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Differences in Mathematical Communication Ability and Self-Efficacy of Students Taught With Team Assisted Individualization and Think Pair Share Cooperative Learning Models Assisted by Digital Books

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Abstrak

Tujuan penelitian ini untuk mengetahui apakah terdapat perbedaan kemampuan komunikasi matematis dan self-efficacy siswa yang diajar dengan model pembelajaran kooperatif tipe TAI dan model pembelajaran TPS berbantuan buku digital dan mengetahui apakah terdapat interaksi antara kemampuan awal matematika dan model pembelajaran terhadap kemampuan komunikasi matematis dan self-efficacy. Jenis penelitian ini adalah qusi eksperimen yang dilaksanakan di SMKS Muhammadiyah 8 Medan. Hasil Penelitian diperoleh bahwa terdapat perbedaan yang signifikan pada kemampuan komunikasi matematis siswa antara kelompok yang mengikuti pembelajaran dengan model TAI dan kelompok yang mengikuti pembelajaran dengan model TPS. Siswa yang belajar dengan model TAI menunjukkan kemampuan komunikasi matematis yang lebih tinggi dibandingkan dengan siswa yang diajar dengan model TPS. Terdapat perbedaan yang signifikan pada self-efficacy siswa antara kelompok pembelajaran TAI dan TPS. Siswa dalam kelompok TAI memiliki tingkat self-efficacy yang lebih tinggi dibandingkan siswa kelompok TPS. Tidak terdapat interaksi yang signifikan antara kemampuan awal matematis dan model pembelajaran terhadap kemampuan komunikasi matematis dan self-efficacy siswa. Hal ini menunjukkan bahwa pengaruh model pembelajaran terhadap kemampuan komunikasi matematis dan self-efficacy berlaku secara konsisten disemua tingkat kemampuan awal, baik tinggi, sedang, maupun rendah.

***Kata Kunci**: Buku Digital, Kemampuan Komunikasi Matematis, Self-Efficacy, Team Assisted Individualization, Think Pair Share*

Abstract

The purpose of this study was to determine whether there were differences in mathematical communication skills and self-efficacy of students taught with the TAI type cooperative learning model and the TPS learning model assisted by digital books and to determine whether there was an interaction between initial mathematical abilities and learning models on mathematical communication skills and self-efficacy. This type of research is a quasi-experimental study conducted at SMKS Muhammadiyah 8 Medan. The results of the study showed that there were significant differences in students' mathematical communication skills between the group that followed learning with the TAI model and the group that followed learning with the TPS model. Students who learned with the TAI model showed

higher mathematical communication skills compared to students taught with the TPS model. There was a significant difference in student self-efficacy between the TAI and TPS learning groups. Students in the TAI group had a higher level of self-efficacy than students in the TPS group. There was no significant interaction between initial mathematical abilities and learning models on students' mathematical communication skills and self-efficacy. This shows that the influence of learning models on mathematical communication skills and self-efficacy applies consistently at all levels of initial ability, whether high, medium, or low.

Keywords: Digital Books, Mathematical Communication Skills, Self-Efficacy, Team Assisted Individualization, Think Pair Share,

A. Introduction

Mathematical communication skills are one of the essential aspects in learning mathematics. (Turmudi, 2019) states that communication is a way to spread ideas and clarify understanding in mathematics. This communication is important so that students are able to express their understanding of mathematical concepts and processes. (Ansari, 2018) mentions two important reasons for developing mathematical communication. First, Mathematics as Language, which explains that mathematics is an important tool for communicating ideas clearly and accurately. Second, learning mathematics as a social activity, which emphasizes that mathematics is a vehicle for interaction between students and between students and teachers. Mathematical communication skills have important indicators that students must have, according to NCTM (NCTM, 2020). However, the importance of mathematical communication is often not in line with conditions in the field. Based on the results of observations carried out at SMK Muhammadiyah 8 Medan Class XI, an initial test was conducted to measure students' mathematical communication skills through questions that were in accordance with the material that had been taught. Of the 30 students who worked on the questions, only 12 students were able to answer correctly.

However, the response reveals that pupils have not been able to meet the first sign of mathematical communication, namely communicating mathematical concepts in the form of visuals. (Sukoco, 2016) This inability develops when pupils do not grasp the challenges offered. As a consequence, the computed distance does not match the desired distance, and the final response concerning the total distance traveled is likewise inaccurate. This implies that pupils not only have difficulties grasping the topic, but also do not understand fundamental concepts, such as the area of flat objects. Based on the outcomes of these observations, it can be stated that students' mathematical communication abilities in the area are still inadequate (Dina, Z. H., Ikhsan, M., 2019). This can be observed from the numerous responses that are not proper, both in terms of the methods for solving and the ultimate outcomes (Ismail Hanif Batubara, Sahat Saragih, Elmanani Simamora, E Elvis Napitupulu, 2022) . Student mistakes include the failure to interpret issues into visuals, as well as errors in estimating the area and diameter of flat

objects, notably triangles. The insufficient comprehension of fundamental mathematical ideas is one of the key reasons of pupils' deficient mathematical communication abilities.

This is in accordance with (Nurullita., Surya, Edy. & Syahputra, 2017) who noted that "Self-Efficacy will affect motivation and achievement". In accordance with this, (Hamidah., 2018) claimed that “individuals who have high self-efficacy consider failure as a lack of effort, while individuals who have low self-efficacy consider failure to come from a lack of ability”. The researcher found poor self-efficacy in SMK Muhammadiyah 8 Medan pupils. Students who are passive in waiting for replies from friends or professors and those who lack confidence in expressing their ideas will usually answer questions if directed by the teacher. Several pupils told the researcher they were terrified of being incorrect and didn't enjoy arithmetic.

According to (Turmudi, 2009), "TPS is one method that can be used to solve mathematical communication problems in junior high school learning". Effective cooperative learning methods like TPS and TAI may increase math learning. According to (Hidayat, A dan Viora, 2018), "the mathematics learning achievement of students who are taught with the TPS cooperative learning model is as good as TAI and both are better than using conventional learning models". Also, (Rahmawati, Hasri., 2022) "states that the Team Assisted Individualization (TAI) type cooperative learning model produces better learning achievement compared to conventional learning models on the material of factors and multiples of numbers". Thus, one learning model must be compared to the TAI and TPS models to ensure that the learning applied is in line with constructivist learning theory, which requires students to communicate mathematically and have self-efficacy.

As seen above, mathematics learning begins with contextual problems presented by the instructor, not definitions, theorems, or qualities. Students must vocally and nonverbally express themselves. (Papyrina, V, Strebel.J, 2020) Students need self-efficacy to express their thoughts and ideas in their own language, both orally and non-verbally, in a way that others can understand. Researchers use mathematics learning to compare students' mathematical communication abilities and self-efficacy after explaining the problems and facts. As a result, the study's name is "Differences in Mathematical Communication Skills and Self-Efficacy of Students Taught with the Team Assisted Individualization (TAI) and Think Pair Share (TPS) Cooperative Learning Models Assisted by Digital Books".

B. Research Method

This is quasi-experimental research. The study was done in SMKS Muhammadiyah 8 Medan. The principal and math instructors have determined that this study will take place during the odd semester of the 2023/2024 academic year. This research included all students from class XI SMKS Muhammadiyah 8 Medan, which comprised five parallel classes: BM, TBSM, TKJ 1, TKJ 2, and DKV. This research used whole-cluster random sampling. This research sampled 53 students from experimental classes XI TKJ 1 and 2. Team Assisted

Individualization will be used for experimental class I, which has 27 students, and Think Pair Share for experimental class II, which has 26 students. Exams and questionnaires collect the data. This method collects accurate and trustworthy data on students' initial mathematics, mathematical communication, and self-efficiency skills. Self-ability and mathematical communication ability assessments are research equipment. The research involved two parallel courses that were randomly selected to represent the population, each with distinct learning applications. First and second classes used Team Assisted Individualization and Think Pair Share cooperative learning models, respectively (Sugiyono, 2018).

Table 1. Research Design

Experimental Class	Pretest	*Posttest*
Experiment I	X_1	T
Experiment II	X_2	T

Information:

X_1 = Treatment with cooperative learning model type *Team Assisted Individualization*.

X_2 = Treatment with cooperative learning model type *Think Pair Share*.

T = *Post-test*

Research variables are factors that play a role in the study. The variables of this study are:
Independent variable

The independent variable in this study is the cooperative learning model of the Team Assisted Individualization and Think Pair Share types. This second learning is said to be an independent variable because it affects other variables. In this study, the independent variables are:

Treatment Variable

The treatment variable in this study is the Team Assisted Individualization and Think Pair Share learning models.

Controlled Variable

The controlled variable in this study is the two groups that are subject to the treatment variable. So that the learning group of the cooperative learning model of the Team Assisted Individualization and Think Pair Share types gets the same teacher, number of hours and materials.

Dependent Variable

The dependent variable in this study is mathematical communication skills and self-efficacy after being given the Team Assisted Individualization and Think Pair Share learning model treatment. Mathematical communication skills are measured by tests and self-efficacy is measured by questionnaires at the end of learning.

C. Result and Discussion

The purpose of this data analysis is to determine the differences in mathematical communication skills and self-efficacy between students who were taught using the Team Assisted Individualization (TAI) and Think Pair Share (TPS) learning models assisted by digital books. Additionally, the analysis will look at the interaction between the learning model and the initial mathematical abilities of both variables.

Description of Students' Initial Mathematical Ability Values

A diagnostic exam tested students' arithmetic skills before therapy. This exam assesses students' initial comprehension of the topic and ensures that both groups have similar circumstances before receiving various learning approaches. This study involved 27 computer network Engineering (TKJ) 1 students and 26 TKJ 2 students. Data analysis indicated that class TKJ 1 pupils' initial mathematical ability (KAM) scores ranged from 48 to 90, with an average of 73.7 and a standard deviation of 14.32. In class TKJ 2, scores ranged from 40 to 87, with an average of 67.4 and a standard deviation of 15.33. Table 2 shows the descriptive statistics of students' first mathematical ability scores from both courses.

Table 2 Descriptive Value of Initial Mathematical Ability

Class	Number of Students	Minimum Value	Maximum Value	Average	Standard Deviation
TKJ 1	27	48	90	73,7	14,32
TKJ 2	26	40	87	67,4	15,33

This description shows that class TKJ 1 has a greater average beginning mathematical aptitude than class TKJ 2. However, this discrepancy must be examined to assess its statistical significance. The research class's KAM scores will also be tested for equality using normalcy and homogeneity tests.

The normality test was conducted on the initial mathematical ability data from two research classes, namely TKJ 1 and TKJ 2. The results of the normality test are shown in Table 3 below.

Table 3. Results of Normality Test of Initial Mathematics Ability Scores

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TKJ_1	,096	26	,200*	,963	26	,449
TKJ_2	,099	26	,200*	,976	26	,785

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Both classes have 0.2 significance values, which are larger than 0.05, according to the normalcy test. This suggests that both groups' basic mathematical ability are regularly distributed. This research may apply parametric statistical analysis.

Description of Students' Mathematical Communication Ability Values

After using various learning approaches in each session, students were tested on problem-solving. Class TKJ 1, which implements the Team Assisted Individualization (TAI) cooperative learning paradigm, scored average 81.61 and standard deviation 3.77, with scores ranging from 72 to 85. Using the Think Pair Share (TPS) cooperative learning approach, class TKJ 2 scored 67 to 79, with an average of 74.31 and a standard deviation of 4.37. Table 4 shows both groups' test results.

Table 4. Description of Students' Mathematical Communication Ability Test

Class	Number of Students	Minimum Value	Maximum Value	Average	Standard Deviation
TKJ 1	27	72	85	81,61	3,77
TKJ 2	26	67	79	74,31	4,37

These data show that the Team Assisted Individualization model in class TKJ 1 had a better average score than the Think Pair Share model in class TKJ 2. Class TKJ 1 has a lower standard deviation, indicating more uniformly dispersed student learning outcomes than class TKJ 2, which has a higher score variance. This suggests that the Team Assisted Individualization approach improves students' problem-solving skills more consistently than the Think Pair Share methodology.

A normality test was performed on students' mathematical communication abilities from two research courses, TKJ 1 and TKJ 2, which used distinct learning models. Classes TKJ 1 and 2 employed the Team Assisted Individualization (TAI) and Think Pair Share (TPS) cooperative learning models, respectively. Table 4 shows normalcy test results.

Table 5. Results of Normality Test of Mathematical Communication Ability Scores

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TKJ_1_MODEL_TAI	,173	26	,44	,894	26	,011
TKJ_2_MODEL_TPS	,102	26	,200*	,970	26	,612
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

The normality test shows that TKJ 1 class using the Team Assisted Individualization cooperative learning model has a significant value of 0.44, whereas TKJ 2 class using the Think Pair Share cooperative learning model has 0.20. As both values are more than 0.05, pupils' initial mathematical ability in both courses are regularly distributed. This research may apply parametric statistical analysis.

Description of Student Self-efficacy Values

Student self-efficacy assessments show that TKJ class 1 employing the Team Assisted Individualization cooperative learning paradigm has a minimum score of 40.45, a maximum score of 97.6, an average of 73.41, and a standard deviation of 18.59. TKJ class 2 employing the Think Pair Share cooperative learning paradigm has a minimum score of 30.16, a maximum of 81.64, an average of 57.23, and a standard deviation of 16.97. Table 6 shows both classes' test results.

Table 6. Description of Students' Self-efficacy Test Scores

Class	Number of Students	Minimum Value	Maximum Value	Average	Standard Deviation
TKJ 1	27	40,45	97,6	73,41	18,59
TKJ 2	26	30,16	81,64	57,23	16,97

From these results, it can be concluded that the self-efficacy of students in class TKJ 1 is higher than that in class TKJ 2. This shows that the use of the Team Assisted Individualization learning model is more effective in increasing student self-efficacy compared to the Think Pair Share model. If the significance value (Sig.) ≤ 0.05, then the data is not normally distributed. The results of the normality test of students' self-efficacy data in TKJ 1 and TKJ 2 classes are presented in Table 7.

Table 7. Results of the Normality Test of Students' Self-efficacy Values

Tests of Normality						
	Kolmogorov-mirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TKJ_1_MODEL_TAI	0,092	26	,200*	0,977	26	0,812
TKJ_2_MODEL_TPS	0,103	26	,200*	0,982	26	0,911
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

The significant value of students' self-efficacy in class TKJ 1 using the Team Assisted Individualization learning model and in class TKJ 2 using the Think Pair Share learning model is 0.20, according to the normalcy test. Both significance values over 0.05 indicate that students' self-efficacy data in both courses follows a normal distribution. This research may apply parametric statistical analysis.

The homogeneity test is a test used to determine the condition of two or more groups, whether they come from populations that have the same or different variances. The homogeneity test in this study uses the Homogeneity of Variances (Levene's Test) at a significance level of 5%. The output of the calculation of the homogeneity test of student self-efficacy test data is presented in Table 8 below:

Table 8. Results of Homogeneity Test of Students' Self-efficacy Values

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Results	Based on Mean	0,234	1	51	0,631
	Based on Median	0,172	1	51	0,680
	Based on Median and with adjusted df	0,172	1	49,132	0,681
	Based on trimmed mean	0,221	1	51	0,640

From Table 8, it can be seen that the significance value of 0.631 is greater than the significance level of 0.05. Thus, the null hypothesis stating that there is no difference in variance between groups can be accepted. This shows that the population has homogeneous data variance.

Testing of hypotheses was conducted to determine the effect of learning models and the interaction between learning models and initial mathematics abilities on students' self-efficacy. The analysis was conducted using a two-way analysis of variance (Two-Way ANOVA) test at a significance level of $\alpha = 0.05$. The test results are presented in full in Table 11 below.

Table 11. Hypothesis Test Results

Source of Variation	db	JK	RJK	F_{count}	F_{table}	Decision
Learning Model (A)	1	750,15	750,15	358,16	4,05	H_0 rejected
Initial Ability (B)	2	458,53	229,26	109,46	3,2	H_0 rejected
Interaction (A × B)	2	9,07	4,54	2,17	3,2	H_0 accepted
Error	47	98,44	2,09			
Total	52	1.316,19				

The results of the analysis in Table 4.12 show that the Fcount value = 1.76, while the Ftable value = 3.20 at degrees of freedom (2, 47). Because Fcount < Ftable or 1.76 < 3.20, then H_0 is accepted. Thus, there is no significant interaction between the learning model and initial mathematics ability on students' self-efficacy. This means that the influence of the learning model on self-efficacy does not depend on the level of students' initial mathematics ability.

Discussion

Teamwork and individual support in the TAI model help students learn more via organized, personalized learning. According to (Slavin, 2018), cooperative learning paired with individual learning, such in the TAI model, allows students to study at their own speed without losing group social collaboration. TPS that emphasizes pair conversations encourages thinking and sharing but offers less individual help. According to (Hidayat, A dan Viora, 2018), TPS pair talks encourage active engagement, but outcomes vary depending on learning partner dynamics. The individualized learning needs-focused TAI method explains this rise in self-efficacy. According to (Bandura, 1989) individuals internalize accomplishment to create self-efficacy. Students develop good self-images using the TAI model, which gives them incremental and planned achievement.

Success in demanding activities may boost students' self-confidence, and adaptive learning like TAI makes this more probable, according to (Santri, 2018). TPS that emphasizes pair

interaction may not benefit all students, particularly those who require more time or attention to learn the topic. This suggests that TAI and TPS learning models may be used with students from varied academic backgrounds due to their adaptability. With its group work and individual coaching, the TAI model gives all students equal learning chances, regardless of their starting point. Low-ability children get supervision via group activities and peer mentorship, while high-ability students are allowed opportunity to grow. According to (Barr, D., 2019), a successful learning method adapts to students' different learning demands and is not unique to one group.

These findings also demonstrate differentiation in learning, where a flexible strategy may provide all students relevant learning experiences without compromising academic equality. (Rahayu, I. F., & Aini, 2021) defines excellent learning as intellectually challenging and supportive for students of all learning readiness levels. The lack of interaction between learning models and beginning abilities in this research suggests that both models, particularly TAI, may enhance mathematical communication without specific division or treatment depending on initial skills.

These data suggest that cooperative-based learning, particularly TAI, may improve self-perceptions in all students. The TAI approach helps students develop self-confidence and self-efficacy by letting them work together, complete tasks independently, and get peer feedback. Self-efficacy comes from four sources, including mastery or success experiences, according to (Bandura, 1989) The TAI model gives students this experience by completing adaptively tough activities and being encouraged by a supportive social setting. TAI also fosters student confidence in their academic abilities by creating a positive learning environment. (Selby, C., Dorling, M., Woolard, 2015) shows that meaningful experiences, confidence in expressing viewpoints, and progressive accomplishment might boost students' self-efficacy. Students' mathematical self-confidence and learning results improve in TAI-based lessons.

D. Conclusion

From the research and discussion, we can say that Team Assisted Individualization (TAI) and Think Pair Share (TPS) cooperative learning models, supported by digital books, have different impacts on students' math communication skills and confidence. Students' mathematics communication abilities vary significantly across the TAI and TPS groups. Student self-efficacy differs significantly across TAI and TPS learning groups. TAI students are more self-confident than TPS pupils. No substantial relationship exists between basic mathematical aptitude and learning models on students' mathematical communication skills. Students' self-efficacy is unaffected by baseline mathematics competence or learning approaches. The Scheffé additional test demonstrated significant variations in mathematics communication abilities and self-efficacy across all pairings of groups.

References

Ansari, B. (2018). *Komunikasi Matematik Strategi Berfikir Dan Manajemen Belajar Konsep dan Aplikasi*. PeNa.

Bandura, A. (1989). *Self-efficacy mechanism in physiological activation and health-promoting behavior. In J. Madden, S. Matthysse, & J. Barchas (Eds.), Adaptation, learning and affect.* Raven.

Barr, D., D. (2019). Computational thinking: A Digital Age Skill for Everyone. *Learning & Leading with Technology*, *6*, 38.

Dina, Z. H., Ikhsan, M., H. (2019). The Improvement of Communication and Mathematical Disposition Abilities through Discovery Learning Model in Junior High School. *Journal of Research and Advances in Mathematics Education, 4(1): 12*.

Hamidah. (2018). Pengaruh Self Efficacy Terhadap Kemampuan Komunikasi Matematik. *STKIP Siliwangi Bandung*, *2*(3), 23.

Hidayat, A dan Viora, D. (2018). Pengaruh Model Pembelajaran Kooperatif Tipe Think-Pair-Share Terhadap Kemampuan Komunikasi matematis Siswa Kelas VIII SMPN 1 Bangkinang. *Jurnal Pendidikan Tambusai, Vol. 2, No*.

Ismail Hanif Batubara, Sahat Saragih, Elmanani Simamora, E Elvis Napitupulu, I. P. S. (2022). Analysis of student's mathematical communication skills through problem based learning models assisted by augmented reality. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*, *5*(1), 1024–1037. https://doi.org/https://doi.org/10.33258/birci.v5i1.3704

NCTM. (2020). *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics, Inc.

Nurullita., Surya, Edy. & Syahputra, E. (2017). The Effect Of Problem Based Learning To Students' Mathematical Problem Solving Ability. *IJARIIE, 3*(2), 3441-3446.

Papyrina, V, Strebel.J, & R. . (2020). The Student confidence gap : Gender differences in job skill self-efficacy. *Sciencedirect Journal of Education for Business*, *96 Issue 2*, 89–98. https://doi.org/10.1080/08832323.2020.1757593.

Rahayu, I. F., & Aini, I. N. (2021). Analisis kemandirian belajar dalam pembelajaran matematika pada siswa SMP. *JPMI (Jurnal Pembelajaran Matematika Inovatif), 4($)*, 789-798.

Rahmawati, Hasri., & M. (2022). Gaya Belajar Peserta Didik Usia Dini Berprestasi Akademik. *Jurnal Obsesi (Jurnal Pendidikan Anak Usia Dini), 6 (6)*, 6384-6394.

Santri, F. (2018). *Pengembangan modul pembelajaran elementer*. Zigie Utama.

Selby, C., Dorling, M., Woolard, J. (2015). *Evidence of Assessing Computational Thingking*. IFIF TC3.

Slavin, R. E. (2018). *Cooperative Learning Teori Riset dan Praktik* (Nusa Media (ed.)).

Sugiyono. (2018). *Metodologi Penelitian Pendidikan (Pendidikan Kuantitatif, Kualitatif dan R&D)*. Alfabeta.

Sukoco, H. (2016). Pengaruh Pendekatan Brain Based Learning terhadap Kemampuan Komunikasi Matematis dan Self-Efficacy Siswa SMA. *Jurnal Pendidikan Matematika, 11(1).*, 11-224.

Turmudi. (2009). *Landasan filsafat dan teori pembelajaran matematika (Berparadigma eksploratif dan investigatif)*. PT Leuser Cita Pustaka.

Turmudi. (2019). *Strategi Pembelajaran Matematika Kontemporer* (FPMIFA-UPI. (ed.).