to reduce the level of students' mathematical communication skills is the low level of mathematical anxiety. Anxiety is an uncomfortable feeling that often occurs in human daily life. Anxiety is an expression of individual feelings towards a situation which can be expressed in several ways, namely: in an easily recognized way such as individual worry, the individual becomes irritable. Anxiety can be seen from individual worries or fears of certain things, for example: anxiety in mathematics (El-Adl & Alkharusi, 2020; Herawaty et al., 2019). Mathematical anxiety is very important to research because several things influence student achievement because mathematics is considered difficult and causes anxiety in students, so this research will reveal its influence on mathematical communication skills which are part of the mathematical abilities that students must master.

Based on some of the findings above, it can be concluded that there has been no research that combines self-efficacy and mathematical anxiety on students' mathematical communication abilities. So we need a study that discusses the Effect of Self-efficacy and Mathematical Anxiety on Students' Mathematical Communication Skills. This research has novelty because there has been no previous research that examines this matter.

Methods

This research is a descriptive research with a quantitative approach. This study uses a survey design. The purpose of this study was to determine the effect of self-efficacy and mathematical anxiety on students' mathematical communication skills. The variables used in this research are self-efficacy, mathematical anxiety, and mathematical communication skills. This research was conducted at SMA Negeri 2 Cianjur in March 2023. The population of this research was students from SMA Negeri 2 Cianjur for the academic year 2022/2023. The sample and subject of this study were 34 students of class

X-D to X-G SMA Negeri 2 Cianjur. The sampling technique was carried out by purposive sampling. Data collection was carried out using a survey method by administering a test instrument with the help of Google and distributing questionnaires with the help of the Google form. Data analysis to describe the results was done manually. The research instruments used were test and non-test instruments. The test instrument is used to measure mathematical communication skills. Meanwhile, non-test instruments are used to measure self-efficacy and mathematical anxiety. The data processing technique used is multiple linear regression tests, by fulfilling the prerequisite tests including the normality test, homoscedasticity test, linearity test and multicollinearity test.

Results and Discussion

The participants in this study were 34 students from class X-D to X-G at SMA Negeri 2 Cianjur. The results of this study discuss the effect of self-efficacy and mathematical anxiety on students' mathematical communication abilities.

Self-efficacy and mathematical anxiety are measured using a questionnaire instrument. However, mathematical communication skills using test instruments. Therefore, the test used is a multiple linear regression test performed on the JASP-16 application. The prerequisite tests that must be carried out in the multiple linear regression test are the normality test, homoscedasticity test, linearity test, and multicollinearity test.
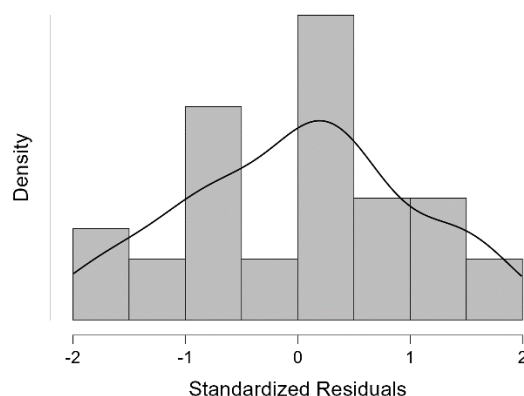
Figure 1. *Test of Normality Assumptions Effect of Self-efficacy and Mathematical Anxiety on Students' Mathematical Communication Skills*

In figure 1, it is known to see whether the residual data is normally distributed or not, seen from the histogram image of standardized residuals in the data processing application, namely JASP-16, it can be seen in the histogram that the data are normally distributed because the results obtained are close to 0 or close to the average. And the data is getting sideways, the line is decreasing.
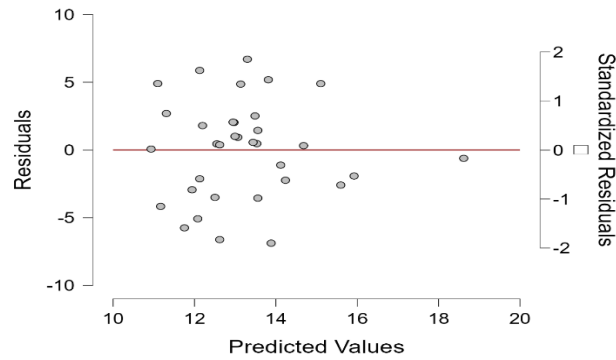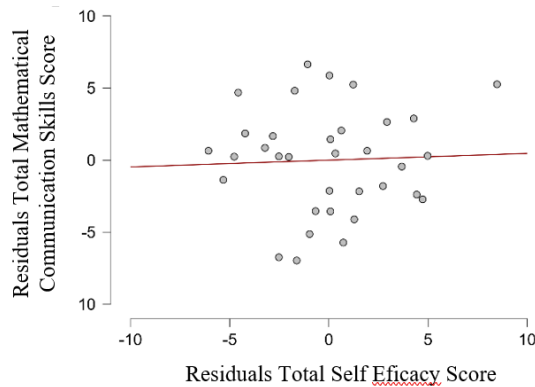
Figure 2. *Homoscedasticity Assumption Test Effect of Self-efficacy and Mathematical Anxiety on Students' Mathematical Communication Skills*
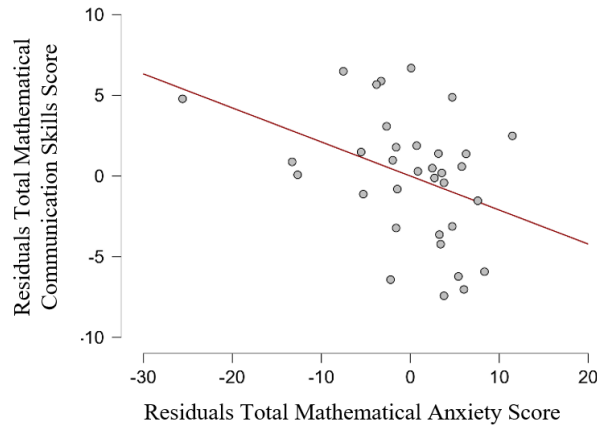
In Figure 2, it is known to see the data there are variables that influence or not. Viewed from the residual vs predicted in the JASP-16 application. It can be seen that the lines are sloping and the points are random, meaning that the residuals here are not influenced by other variables. So, the homoscedasticity assumption test is fulfilled.

Figure 3. *Test of Linearity Assumptions Effect of Self-efficacy on Mathematical Communication Skills*

In Figure 3, it is known to see that the data is linearity or not, it can be seen from the partial

regression plots in the JASP-16 application. Self-efficacy and mathematical communication skills look linear because they form a straight line and the dots in the image are random or do not form a pattern. So, the linearity assumption test is fulfilled.

Figure 4. *Linearity Assumption Test of the Effect of Mathematical Anxiety on Mathematical Communication Skills*

In Figure 4, it is known to see that the data is linearity or not, it can be seen from the partial regression plots in the JASP-16 application. Mathematical anxiety and mathematical communication skills look linear because they form a straight line and the dots in the image are random or do not form a pattern. So, the linearity assumption test is fulfilled.

Table 1. *Test of Multicollinearity Assumptions Effect of Self-efficacy and Mathematical Anxiety on Mathematical Communication Skills*

Coefficient

Model		Unstandardized	Standard Error	Standardized	t	p	Colleniarity Statistic	
H_0	(Intercept)	13.206	0.674		19.596	9.538e-20		
H_1	(Intercept)	22083	9.773		2.260	0.031		
	self-eficacy	0.047	0.195	0.042	0.241	0.811	0.897	1.115
	mathematical anxiety	-0.211	0.091	-0.405	-2.322	0.027	0.897	1.119

Based on Table 1, which contains the multicollinearity assumption test using the help of the JASP-16 application, the VIF value is 1.115, meaning <10, so multicollinearity does not occur. This means that multicollinearity in the data is safe.

Table 2. *Model Summary – Mathematical Communication Skills*

Model	R	R^2	Adjusted R^2	RMSE
H_0	0.000	0.000	0.000	3.930
H_1	0.393	0.155	0.100	3.727

Based on Table 2, it can be seen in H_1 which is the hypothesis that R^2 (explanatory variant/effective contribution) of the mathematical communication skills variable which can be explained in the self-efficacy and Mathematical Anxiety variables is 0.155/15.5%.

Table 3. ANOVA. Multiple Linear Regression Test of self-efficacy and mathematical anxiety on students' mathematical communication abilities

Model		Sum of Squares	df	Mean Square	F	P
H_1	Regression	78.847	2	39.423	2.837	0.074
	Residual	430.712	31	13.894		
	Total	509.559	33			

Based on Table 3, which contains multiple linear regression tests using the help of JASP-16. The hypothesis used is as follows:

$H_{0=}\rho = 0$ (no effect)

$H_{1=}\rho \neq 0$ (there is influence)

The criteria for the toll test are H_0 if the p-value <0,05.

The p-value is 0.074, meaning >0.05, then H_0 is accepted and H_1 is rejected. This means that there is no influence between Self-efficacy and Mathematical Anxiety on Mathematical Communication Skills in students of SMA Negeri 2 Cianjur.

The results of this study indicate that there is no influence between self-efficacy and mathematical anxiety on students' mathematical communication skills at SMA Negeri 2 Cianjur. In contrast to Hamidah, (2020) which found that a person's self-efficacy has a large influence on mathematical communication skills. This means that the higher a person's self-efficacy for his abilities both in formulating concepts, conveying ideas, and sharpening ideas to convince others, the higher his mathematical communication skills. Conversely, the lower a person's self-efficacy, the lower his mathematical communication skills. Another factor behind the absence of influence between self-efficacy and mathematical communication skills is the lack of motivation or support provided by teachers to students.

In this study there was no influence between self-efficacy and mathematical anxiety on mathematical communication skills because it was hampered by several factors when conducting the research. The most prominent is personality or psychological and emotional factors. If a student always has a feeling of fear of having it, then there will be no self-confidence and a lack of students' mathematical communication skills. According to Lauster, there are several characteristics of a

confident person (Noviyana et al., 2019). Namely: a) believe in one's own abilities, namely a belief in oneself for all phenomena that occur that are related to the individual's skills to evaluate and overcome these phenomena, b) act independently in making decisions, namely being able to act in making decisions against oneself independently or without the involvement of other people and being able to believe in the actions taken, c) having a positive sense of oneself, namely having a good self-assessment, both in terms of views and actions taken that give rise to a positive sense of self and its future , d) dare to express opinions, meaning that there is an attitude to be able to express something within yourself that you want to express to others without any coercion or feeling that can hinder such disclosure.

Students' mathematical communication skills can be seen from oral or written. This could just be the lack of students communicating mathematically in verbal terms or vice versa. Because communication skills are one of the abilities that students must master when learning mathematics. In line with Anggriani & Septian (2019) argues that mathematical communication skills is the skills of students to communicate their mathematical ideas both orally and in writing so that these students can develop their own understanding and can build their knowledge and students can also relate learning experience in learning actual mathematical concepts.

Literature review of previous research matters that affect mathematical communication including factors that influence students' written mathematical communication skills including the learning process, student attitudes and understanding, as well as habituation or giving questions that can measure mathematical communication skills routinely (Hikmawati et al., 2019). other factors that influence mathematical communication skills, namely internal factors in psychological aspects such as attitudes, talents, interests, motivation and personality (Putri & Sundayana, 2021). Although it was found that self-efficacy and mathematical anxiety were part of the attitudes that would affect mathematical communication skills, this was because there was no effect on self-efficacy, so there was no influence between self-efficacy and mathematical anxiety on students' mathematical communication abilities.

Conclusion

The results of the study it can be concluded that there is no effect between Self-efficacy and Mathematical Anxiety on Mathematical Communication Skills in students at SMA Negeri 2 Cianjur. With this research, it is hoped that it can become a reference in improving students' mathematical communication skills through a high sense of self-efficacy in learning, especially mathematics. Then, students can control their mathematical anxiety towards learning mathematics so that they are more optimistic in working on the questions given by the teacher, especially in practicing mathematical communication skills. Subjects or participants are very limited both in terms of quantity and time in

sampling. Therefore, the researcher recommends those who wish to conduct similar research or follow-up research on the study "The Effect of Self-efficacy and Mathematical Anxiety on Students' Mathematical Communication Skills" to take a wider range of subjects in order to find more detailed results.

References

Akkaya, S., & Polat, K. (2022). An Investigation of the Relationship between the Parents' Math Literacy Self-Efficacy and Their Math Anxieties. *Educational Policy Analysis and Strategic Research*, *17*(2), 246–265. https://doi.org/10.29329/epasr.2022.442.11

Anggriani, A., & Septian, A. (2019). Peningkatan Kemampuan Komunikasi Matematis dan Kebiasaan Berpikir Siswa Melalui Model Pembelajaran IMPROVE. *IndoMath: Indonesia Mathematics Education*, *2*(2), 105. https://doi.org/10.30738/indomath.v2i2.4550

Anita, I. W. (2014). Pengaruh Kecemasan Matematika (Mathematics Anxiety) Terhadap Kemampuan Koneksi Matematis Siswa Smp. *Infinity Journal*, *3*(1), 125. https://doi.org/10.22460/infinity.v3i1.43

Bandura, A. (2012). Social cognitive theory. In *Handbook of Theories of Social Psychology: Volume 1* (pp. 349–374). https://doi.org/10.4135/9781446249215.n18

El-Adl, A., & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, learning motivation and mathematics achievement. *Cypriot Journal of Educational Sciences*, *15*(1), 104–111. https://doi.org/10.18844/cjes.v15i1.4461

Hakim, A. R., Supratman, S., & Madawistama, S. T. (2022). Proses Berpikir Representasi Matematis Siswa Berdasarkan Tipe Kepribadian Guardian dan Rasional. *Prisma*, *11*(1), 193. https://doi.org/10.35194/jp.v11i1.2150

Hamidah, M. P. (2020). Pengaruh Self-efficacy Terhadap Kemampuan Komunikasi. *Prosiding Seminar Nasional, Penelitian, Pendidikan Dan Penerapan MIPA*, *August*, 79–84.

Hendriana, H., Eti Rohaeti, E., & Hidayat, W. (2017). Metaphorical thinking learning and junior high school teachers' mathematical questioning skills. *Journal on Mathematics Education*, *8*(1), 55–64. https://doi.org/10.22342/jme.8.1.3614.55-64

Hendriana, H., & Kadarisma, G. (2019). Self-Efficacy dan Kemampuan Komunikasi Matematis Siswa SMP. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *3*(1), 153–164. https://doi.org/10.33603/jnpm.v3i1.2033

Herawaty, D., Gusri, S. A., Saputra, R., Liana, E., & Aliza, F. (2019). The mathematics communication of students in learning based on ethnomathematics Rejang Lebong. *Journal of Physics: Conference Series*, *1318*(1), 012074. https://doi.org/10.1088/1742-6596/1318/1/012074

Hidayat, W., & Sariningsih, R. (2018). Kemampuan Pemecahan Masalah Matematis dan Adversity Quotient Siswa SMP Melalui Pembelajaran Open Ended. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *2*(1), 109–118.

Hikmawati, N. N., Nurcahyono, N. A., & Balkist, P. S. (2019). Kemampuan Komunikasi Matematis Siswa Dalam Menyelesaikan Soal Geometri Kubus Dan Balok. *PRISMA*, *8*(1), 68. https://doi.org/10.35194/jp.v8i1.648

Khofifah, L., Supriadi, N., & Syazali, M. (2021). Model Flipped Classroom dan Discovery Learning terhadap Kemampuan Pemahaman Konsep dan Pemecahan Masalah Matematis. *PRISMA*, *10*(1), 17–29. https://doi.org/10.35194/jp.v10i1.1098

Mayestika, T. R. (2016). *Meningkatkan Kemampuan Komunikasi dan Koneksi Matematis serta Self-efficacy Siswa SMP melalui Pembelajaran Berbasis Masalah* (Doctoral dissertation, Universitas Pendidikan Indonesia).

Noviyana, I. N., Dewi, N. R., & Rochmad. (2019). Kemampuan Komunikasi Matematis Siswa Ditinjau Dari Self-Confidence. *Prisma, Prosiding Seminar Nasional Matematika*, *2*(1), 704–709. https://doi.org/10.25157/j-kip.v3i3.8769

Palomares-Ruiz, A., Cebrián, A., López-Parra, E., & García-Toledano, E. (2020). Influence of ICTs on math teaching-learning processes and their connection to the digital gender gap. *Sustainskills (Switzerland)*, *12*(16). https://doi.org/10.3390/su12166692

Putri, N. I., & Sundayana, R. (2021). Perbandingan Kemampuan Komunikasi Matematis Siswa antara Problem Based Learning dan Inquiry Learning. *Plusminus : Jurnal Pendidikan Matematika*, *1*(1), 157–168. https://doi.org/https://doi.org/10.31980/plusminus.v1i1.1034

Rahmawati, A., Cholily, Y. M., & Zukhrufurrohmah, Z. (2023). Analyzing Students' Mathematical Communication Skills in Solving Numerical Literacy Problems. *Mosharafa: Jurnal Pendidikan Matematika*, *12*(1). https://doi.org/10.31980/mosharafa.v12i1.1938

Ramadhan, I., & Minarti, E. D. (2018). Analisis Kemampuan Komunikasi Matematis Siswa SMP dalam Menyelesaikan Soal Lingkaran. *Journal of Medives : Journal of Mathematics Education IKIP Veteran Semarang*, *2*(2). https://doi.org/10.31331/medives.v2i2.624

Sanhadi, K. C. D. (2015). Pengaruh Kemampuan Penalaran dan Self-Efficacy terhadap Hasil Belajar Matematika Siswa Kelas VIII. *Seminar Nasional Matematika Dan Pendidikan Matematika Uny*, 341–350.

Saparudin & Effendi. (2019). Kemampuan Komunikasi Matematis Pada Peserta Didik SMP Kelas VII Terhadap Materi Bangun Dimensi Tiga. *Sesiomadika: Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika*, *c*, 687–694.

Schneider, S. L., & Council, M. L. (2020). Distance learning in the era of COVID-19. *Archives of Dermatological Research*, *0123456789*, 3–4. https://doi.org/10.1007/s00403-020-02088-9

Septian, A., Inayah, S., & Monika Putri, M. (2022). Peningkatan Kemampuan Pemahaman Konsep Matematika Siswa melalui Model Pembelajaran Flipped Classroom. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 2787–2798.

Septian, A., & Maghfirah, D. (2021). Mathematical Literacy Skills using Google Classroom on Trigonometry. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2515–2525. https://doi.org/10.24127/ajpm.v10i4.4263

Septian, A., & Rahayu, S. (2021). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa melalui Pendekatan Problem Posing dengan Edmodo. *PRISMA*, *10*(2), 170–181. https://doi.org/10.35194/jp.v10i2.1813

Soleh, E. R. A., Setiawan, W., & Haqi, R. (2020). Upaya Meningkatkan Kemampuan Komunikasi Matematis dan Aktivitas Belajar Siswa Menggunakan Model Problem Based Learning. *Prisma*, *9*(1), 1. https://doi.org/10.35194/jp.v9i1.798

Takeuchi, H., & Shinno, Y. (2020). *Comparing the Lower Secondary Textbooks of Japan and England :*

a Praxeological Analysis of Symmetry and Transformations in Geometry. 791–810.