THE IMPLEMENTATION OF MULTIMEDIA-ASSISTED *MATHEMATICAL HABITS OF MIND* TO IMPROVE STUDENTS CRITICAL THINKING

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Abstract
One of the current educational goals is to train students to communicate in the teaching and learning process and have the skills to think in enhancing learning outcomes, one of which is critical thinking skills. This study aimed to compare students' critical thinking skills taught by multimedia-assisted mathematical habits of mind (MHM) learning strategies and those taught by conventional learning strategies for students at SMPS Ummul Ayman Samalanga. It uses a quasi-experimental method. The population of this study is all grade 8 students at the Private Yunior High School (SMPS) Ummul Ayman Samalanga. Two classes of grade 8 were randomly selected as experimental and control groups. Data was collected by using pre-test and post-test procedures. The results of data analysis by using the independent samples t-test showed that the value of t-observation is 9.53 and the value of t-table is 1.68. So, because the value of t-observation is greater than the value of t-table, it can be concluded that students' mathematical critical thinking skills taught by MHM learning strategies are better than the critical thinking skills of those taught by conventional learning strategies. The conclusion can be reached because the instruction in the experiment class motivated students to be more active in reconstructing teaching materials individually and in pairs.

Keywords*:* Mathematical Habits of Mind Strategy, Critical Thinking Ability

INTRODUCTION

Mathematics is needed to support the improvement of students' critical thinking skills. Critical thinking guides students in making accurate decisions by themselves. Critical thinking is checking or analyzing information generated from experience, observation, logic, and communication.[1] Students can use critical thinking skills to build their knowledge. Every individual has different critical thinking and someone who has critical thinking can be identified from his character in addressing a problem, arguing, and utilizing his knowledge,

[1] Hardika Saputra, "Kemampuan Berpikir Kritis Matematis*", Jurnal Perpustakaan IAI Agus Salim*, Vol 2, No 1, April 2020, p. 2.

such as: (1) looking for clear statements for each question; (2) finding the cause; (3) trying to stay informed; (4) use reliable sources; and mention it.[2]

Ennis defined critical thinking as "reflective and reasonable thinking that is focused on deciding what to believe or do".[3] These cognitive skills include interpretation, analysis, evaluation, self-control, drawing conclusions and explanations along with their sub-skills. Facione reported that critical thinking is also a willingness to seek the truth, carefully use critical thinking processes, and support previous research on critical thinking.[4] In line with that, Paul emphasized that critical thinking is defined as based on the mastery of skills and dispositions such as being automatic, diligent, and open-minded to avoid being egocentric.[5] Paul also mentions examples that are included in a disposition, namely being open-minded, willing to seek the truth, alert to apply critical thinking processes, and supporting previous research on critical thinking.

Using the framework of Facione as a guide to identifying the perspective of critical thinking processes of mathematics teachers when they read certain studies that convey statistical information in newspaper articles that are represented through the use of mathematical ideas such as percentages and probabilities. In other words, this research involves combining the cognitive processes of critical thinking with the statistical literacy needed to rationalize the texts contained in the media. The Facione framework applied by Mehtap & Erdinç (2020) for research on teachers' critical thinking processes is also suitable for application to students' critical thinking processes.[6]

Critical thinking skills are usually used in managing, adjusting, changing, or improving the results of one's thinking to make better decisions.[7] Maulana explained that "Critical thinking skills include the ability to: (1) explore; (2) identify relevance; (3) clarify; (4) reconstruct the argument; and (5) make generalizations and consider generalizations".[8] One of the problems related to critical thinking skills is the Pythagorean theorem and Pythagorean triples which were used as experiments in this study and submitted to KD 3.6. "Explaining and proving the Pythagorean theorem and Pythagorean triples" and KD 4.6. "Solving problems related to the Pythagorean theorem and Pythagorean triples".[9]

One of the roles of teaching mathematics is to form students' thinking skills, which are useful at school and in dealing with everyday problems. In the learning process in a class, critical thinking skills are generally needed by students in dealing with material problems that

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[2] Maulana, *"Konsep Dasar Matematika dan Pengembangan Kemampuan Berpikir Kritis-Kreatif"*. (Sumedang: UPI Sumedang Press, 2017). p. 7.

[3] Mehtap Kuş & Erdinç Çakıroğlu, "Prospective mathematics teacher' critical thinking processes about scientific research: Newspaper article example", Turkish Journal of Education, Vol. 9, No. 1, 2020, p. 24.

[4] Mehtap Kuş & Erdinç Çakıroğlu, "Prospective …, p. 25.

[5] Mehtap Kuş & Erdinç Çakıroğlu, "Prospective …, p. 23.

[6] Mehtap Kuş & Erdinç Çakıroğlu, "Prospective …, p. 27.

[7] Wowo Sunaryo Kuswana, *Taksonomi Berpikir*, (Bandung: Remaja Rosdakarya, 2013), p.1.

[8] Wowo Sunaryo Kuswana, *Taksonomi …*, p. 7.

[9] Abdul Rahman As'ari, et al, "*Matematika SMP/MTs Kelas VIII Semester 2"*. (Pusat kurikulum dan perbukuan, Balitbang: Kemendikbud, 2017), p. 219-252.

require the ability to calculate and analyze the use of formulas.[10] One of them is the need on the subject of Pythagorean theorem which discusses right triangles and their hypotenuses. The use of certain methods or strategies is very important in improving students' critical thinking skills to solve problems to achieve the expected goals.

One of the learning strategies that can be applied is Mathematical Habits of Mind (MHM) namely a strategy that cultivates habits of students' thinking skills. This strategy was first developed by Milman & Jacobbe where Mathematical Habits of Mind (MHM) is a strategy used to develop thinking habits in solving mathematical problems.[11]

The results of research conducted by Melisa and Wilda show that "one of the reasons used to improve creative thinking skills with the MHM strategy is because students will be accustomed to exploring mathematical ideas". In this case, creative thinking is related to students' critical thinking. One's creativity in getting a solution to a problem must also be critical in solving the problem by making decisions from the right solution.[12]

The habits of thinking mathematically with the MHM strategy will be more effective and enjoyable if it is assisted with the use of multimedia learning media. Multimedia is a system that describes text, images, animations, and videos. So the more concrete the explanation of a learning media in the learning process, the more experience students will get.[13]

Suwarsiah's journal article reported that interactive media played an important role in motivating students to solve problems, analyze, conclude, and emphasize the process of critical thinking skills. Thus, interactive media in this study will present material with clear text, animation, and sound images in the form of interactive PPt. The purpose of this study was to compare the critical thinking skills of students who were taught with multimedia-assisted MHM with the critical thinking abilities of students who were taught with conventional learning strategies at SMP/MTs.

The implementation of *MHM* is referred to as a means for placing new ideas, programs, or activities to get change.[14] Based on this perspective, researchers conclude that the implementation in this study is the implementation of strategies in fostering good critical thinking skills for students by applying the MHM Strategy.

The MHM is a teaching strategy that gets students used to thinking mathematically. The MHM strategy trains students to explore their mathematical ideas by providing freedom

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10 Delia Khoerunnisa, et al, "Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Teorema Pythagoras", *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, Vol. 4, No. 6, November 2021, h.1740.

11 Iskandar, Ratu Sarah Fauziah, et al., "Pengaruh Strategi Pembelajaran Mathematical Habits of Mind (MHM) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa SMP", *Jurnal AdMathEdu*, Vol. 9, No. 1, Juni 2019. p. 55.

12 Iskandar, Ratu Sarah Fauziah, et al., "Pengaruh Strategi ..., p. 55.

13 Ferdian Falah, et. al, "Penggunaan Multimedia Animasi Untuk Meningkatkan Kemampuan Berpikir Kritis Dalam Pembelajaran Materi Bidang Geser", *Jurnal of Mechanical Engineering Education*, Vol. 3, No. 2, Desember 2016, p. 164

14 Abdul Majid, "*Implementasi Kurikulum 2013 Kajian Teoritis dan Praktis"*, (Bandung: Interes Media, 2014), p. 6.

of thought, where the average normalized gain is high and moderate with this strategy.[15] Exploration of mathematical ideas is carried out in student activity environments such as schools, residences and so on by adjusting to aspects of critical thinking skills. Teachers can cultivate the habits of exploring mathematical ideas by asking questions related to the material or problems being discussed, such as: (1) what plans will be made to solve a problem?; (2) what material concepts can be used?; etc.

The implementation of the *MHM* strategy uses multimedia namely a system that is integrated with a computer and the information handled is presented digitally. In presentations using multimedia, it is usually a combination of text, images, sound, animation, and video that can be displayed interactively.[16] This multimedia is used as a learning facility to attract students' attention to understanding material explanations.[17]

The multimedia used in this experiment is a type of interactive multimedia. Interactive multimedia is a form of media that combines many elements and is equipped with a controller. The interactive multimedia used is in the form of PowerPoint (PPt.) which is designed based on the material to be studied. This PPt. media is displayed with the help of a projector or in focus. With these supporting facilities, the use of multimedia will help teachers to be more creative in conveying and designing learning as well as stimulating students' thinking power.

The PPt. media is designed to include or embed audio on each slide so that the teacher can control each slide that will be displayed. The control device used in the PPt. is an arrow that can be pressed by the teacher to continue to the next slide, and vice versa to return to the previous slide. Another controller is that from time to time the teacher may add some new things or additional slides if needed in the teaching and learning process. Usually, the teacher adds a slide to write another sample problem with students seeing and trying to solve it on paper. If then there is an agreed correct answer then the teacher can post the student sheet on the PPt. slide that was added earlier. So all students can see how the process of finding the correct answer was.

As a comparison to the implementation of the MHM strategy, this study uses the conventional learning strategy that is often used by the teachers in the school to stick to the teaching habits. The conventional strategy in this study is associated with habits that are often applied by mathematics teachers at SMPS Ummul Ayman Samalanga by using ordinary learning and expository methods. The expository method is a way of teaching that focuses on presenting material orally by the teacher to a group of students with the aim that students can master the material well. Students are not required to find contextual materials and problems themselves in this strategy, because the subject matter and problems are presented directly by the teacher.

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[15] Hedi Budiman, et al., "Implementasi Strategi Mathematical Habits of Mind (MHM) Berbantuan Multimedia Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa", *Jurnal PRISMA Universitas SuryaKancana*. Vol. 6, No. 1, Juni 2017, p. 32.

[16] Nienke Nieveen, *Prototyping to Reach Product Quality*, (London: Kluwer Academic publisher, 1999), p. 125

[17] Saprudin, et al., "Pembelajaran Multimedia", *JAMAIKA: Jurnal Abdi Masyarakat*, Vol. 1, No. 1, 2020, h. 66.

METHODS

This study uses an experimental method to examine the effect of a treatment on a certain group that is given different treatment. This research was conducted at Ummul Ayman Samalanga Secondary School located at Jalan Gampong Putoh, Samalanga District, Bireuen Region, Aceh Province. This research was carried out from January 18 to February 22, 2023, with a population of all grade 8 students at SMPS Ummul Ayman Samalanga for the 2022/2023 Academic Year.

Furthermore, by using a random sampling technique, the selection of classes randomly from the 12 existing equivalent classes, one experimental class was selected. From the remaining 11 classes, one control class was randomly also selected. The instruments used as experimental implementation devices in this study were a lesson plan (RPP for the Indonesian Education System) and PPt. as an interactive medium. The instrument for data collection used test kits containing essay items. The experimental design used is shown in the table below.

Table 1. The Experimental Design

Groups	Pre-test	Treatment	Post-test
Experiment	O_1	X	O_2
Control	O_1	Y	O_2

Data collection was carried out using a test technique and analyzed using the independent samples t-test. Before analysis using the t-test, the ordinal scale data was first converted into interval scale data. Furthermore, testing for normality and homogeneity was carried out as a prerequisite for the t-test analysis.
The statistical hypothesis and research hypothesis are formulated as follows:

H_0: $\mu_1 \leq \mu_2$: Students' mathematical critical thinking skills taught using *Mathematical Habits of Mind* (MHM) strategies are not better than students' mathematical critical thinking skills taught using conventional learning strategies.

H_1: $\mu_1 > \mu_2$: Students' mathematical critical thinking skills taught using *Mathematical Habits of Mind* (MHM) strategies are better than students' mathematical critical thinking skills taught using conventional learning strategies.

The test used is the right side test with α = 0.05 and $df = (n_1 + n_2 - 2)$. If the *t* valu calculated from the data > critical value then H_0 is rejected and it is concluded that the two samples come from populations with different average values. If the data-based t value is not as large as the critical value, then H_0 is accepted.[18] If the t value calculated from the data ≥ the critical value then H_0 is rejected and H_1 is accepted and it can be concluded that the hypothesis proposed is correct.[19] In line with Miller & Miller, (Sudjana, 2005:231) states that

[18] Spatz, Chris., Basic Statistics: Tales of distribution (8th edition), *Belmont, CA: Wadsworth Thomson Learning*, p. 206

[19] Miller, I. & Miller, M., John E. Freund's Mathematical Statistics with Applications (7th Ed.), *Upper Saddle, NJ: Pearson Education*, 2008, p. 366).

the test criteria are rejected H_0 if $t_{observation} \geq t_{(1-\frac{1}{2}\alpha)}$ and accepted H_0 if $t_{observation} < t_{(1-\frac{1}{2}\alpha)}$.

RESULTS AND DISCUSSION

Results

The results showed that the average score of students' mathematical critical thinking skills taught using MHM strategies was higher than the critical thinking skills taught using conventional learning strategies. Then from the data analysis, it is known that students who are taught with the MHM strategy experience an increase in scores. The following will show the acquisition of pre-test results in both classes.

Table 2. Pre-test Results of Students' Mathematical Critical Thinking Ability in Experimental and Control Classes (Ordinal data)

Students' ID	Experimental Group Pretest Score	Control Group Pretest Score	Students' ID	Experimental Group Pretest Score	Control Group Pretest Score
1	23	23	14	21	22
2	23	22	15	22	18
3	25	25	16	22	18
4	25	25	17	33	30
5	26	22	18	25	25
6	17	17	19	21	22
7	22	20	20	20	22
8	22	21	21	14	17
9	26	25	22	23	19
10	20	21	23	22	17
11	15	18	24	21	24
12	25	23	25	19	21
13	19	20			

Source: The Results of Data Processing

Then by using Excel, the data in Table 2 are converted into interval data. The results of the data conversion for the experimental group are displayed in the Table 3 below.

Table 3. Results of Changing The Ordinal Scale to an Interval Scale of The Experimental Group Using The MSI

Col	Category	Freq	Prop	Cum	Density	Z	Scale
1.000	1.000	96.000	0.256	0.256	0.322	-0.656	1.000
	2.000	80.000	0.213	0.469	0.398	-0.077	1.901
	3.000	136.000	0.363	0.832	0.251	0.962	2.661
	4.000	61.000	0.163	0.995	0.015	2.553	3.707
	5.000	2.000	0.005	1.000	0.000	-	5.128

Source: Results of Converting Ordinal Data Into Interval Data Using MSI Microsoft Excel Procedures

Then, the results of the data conversion for the experimental group are displayed in Table 4 below.

Table 4. Results of Changing The Ordinal Scale to an Interval Scale of The Control Group Using The MSI

Col	Category	Freq	Prop	Cum	Density	Z	Scale
1.000	1.000	95.000	0.253	0.253	0.320	-0.664	1.000
	2.000	87.000	0.232	0.485	0.399	-0.037	1.924
	3.000	133.000	0.355	0.840	0.243	0.994	2.701
	4.000	58.000	0.155	0.995	0.015	2.553	3.737
	5.000	2.000	0.005	1.000	0.000		5.135

Source: Results of Converting Ordinal Data Into Interval Data Using MSI

Lastly, based on the whole data from Table 2, Table 3 and Table 4 shows the scores of converted ordinal scales to be scores of interval scale as provided in Table 5 below.

Table 5. Results of Converting Ordinal Scale of Pre-Test Data to Interval Scale of Students' Mathematical Critical Thinking Ability of Experimental and Control Classes

Students' ID	Experimental Group Pretest Score	Control Group Pretest Score	Students' ID	Experimental Group Pretest Score	Control Group Pretest Score
1	34,454	35,265	14	33,369	33,305
2	34,885	34,229	15	34,363	30,827
3	36,691	37,113	16	33,984	31,630
4	36,836	37,078	17	44,721	42,655
5	37,451	34,264	18	36,695	37,113
6	29,616	30,456	19	26,008	33,564
7	34,129	32,934	20	32,609	34,376
8	34,129	33,711	21	27,054	29,791
9	37,737	37,001	22	34,889	31,604
10	32,041	33,746	23	33,984	29,938
11	27,810	30,862	24	33,079	35,930
12	36,981	35,300	25	31,422	33,417
13	31,422	32,528			

Source: Experiment and Control Classes Pre-test Data Processing Results

After the data is converted into intervals, tests for normality, homogeneity, and similarity of the two averages are then carried out to determine whether the data comes from the same population.

1. Normality Test

The experimental and control *pre-test* data show that $\chi^2{}_{observation} \leq \chi^2{}_{table,}$ namely $5.339 \leq 11.1$ and $6.4036 \leq 11.1$, so it can be concluded that the sample comes from a normally distributed population.

2. Homogeneity Test

Base on a significance level of 5% (α=0.05) with $df_1 = (n_1 - 1)$ and $df_2 = (n_2 - 1)$. The decision-making criteria are: "If $F_{observation} < F_{tabel}$ then accept H_0, reject H_0 if If $F_{observation} \geq F_{table}$. $F_{table} = F_{\alpha(dk_1, dk_2)} = 0{,}05_{(24,24)} = 1{,}98$". ". Therefore $F_{observation} <$

F_{table} namely $1{,}6307 < 1{,}98$ thus H_0 is accepted and it can be concluded that the data have the same variance.

3. Average Similarity Test

Based on the data obtained with the degrees of freedom, namely *df* = 25 + 25 – 2 = 48 and a significance level of α = 0.05, the value of $t_{(0{,}975)(48)} = 2{,}01$ so that $-t_{\left(1-\frac{1}{2}\alpha\right)} < t_{observasion} < t_{\left(1-\frac{1}{2}\alpha\right)}$ namely $-2{,}01 < -0{,}30237 < 2{,}01$, then according to the testing criteria, H_0 is accepted. Thus it can be concluded that the average *pre-test* scores of the two classes were not significantly different.

In the following, the results of the *post-test* in both classes will be displayed for the Independent sample t-test.

Table 6. Post-test Ordinal Scale Scoring Results for Students' Mathematical Critical Thinking Ability in Experimental and Control Classes

Students' ID	Experimental Group Pretest Score	Control Group Pretest Score	Students' ID	Experimental Group Pretest Score	Control Group Pretest Score
1	44	34	14	47	40
2	43	33	15	45	37
3	50	40	16	47	32
4	51	26	17	55	24
5	53	29	18	50	32
6	44	31	19	46	32
7	46	41	20	42	33
8	49	34	21	48	35
9	52	27	22	52	35
10	40	28	23	46	29
11	55	21	24	42	38
12	51	37	25	50	36
13	51	34			

Source: Experiment and Control Classes Post-test Data Processing Results

Then by using Excel, the data will be converted into interval data. The following test results are displayed in the table 7 below:

Table 7: Results of Changing The Ordinal Scale to an Interval Scale of Experiment Group Using The MSI

Col	Category	Freq	Prop	Cum	Density	Z	Scale
1.000	1.000	6.000	0.016	0.016	0.040	-2.144	1.000
	2.000	8.000	0.021	0.037	0.081	-1.783	1.559
	3.000	52.000	0.139	0.176	0.259	-0.931	2.224
	4.000	149.000	0.397	0.573	0.392	0.185	3.166
	5.000	160.000	0.427	1.000	0.000		4.421

Source: Results of Converting Ordinal Data Into Interval Data Using MSI

Table 8. Results of Changing The Ordinal Scale to an Interval Scale of Control Group Using The MSI

Col	Category	Freq	Prop	Cum	Density	Z	Scale
1.000	1.000	37.000	0.099	0.099	0.174	-1.289	1.000
	2.000	52.000	0.139	0.237	0.309	-0.715	1.786
	3.000	119.000	0.317	0.555	0.395	0.137	2.490
	4.000	140.000	0.373	0.928	0.137	1.461	3.452
	5.000	27.000	0.072	1.000	0.000	8.210	4.667

Source: Results of Converting Ordinal Data Into Interval Data Using MSI

Lastly, the whole data from Table 6, Table 7 and Table 8 shows the scores of converted ordinal scales to be scores of interval scale as provided in Table 9 below.

Table 9. Results of *Post-test* Data Conversion from Ordinal Scale to Interval Scale of Students' Mathematical Critical Thinking Ability of Experiment Class and Control Class

Students' ID	Experimental Group Pretest Score	Control Group Pretest Score	Students' ID	Experimental Group Pretest Score	Control Group Pretest Score
1	48,077	41,632	14	52,225	47,910
2	49,011	41,779	15	49,055	45,793
3	55,364	48,240	16	52,225	40,993
4	55,646	35,742	17	60,353	34,693
5	57,843	37,854	18	54,078	40,993
6	47,800	40,125	19	50,310	40,482
7	49,058	48,949	20	45,603	41,104
8	52,510	42,736	21	54,453	43,105
9	56,588	37,398	22	57,527	43,281
10	43,683	37,145	23	49,371	37,338
11	60,040	31,202	24	46,747	45,991
12	55,333	44,853	25	55,294	44,243
13	55,020	41,890			

Source: Results of Data Processing

After the data is converted into intervals, tests for normality, homogeneity and hypothesis testing will then be carried out to determine whether there are differences in test scores that have increased.

1. **Normality Test**

The experimental and control *pre-test* data $\chi^2{}_{observation} \leq \chi^2{}_{table,}$ yaitu 5,8623 ≤ 11,1 and 1,3291 ≤ 11,1, so it can be concluded that the sample comes from a normally distributed population.

2. **Homogeneity Test**

Based on a significance level of 5% (α=0.05) with $df_1 = (n_1 - 1)$ and $df_2 = (n_2 - 1)$. The decision-making criteria are: "If $F_{observation} < F_{table}$ then H_0 is accepted and H_0 is rejected if $F_{observation} \geq F_{table}$. $F_{table} = F_{\alpha(dk_1,dk_2)} = 0{,}05_{(24,24)} = 1{,}98$". Therefore $F_{observation} < F_{table}$ is 1.37 < 1.98, H_0 is accepted and it can be concluded that the data have the same variance.

3. **Hypothesis Test**

Based on the calculations, t = 9.53 is to compare with t_{table}, so first it is necessary to find the degrees of freedom (*df*) using the formula $df = (n_1 + n_2 - 2) = 25 + 25 - 2 = 48$,

than $t_{table} = (1 - \alpha)(dk) = (1 - 0{,}05)(48) = (0{,}95)(48) = 1{,}68$. Thus, because of $t_{observation} \geq t_{table}$ so that H_0 is rejected and H_1 is true or it can be concluded that students' mathematical critical thinking skills taught by *Mathematical Habits of Mind* teaching strategies are better than critical thinking skills of students' mathematical critical thinking skills taught by conventional learning strategies.

DISCUSSION

The lowest *pre-test* score in the experimental class was 26.008 and the highest score was 44.721. The average *pre-test* score was 33.854. While the lowest *post-test* score was 43.683 and the highest score was 60.353. The average *post-test* score was 52.528.

The lowest *pre-test* score in the control class was 29.791 and the highest score was 42.655. The average *pre-test* score was 33.945. While the lowest *post-test* score was 31.202 and the highest score was 48.949. The average *post-test* score was 41.418.

These facts show that the implementation of the *MHM* strategy is proven to be better in improving students' critical thinking skills. This makes sense because through learning activities in the experimental class by applying the *MHM* strategy is proven to encourage students actively reconstruct subject matters independently and in pairs. In addition, the learning objectives by applying the *MHM* strategy to improve students' critical thinking skills are also well achieved.

These facts are also relevant to the results of research conducted by Melisa Wantania entitled "Implementation of the MHM Strategy in Improving Students' Mathematical Creative Thinking Ability in Circle Material".[20] and also to Nurjannah's study entitled "Mathematical Habits of Mind Factors and Literacy Ability of Middle School Students in West Bandung Regency".[21] These results indicate that the use of the *MHM* strategy can have an impact on students in improving their mathematical thinking skills.

The *MHM* strategy also involves students in individual activities such as debating with peers, reading independently, and trying harder to be mastered. In addition to having advantages, the *MHM* strategy also has several weaknesses, for example, if students do not have interest or do not have confidence that the problems being studied can be solved, they will feel reluctant to try. Both advantages and disadvantages of the learning strategy will be successfully applied in the learning process if teachers and students can work together with a stronger roles of the teacher to direct and motivate students to make the thinking process to be their habits.

CONCLUSION

Based on the results of this research for the role of *Mathematical Habits of Mind* learning strategies on students' critical thinking skills for the subject of the Pythagorean theorem, it was concluded that students' critical thinking abilities who received *Mathematical Habits of Mind* learning strategies were better than those who received conventional learning

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[20] Melisa Wantani dan Wilda Syam Tonra, "Penerapan Strategi Mathematical Habits of Mind (MHM) Dalam Peningkatan Kemampuan Berpikir Kreatif Matematis Siswa Pada Materi Lingkaran", *Jurnal SIGMA (Suara Intelektual Gaya Matematika),* Vol. 12, No. 2, Desember 2020, p. 176.

[21] Putri Eka Indah Nurjannah, et al., "Faktor Mathematical Habits of Mind dan Kemampuan Literasi Matematis Siswa", *Jurnal Penelitian Matematika dan Pendidikan Matematika*, Vol. 2, No. 2, April 2018, p. 51.

strategies in grade-8 students of SMPS Ummul Ayman Samalanga. This conclusion is quite reasonable because this learning strategy is proven to encourage students to actively reconstruct subject matters independently and in pairs with the practice of thinking out loud to students individually and with their friends.

REFERENCES

As'ari, Abdul Rahman, et al, "*Matematika SMP/MTs Kelas VIII Semester 2"*. Jakarta: Pusat kurikulum dan perbukuan, Balitbang: Kemendikbud, 2017.

Budiman, Hedi, et al, "Implementasi Strategi Mathematical Habits of Mind (MHM) Berbantuan Multimedia Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa", *Jurnal PRISMA Universitas SuryaKancana*, 6(1), 2017.

Falah, Ferdian, et al, "Penggunaan Multimedia Animasi Untuk Meningkatkan Kemampuan Berpikir Kritis Dalam Pembelajaran Materi Bidang Geser", *Jurnal of Mechanical Engineering Education*. 3(2) 2016.

Iskandar, et al, "Pengaruh Strategi Pembelajaran Mathematical Habits of Mind (MHM) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa SMP", *Jurnal AdMathEdu*, 9(1) 2017.

Jacobbe, T. and Millman, R.S., "Mathematical Habits of the Mind for Preservice Teacher". *School Science and Mathematics*, 109(5) 2009. DOI: 10.1111/j.1949-8594.2009.tbl8094.x.

Khoerunnisa, Delia, et al., "Analisis Kesulitan Siswa Dalam Menyelesaikan Soal Teorema Pythagoras", *JPMI (Jurnal Pembelajaran Matematika Inovatif),* 4(6) 2021.

Kuş, Mehtap & Çakıroğlu, Erdinç, "Prospective mathematics teacher' critical thinking processes about scientific research: Newspaper article example". Turkish Journal of Education, 2020. DOI: 10.19128/turje.605456. https://files.eric.ed.gov/fulltext/EJ1290823.pdf

Kuswana, Wowo S, *Taksonomi Berpikir*. Bandung: Remaja Rosdakarya, 2013.

Majid, Abdul. *Implementasi Kurikulum 2013 Kajian Teoritis dan Praktis*. Bandung: Interes Media: 2014.

Maulana, *Konsep Dasar Matematika dan Pengembangan Kemampuan Berpikir Kritis-Kreatif*. Sumedang: UPI Sumedang Press, 2017.

Miller, I. & Miller, M, John E. Freund's Mathematical Statistics with Applications (7th Ed.). Upper Saddle, NJ: Pearson Education, 2008.

Nurjannah, Putri E. I., et. al., "Faktor Mathematical Habits of Mind dan Kemampuan Literasi Matematis Siswa", *Jurnal Penelitian Matematika dan Pendidikan Matematika,* 2(2) 2018.

Spatz, Chris, *Basic Statistics: Tales of distribution (8th edition).* Belmont, CA: Wadsworth Thomson Learning, 2011.

Sudjana, *Metode Statistika*, Bandung: Tastiso, 2005.

Wantani, Melisa, et al., “Penerapan Strategi Mathematical Habits of Mind (MHM) Dalam Peningkatan Kemampuan Berpikir Kreatif Matematis Siswa Pada Materi Lingkaran”, *Jurnal SIGMA (Suara Intelektual Gaya Matematika).* 12(2) 2020.

Yusuf, A. Muri, *Metode Penelitian (Kuantitatif, Kualitatif & Penelitian Gabungan)*, Jakarta: Kencana, 2017.