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MATHEMATICAL RESILIENCE, HABITS OF MIND, AND SOCIOMATHEMATICAL NORMS BY SENIOR HIGH SCHOOL STUDENTS IN LEARNING MATHEMATICS: A STRUCTURED EQUATION MODEL

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ABSTRACT

The process of learning mathematics is determined by cognitive aspects and requires an affective domain. The affective domain is essential in developing mathematical abilities to solve mathematical problems. This study aims to analyze the effect of mathematical resilience (RM) and habits of mind (HOM) on socio-mathematical norms (SMN) in mathematics learning. The research method used is quantitative, with survey techniques and structured inquiry models. The sample in this study was 100 high school students in the DKI Jakarta area. Data analysis was performed using the structured equation model (SEM) using SmartPLS software. This research uses eight items of mathematics resilience instrument, ten items of habits of mind instrument, and 12 items of socio-mathematical norm instrument. Each instrument has four alternative answers with a Likert scale. The results of the study concluded: 1) there is a positive impact of mathematical resilience on socio-mathematical norms; 2) there is a positive impact of habits of mind on socio-mathematical norms; 3) there is a positive impact of mathematical resilience on habits of mind; 4) there is a positive impact of mathematical resilience on sociomathematical norms mediated by habits of mind.

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1. INTRODUCTION

The study of the affective domain in mathematics learning has been going on for a long time. This is intended to explore the positive contribution of the affective domain in the learning process. The scope of study of affective has begun to develop, not only examining attitudes but examining several aspects such as beliefs and emotional reactions (Ignacio et al., 2006), mathematical resilience (Hendriana et al., 2019; Johnston-Wilder et al., 2018;

Johnston-Wilder et al., 2015; Kooken et al., 2013; Thornton et al., 2012), habits of mind (Costa & Kallick, 2008; Dwirahayu et al., 2017; Matsuura et al., 2013; Yellamraju et al., 2019), sociomathematical norm (Güven & Dede, 2017; Maarif et al., 2022; Sánchez & García, 2014; Yackel & Cobb, 1996; Zembat & Yasa, 2015), and so on. These affective aspects must be developed and optimized in teaching and learning activities, especially mathematics.

It is undeniable that in the process of learning mathematics it is possible for students to experience failure and unpleasant experiences can occur (Hutauruk & Priatna, 2017). Unpleasant experiences can be in the form of psychological pressure or high cognitive load or difficulties in understanding the mathematical concepts being studied (Maarif et al., 2019; Roth, 2019). The failure of the mathematics learning process experienced by students cannot be avoided, but the impact of this failure can be minimized or even eliminated. This is where the importance of mathematical resilience exists, to help students minimize the impact of student difficulties or failures in the learning process they experience (Ishak et al., 2020; Johnston-Wilder et al., 2018).Mathematical resilience is defined as a person's resilience to the difficulties encountered, being able to collaborate in collaboration, having language skills in communicating strengths and weaknesses, being resilient in dealing with difficulties related to learning problems (Johnston-Wilder et al., 2015), having a positive perspective on problems (Gürefe & Akçakin, 2018), easy to respond positively to the difficulties encountered (Kooken et al., 2013), the ability to adapt to the challenges encountered for the continuity of work in the future (Chirkina et al., 2020). Someone who has good mathematical resilience will respond to problems in positive ways rather than prioritizing the anxiety they experience (Gürefe & Akçakin, 2018; Kooken et al., 2013).

Developing mathematical resilience allows students to adapt the mathematical problems they face sustainably as a learning experience they have experienced (Thornton et al., 2012). Mathematical resilience allows a student to face difficult situations with the opposite situation which can have an impact on motivation gradually towards something better than the learning difficulties they face (Johnston-Wilder et al., 2018). Therefore, it is important that in the process of learning mathematics, students develop mathematical resilience in order to foster productive thinking patterns in dealing with problems so that they are clear in their thinking processes to find solutions.

The right action to build resilience is to cultivate a student's productive mindset which is called the habit of mind. Habits of mind are organizing principles of how to think about mathematical concepts by resembling the way of thinking of previous mathematicians (Cuoco et al., 1996; Matsuura et al., 2013). It’s not about how theorems or algorithms are used, but rather about how mathematicians develop their thinking processes to find these mathematical theorems or algorithms (Matsuura et al., 2013). For example: in learning mathematics a geometric theorem can be learned and used to solve a problem, but it will be more important for students to develop a thinking process on how mathematicians construct their thinking process to find the geometric theorems used. So, habits of mind are important to do so that students can fully understand mathematics with their thoughts by following the way mathematicians think, not directly applying a concept that can cause failure in comprehensive application (Dwirahayu et al., 2017).

Levasseur and Cuoco (2003) divides two groups of habits of mind, namely: 1) habits of mind which are common to all scientific disciplines which include determining patterns, experimenting, formulating, visualizing, creating and guessing; and 2) habits of mind that are specific to the field of mathematics include giving examples with examples, generalizing, abstracting, thinking in terms of functions, using several points of view and combining several experimental deductions. The two groups of habbit of mind are useful for someone to think, take action, behave in the learning environment and the surrounding environment

(Anggriani & Septian, 2019). In addition, habits of mind will grow someone to be smart by knowing how to act to find solutions to the mathematical problems being faced (Farida et al., 2019).

Costa and Kallick (2008) explain that habits of mind are the foundation of students in ongoing learning. Students are required to have good thinking habits in order to be able to respond to any problems that arise in learning and find solutions. Habits of mind require a combination of attitudes, skills, previous experience and personality when deciding what to do in various situations. Thus, in the process of forming habits of mind, toughness is needed in thinking and facing problems.

Mathematical resilience and habits of mind aim to develop thinking skills in dealing with mathematical problems (Chusna et al., 2021; Hodiyanto & Firdaus, 2020). The process of solving mathematical problems in learning is inseparable from how the interaction process occurs in learning (Wu et al., 2019). This is in line with the statement which revealed that Güven and Dede (2017) the interaction between students in the process of learning mathematics is very complex involving collective and interactive relationships. Therefore, in developing resilience and habits of mind a process of social interaction norms of students is needed in the mathematical thingking process which is called the sociomathematical norm.

Yackel and Cobb (1996) revealed that sociomathematical norms are an aspect of a person's normative understanding of the process of mathematical activity which is considered to be different mathematically, efficiently and elegantly. Social interaction in learning mathematics is needed to develop their ideas in solving math problems (Kang & Kim, 2016). As long as students play an active role in building sociomathematical norms, they develop self-confidence and mathematical values that can be used as a basis for thinking actions in autonomous learning communities (Dickes et al., 2020; Zembat & Yasa, 2015).

Talking about the relationship with socimathematical norms, resilience has a positive influence on students' self-confidence in the process of social interaction in the learning process (Amelia et al., 2020). The results of Nettles et al. (2000) revealed that students with good resilience skills will provide significant opportunities to interact with peers with a sense of optimism, participation and academic achievement in learning mathematics. Laia's research also revealed that social interaction with peers in the learning process can be developed by mathematical resilience skills in the learning process (Liew et al., 2018). Furthermore, The results of research conducted by Hodiyanto and Firdaus (2020) reveal that habits of mind contribute to students' creative thinking abilities which are built by a process of social interaction in the mathematics learning process. Research conducted by Levasseur and Cuoco (2003) found habits of mind determine interaction behavior that can reduce memory workload in the process of learning mathematics. Agree with Levasseur and Cuoco, the results of research by Anggriani and Septian (2019) students' habits of mine will lead to an optimal pattern of social interaction, a spirit of togetherness and provide a pleasant new atmosphere in learning mathematics with a group discussion process where students give ideas. The results of research conducted by Hutauruk and Priatna (2017) revealed that mathematical resilience has a positive effect on positive responses in learning mathematics as indicated by students' thinking habits. Other studies have also confirmed that mathematical resilience has a positive effect on thought processes for solving problems (Fitriani et al., 2023). Therefore, from some of these studies it is necessary to analyze in more depth the relationship between mathematical resilience, habits of mind and sociomathematical norms in the process of learning mathematics.

From some of the previous explanations, it is necessary to analyze the relationship between mathematical resilience, habits of mind and sociomathematical norms from the process of learning mathematics. This study aims to determine the relationship between the three with research questions: (1) Is there a positive impact of mathematical resilience on sociomathematical norms? (2) Is there a positive impact of habits of mind on sociomathematical norms? (3) Is there a positive impact of mathematical resilience on habits of mind? (4) Is there a positive impact of mathematical resilience on sociomathematical norms mediated by habits of mind?

1.1. Conceptual Framework

The process of learning mathematics is inseparable from the process of social interaction to develop students' ideas and thought processes. Kang and Kim (2016) said that sociomathematical norms are an attitude of consideration from mathematical explanations to differences in mathematical understanding received by someone. The results of Nettles et al. (2000) said that students with good resilience skills will provide significant opportunities to interact with peers with a sense of optimism, participation and academic achievement in learning mathematics. Furthermore, Levasseur and Cuoco (2003) found habits of mind determine interaction behavior that can reduce memory workload in the process of learning mathematics. In line with Levasseur and Cuoco, the results of research by (Anggriani & Septian, 2019) found students' habits of mine will lead to an optimal pattern of social interaction, a spirit of togetherness and provide a pleasant new atmosphere in learning mathematics with a group discussion process in which students give ideas. The research results of Hutauruk and Priatna (2017) revealed that mathematical resilience has a positive effect on positive responses in learning mathematics as indicated by students' thinking habits. Other studies have also confirmed that mathematical resilience has a positive effect on thought processes for solving problems (Fitriani et al., 2023). Therefore, from some of these studies it is necessary to analyze in more depth the relationship between mathematical resilience, habits of mind and sociomathematical norms in the process of learning mathematics. Figure 1 shows the conceptual framework model and the hypotheses proposed in the study.

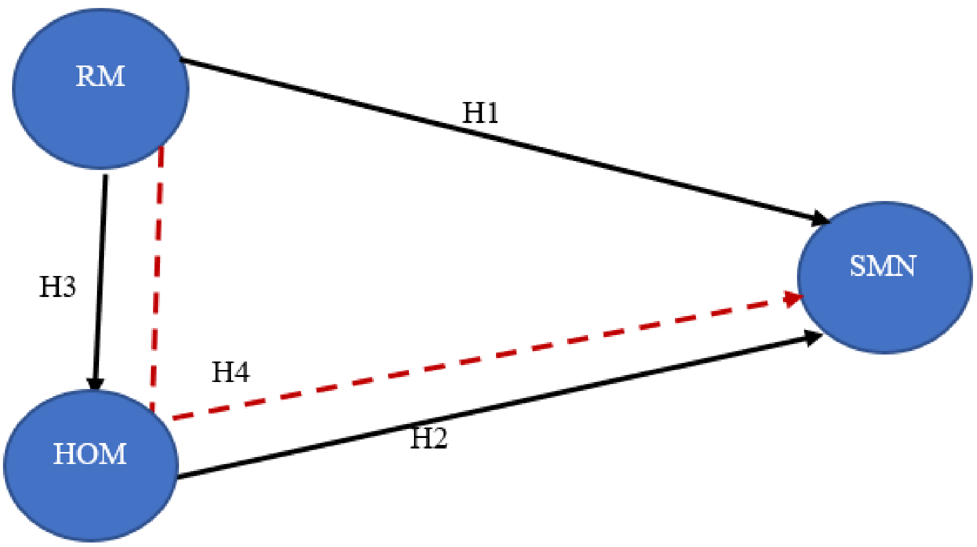

Figure 1. Conceptual framework model

Note:
RM : mathematical resilience;
HOM : habits of mind;

SMN : sociomathematical norm;
H1 : there is a positive impact of mathematical resilience on sociomathematical norms;
H2 : there is a positive impact of habits of mind on sociomathematical norms;
H3 : there is a positive impact of mathematical resilience on habits of mind;
H4 : there is a positive impact of mathematical resilience on sociomathematical norms mediated by habits of mind.

2. METHOD

This study uses a survey-based correlational research design with an inquiry model structural approach (Karakus et al., 2021). This study aims to analyze the effect of mathematical resilience and habit of mind on the sociomathematical norms of senior high school students in DKI Jakarta.

Participants in this study were 100 senior high school students consisting of 54 (54%) male students and 46 (46%) female students in DKI Jakarta. Samples were taken randomly which then responded by filling in the mathematical, habit of mind and sociomathematical resilience questionnaires which were distributed via the Google form.

The research instrument was compiled based on several article sources in determining the indicators. The instrument consists of a mathematical resilience questionnaire, habits of mind and sociomethanetical norms. This research uses 8 items of mathematics resilience instrument, 10 items of mind habits instrument, and 12 items of sociomathematical norms instrument. Each instrument has 4 alternative answers with a Likert scale. Each instrument is composed of indicators adapted from several article sources. Mathematical resilience instruments are structured based on indicators: persistent, work hard, have a willingness to discuss, look for various alternative solutions in solving problems, self-reflect, cooperate with peers, use failure experiences to build self-motivation, and have the ability to control oneself (Hendriana et al., 2019; Johnston-Wilder et al., 2018; Kooken et al., 2013).

The habits of mind instrument refers to the following indicators: 1) persistent: being serious in solving a problem and not giving up easily in solving problems. Someone who has; 2) flexible thinking: changing perspectives when receiving new information, knowing when to think big carefully and in detail, and using several alternative solutions in solving problems; 3) thinking about thinking: knowing what is known and what is not known, and being aware of the strategies used in solving problems; 4) apply existing knowledge to new situations: use experience in problem solving to apply to new problems; 5) critical response: detecting symptoms of doubtful solutions, statements, and arguments, as well as distinguishing several situations from the solutions that have been constructed (Costa & Kallick, 2008; Dwirahayu et al., 2017; Yellamraju et al., 2019).

Furthermore, for the sociomathematical norm instrument in this study, it refers to the following indicators: 1) experience of mathematics: contributing carefully and actively in discussion activities in the process of learning mathematics; 2) explanation of mathematics: understanding ideas and being able to explain their ideas from solutions systematically; 3) mathematical difference: identifying the similarities and differences in the ideas of several alternative solutions, as well as comparing the similarities and differences in the ideas of several alternative solutions that have been constructed; 4) mathematical communication: making sense as a basis for communication in the learning process and submitting statements to understand an idea in a language that is easy to understand; 5) mathematics effectiveness: finding the most effective alternative solutions and explaining the solutions to problems in a straightforward manner; 6) mathematical insight: interact in depth in discussion activities and use various sources in the discussion process to solve problems (Kang & Kim, 2016; Ningsih & Maarif, 2021; Widodo et al., 2020; Yackel & Cobb, 1996; Zembat & Yasa, 2015).

Analysis of research data to test hypotheses was carried out using Partial Least Squares Structural Equation Modeling (PLS-SEM) using SmartPLS 3 software. The use of the PLS-SEM method can be applied in various fields, including the field of mathematics education with reliable analysis results (Xu & Zhou, 2022). The use of SmartPLS software is because it is appropriate for analyzing a research model that integrates empirical theory and facts (Wong, 2013). Before testing the hypothesis, convergent validity and reliability tests were first carried out, as well as the discriminant external model (Karakus et al., 2021). Hypothesis testing was carried out to examine the relationship between latent variables, namely mathematical resilience, habits of mind and sociomathematical norms.

3. RESULT AND DISCUSSION

3.1. Results

A statistical description from research on mathematical resilience, habits of mind and sociomathematical norms is presented by showing the maximum score, minimum score, average, kurtosis and skewenes, as shown in Table 1.

Table 1. Statistical description

Variable	Item Code	Min	Max	Mean	Stdev	Kuart.	Skew.
Mathematical Relisience	RM.1	1	4	2.990	0.877	-0.683	-0.341
	RM.2	1	4	2.860	0.906	-0.670	-0.373
	RM.3	1	4	2.890	0.958	-0.740	-0.468
	RM.5	1	4	2.650	0.953	-0.850	-0.228
	RM.6	1	4	2.940	1.037	-0.762	-0.642
	RM.7	1	4	3.040	1.009	-0.609	-0.733
	RM.8	1	4	2.820	0.953	-0.652	-0.474
	RM.9	1	4	2.800	0.917	-0.424	-0.538
Habits of Mind	HOM.1	1	4	3.150	0.817	0.013	-0.733
	HOM.2	1	4	3.120	0.962	-0.084	-0.929
	HOM.3	1	4	3.110	0.904	0.303	-0.963
	HOM.4	1	4	3.130	0.945	0.050	-0.843
	HOM.5	1	4	3.090	0.850	0.387	-0.870
	HOM.6	1	4	3.070	0.941	0.131	-0.946
	HOM.7	1	4	3.170	0.906	0.537	-1.083
	HOM.8	1	4	3.190	0.857	0.711	-1.058
	HOM.9	1	4	3.110	0.937	0.341	-1.038
	HOM.10	1	4	3.040	0.916	0.300	-0.953
Sociomathematical Norm	SMN.1	1	4	3.170	0.849	-0.251	-0.737
	SMN.2	1	4	3.080	0.913	-0.126	-0.801
	SMN.3	1	4	3.080	0.902	-0.126	-0.801
	SMN.4	1	4	3.110	0.904	0.072	-0.880
	SMN.5	1	4	3.190	0.796	0.386	-0.841
	SMN.6	1	4	3.190	0.875	0.378	-0.961
	SMN.7	1	4	3.180	0.853	0.387	-1.045
	SMN.8	1	4	3.200	0.860	0.707	-1.072
	SMN.9	1	4	3.100	0.831	0.366	-0.829

Variable	Item Code	Min	Max	Mean	Stdev	Kuart.	Skew.
	SMN.10	1	4	3.130	0.820	0.970	-1.020
	SMN.11	1	4	3.120	0.930	0.674	-1.151
	SMN.12	1	4	3.590	0.928	3.046	-2.133

Table 1 shows that each item in the mathematical reliability, habits of mind and socimathematical instruments all have a kurtosis value between -7 to 7 and a skewness between -2 to 2 (Levasseur & Cuoco, 2003). That is, all items in each instrument are all distributed.

The SEM PLS convergent validity test and discriminant validity were carried out on each item of the mathematical resilience instrument, habits of mind and sociomathematical norms to find out whether the instrument is valid or measures what it should measure. Convergent validity is carried out by looking at the loading factor and Average Variance Extracted (AVE) values, while discriminant validity is done by looking at the Fornell & Larcker Criterion values (Hermanda et al., 2019).The results of the loading factor are as shown in Figure 2.

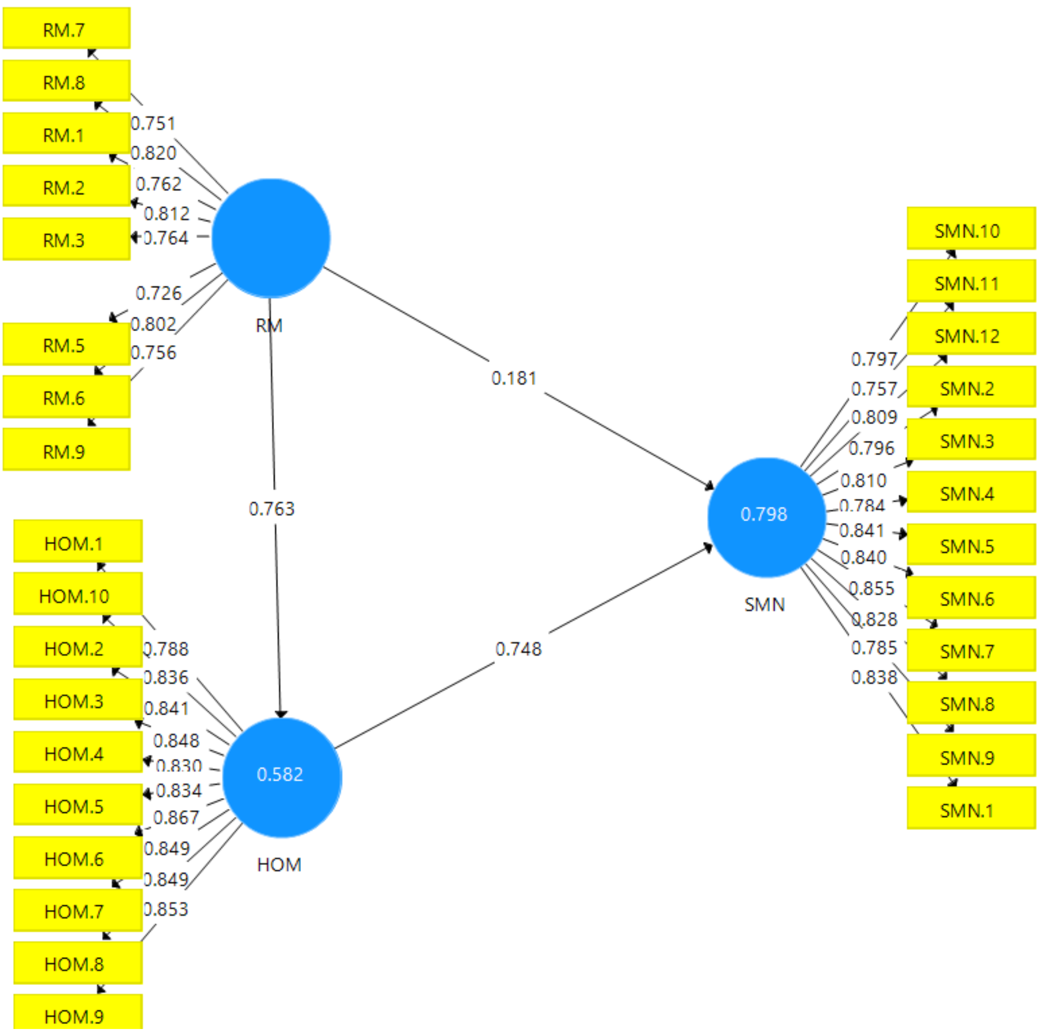

Figure 2. PLS algorithm results (modification)

The item criteria for each variable are said to be valid if the outer loading > 0.7 (Wong, 2013). Table 2 shows that each item the instrument of mathematical resilience, habits of mind and sociomathematical norm has a loading factor value of >0.7, which means that each item is valid as shown in Table 2.

Table 2. The results of the modification on the validity of testing covergent

Variable	Indicator	Outer Loading	Explanation
Mathematical Relisience	MR.1	0.762	**Valid**
	MR.2	0.812	**Valid**
	MR.3	0.764	**Valid**
	MR.5	0.726	**Valid**
	MR.6	0.802	**Valid**
	MR.7	0.751	**Valid**
	MR.8	0.820	**Valid**
	MR.9	0.756	**Valid**
Mathematical Habits of Mind	HOM.1	0.788	**Valid**
	HOM.2	0.841	**Valid**
	HOM.3	0.849	**Valid**
	HOM.4	0.830	**Valid**
	HOM.5	0.834	**Valid**
	HOM.6	0.887	**Valid**
	HOM.7	0.849	**Valid**
	HOM.8	0.849	**Valid**
	HOM.9	0.853	**Valid**
	HOM.10	0.836	**Valid**
Socio-mathematical Norm	SMN.1	0.838	**Valid**
	SMN.2	0.796	**Valid**
	SMN.3	0.810	**Valid**
	SMN.4	0.784	**Valid**
	SMN.5	0.841	**Valid**
	SMN.6	0.840	**Valid**
	SMN.7	0.855	**Valid**
	SMN.8	0.828	**Valid**
	SMN.9	0.785	**Valid**
	SMN.10	0.797	**Valid**
	SMN.11	0.757	**Valid**
	SMN.12	0.809	**Valid**

The validity of each instrument is determined by the Average Variance Extracted (AVE) value with the criterion of an AVE value > 0.5 (Wong, 2013). From the results of testing the instrument of mathematical resilience, habits of mind and sociomathematical norms have an AVE > 0.05 as shown in Table 3. This means that the indicators for each instrument are said to be valid.

Table 3. The result of average variance extracted (AVE)

Variable	AVE	Rule of thumb	Explanation
Mathematical Relisience	0.600	>0.500	**Valid**
Mathematical Habits of Mind	0.705	>0.500	**Valid**
Sociomathematical Norm	0.659	>0.500	**Valid**

Furthermore, discriminant validity testing was carried out with the Fornell & Larcker criterion on mathematical resilience instruments, habits of mind and sociomathematical norms. The results of discriminant validity testing are shown in Table 4.

Table 4. The result of discriminant validity: Fornell & Larcker criterion

	Mathematical Relisience (RM)	Mathematical Habits of Mind (HOM)	Sociomathematical Norm (SMN)
Mathematical Relisience	**0.775**		
Mathematical Habits of Mind	0.763	**0.880**	
Sociomathematical Norm	0.751	0.840	**0.812**

The criterion for discriminant validity with the Fornell & Larcker criterion is that the AVE value on the diagonal (see Table 4) is higher than the other values (Karakus et al., 2021). So that the discriminant validity requirements are met. From testing convergent and discriman validity through the three criteria, all of them meet the requirements. Thus, based on confirmatory factor analysis (CFA) concluded that the developed instrument of mathematical resilience, habits of mind and sociomathematical norms can be used to test the proposed model hypothesis.

After the instrument of mathematical resilience, habits of mind and sociomathematical norms are declared valid. The next step is to test the PLS SEM reliability with Cronbach's Alpha. The results of the reliability test for the instrument are shown in Table 5.

Table 5. The result of reliability test

Variable	Cronbach's alpha	Composite Reliability	Rule of thumb	Explanation
Mathematical Relisience	0.905	0.907	>0.700	**Reliable**
Mathematical Habits of Mind	0.953	0.954	>0.700	**Reliable**
Sociomathematical Norm	0.953	0.954	>0.700	**Reliable**

Table 5 shows the reliability testing criteria are Cronbach's Alpha > 0.7 and Composite Reliability > 0.7 (Wong, 2013). Table 5 shows the results of reliability testing for each the instrument of mathematical resilience, habits of mind and sociomathematical norms have a Cronbach's alpha value and Composite Reliability > 0.7. So it can be concluded that the instrument meets the reliability requirements.

There are four hypotheses proposed in this study as previously mentioned in Figure 1. To test the hypotheses of the structural model that has been proposed, the T-value can be used through a bootstrap procedure with 5000 repeated samples (Hermanda et al., 2019). Figure 3 shows the results of bootstrapping that has been done.

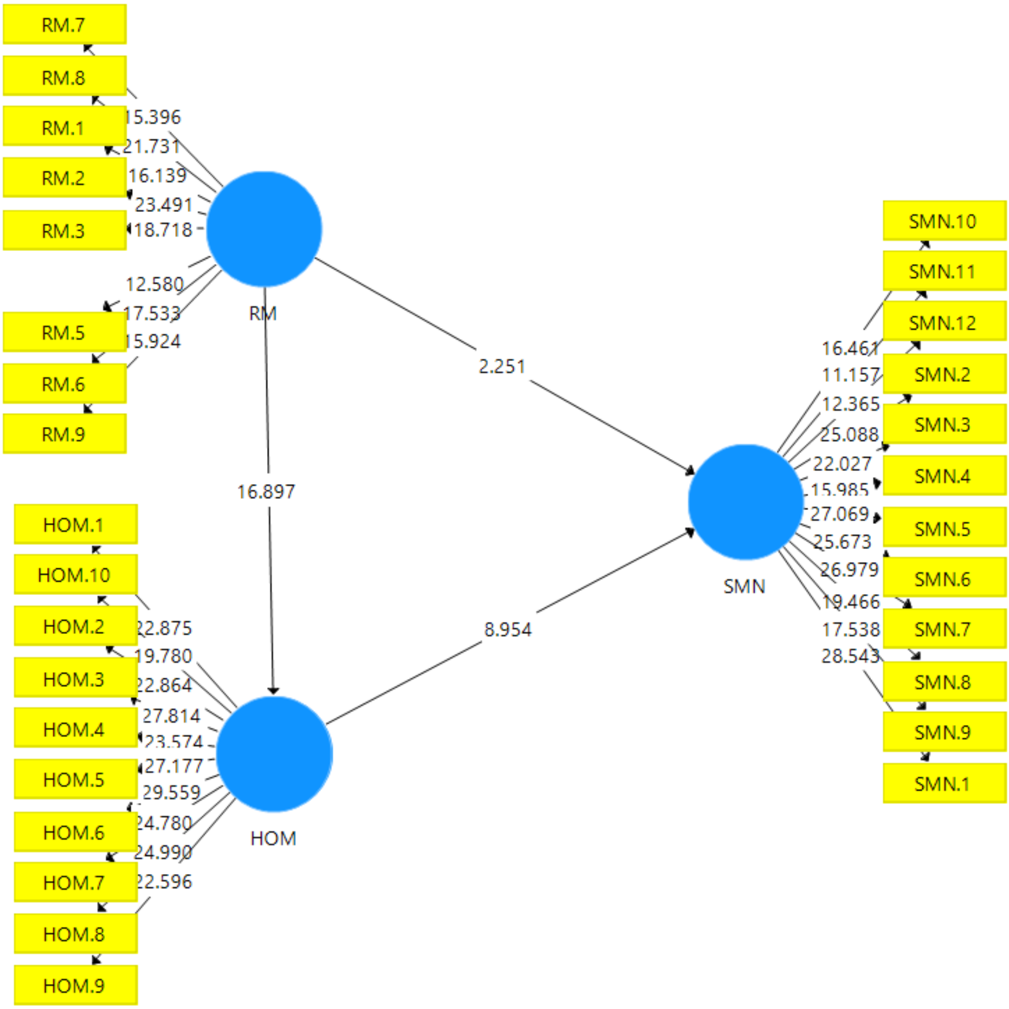

Figure 3. Bootstrapping test results.

Furthermore, the results of testing the structural model which shows the results of testing the hypothesis using the T-value as shown in Table 6.

Table 6.The result of hypothesis testing

Hypotesis	Variable	Original Sample	Standard Deviation	T-Value	P-Value	Explanation
H1	RM -> SMN	0.181	0.085	2.112	0.035	**Accepted**
H2	HOM -> SMN	0.748	0.086	8.666	0.000	**Accepted**
H3	RM -> HOM	0.763	0.047	16.193	0.000	**Accepted**
H4	RM ->HOM -> SMN	0.571	0.075	7.565	0.000	**Accepted**

Criteria for the significance of the hypothesis by looking at the parameter coefficient values and the significance value of the T-statistic in the bootstrapping algorithm report. By looking at the T-table at alpha 0.05 (5%) = 1.96 and comparing it with the T-test we can conclude whether the hypothesis proposed is significant or not. If the T-test value is > T-table, then the proposed hypothesis is accepted (Wong, 2013). Table 6 shows H1, H2, H3 and H4 each having a T-value > 1.96, so it can be concluded that H1, H2, H3 and H4 are accepted.

3.2. Discussion

The results of testing the hypothesis in Table 6 conclude that there is a positive impact on socio-mathematical norms with a T-value = 2.222 > 1.96 with a P-value = 0.035. This shows that someone who has good mathematical resilience will influence socio-mathematical norms in learning mathematics. This finding shows that each indicator on mathematical resilience supports the formation of indicators on socio-mathematical norms. Mathematical resilience is supported by how a student has a willingness to discuss which can play a role in carrying out in-depth interactions in discussion activities or mathematical insights. Interaction in depth in the consultation process will build social intelligence. This is in line with the wishes of Sánchez and García (2014) that the experience of interacting with the surrounding environment or social interaction influences the development of mathematical thinking processes in solving problems.

In addition, students with good resilience will try optimally to find various alternative solutions in solving problems. This is in line with the results of his research (Kang & Kim, 2016; Maarif et al., 2022) which revealed that someone with good socimathematical norms would find the most effective alternative solutions and be able to explain solutions to problems straightforwardly. So that resilience can have an impact on the ability of sociomathematical norms. Thus, it appears that mathematical resilience has an effect on the formation of students' societal norms. The results of Nettles et al. (2000) revealed that students with good resilience skills will provide significant opportunities to interact with peers with a sense of optimism, participation and academic achievement in learning mathematics.

The results of testing the hypothesis in Table 6 conclude that there is an impact of positive thinking habits on socio-mathematical norms by showing a T-value = 8.666 > 1.96 with a P-value = 0.000. This shows that someone who has good thinking habits will influence socio-mathematical norms in learning mathematics. Habits of mind allow students to think flexibly by using several alternative solutions to problem solving while using several alternative solutions is a characteristic of socio-mathematical norms. That is, habit of mind has a contribution to socio-mathematical norms. To find alternative solutions, interaction is needed to multiply ideas. This is what Levasseur and Cuoco (2003) found in their research that habit of mind determines interactive behavior that can reduce memory workload in the process of learning mathematics. In line with Levasseur and Cuoco, the research results of Anggriani and Septian (2019) students' habit of mine will lead to an optimal pattern of social interaction, a spirit of togetherness and provide a fun new atmosphere in learning mathematics with the process of student group discussions where give ideas.

In addition, students with good sociomathematical norms will be able to explain solutions to problems in a straightforward manner. The ability to explain in a straightforward manner can be easily carried out by students when they are aware of the steps/strategies used in solving problems. Students who are aware of problem solving strategies will master the solution and easily explain the solution. This is in line with the research of Murtafiah et al. (2018) who revealed that explanations of problem solutions can help students understand concepts, procedures and be flexible in choosing information in solving mathematical problems.

Table 6 concludes that there is a positive impact of mathematical resilience on the habit of mind which is indicated by a T-value = 16.193 > 1.96 with a P-value = 0.000. This shows that someone who has good thinking habits will influence socio-mathematical norms in learning mathematics. This is in line with the research findings of Hutauruk and Priatna (2017) reveal that mathematical resilience has a positive effect on positive responses in learning mathematics as indicated by students' thinking habits. Other studies have also revealed that mathematical resilience has a positive effect on the thought process for solving problems (Fitriani et al., 2023).

The results of hypothesis testing in Table 6 show a T-value = 7.565 > 1.96 with a P-value = 0.000 which means that there is a positive impact of mathematical resilience on sociomathematical norms mediated by habits of mind. These findings have the meaning that apart from mathematic resilience directly influencing sociomathematical norms, it also has an influence based on mediation by aspects of habits of mind. This shows that in the process of learning mathematics, someone who has good resilience and a good habit of mind will support socio-mathematical norms either directly or indirectly. Habits of mind can directly affect resilience or can also mediate students who have less math resilience.

4. CONCLUSION

The results of the study concluded: 1) there is a positive impact of mathematical resilience on sociomathematical norms; 2) there is a positive impact of habits of mind on sociomathematical norms; 3) there is a positive impact of mathematical resilience on habits of mind); 4) there is a positive impact of mathematical resilience on sociomathematical norms mediated by habits of mind.

The results of this study indicate that the affective aspects of learning mathematics are related to one another. Therefore, in the learning process it is important to develop affective aspects, especially mathematical resilience, habits of mind and sociomathematical norms. These three aspects can be taken into consideration in developing a learning strategy to improve mathematical competence. In addition, these three aspects can also be used as a reference in determining the success of learning in addition to cognitive aspects in order to create effective and efficient mathematics learning, especially at the senior high school level.

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REFERENCES

Amelia, R., Kadarisma, G., Fitriani, N., & Ahmadi, Y. (2020). The effect of online mathematics learning on junior high school mathematic resilience during covid-19 pandemic. *Journal of Physics: Conference Series*, *1657*(1), 012011. https://doi.org/10.1088/1742-6596/1657/1/012011

Anggriani, A., & Septian, A. (2019). Peningkatan kemampuan komunikasi matematis dan kebiasaan berpikir siswa melalui model pembelajaran IMPROVE [Improving students' mathematical communication skills and thinking habits through the IMPROVE learning model]. *IndoMath: Indonesia Mathematics Education*, *2*(2), 105-116. https://doi.org/10.30738/indomath.v2i2.4550

Chirkina, T., Khavenson, T., Pinskaya, M., & Zvyagintsev, R. (2020). Factors of student resilience obtained from TIMSS and PISA longitudinal studies. *Issues in Educational Research*, *30*(4), 1245-1263. https://search.informit.org/doi/10.3316/informit.606111940684440

Chusna, C. A., Rochmad, R., & Zaenuri, Z. (2021). Mathematical reasoning of class VII students in terms of mathematical resilience in TAI learning with the RME approach aided by graphic organizer. *Unnes Journal of Mathematics Education Research*, *10*(A), 9-16.

Costa, A. L., & Kallick, B. (2008). *Learning and leading with habits of mind: 16 essential characteristics for success*. Association for Supervision and Curriculum Development (ASCD).

Cuoco, A., Paul Goldenberg, E., & Mark, J. (1996). Habits of mind: An organizing principle for mathematics curricula. *The Journal of Mathematical Behavior*, *15*(4), 375-402. https://doi.org/10.1016/S0732-3123(96)90023-1

Dickes, A. C., Farris, A. V., & Sengupta, P. (2020). Sociomathematical Norms for Integrating Coding and Modeling with Elementary Science: A Dialogical Approach. *Journal of Science Education and Technology*, *29*(1), 35-52. https://doi.org/10.1007/s10956-019-09795-7

Dwirahayu, G., Kustiawati, D., & Bidari, I. (2017). Corresponding habits of mind and mathematical ability. *Journal of Physics: Conference Series*, *895*(1), 012013. https://doi.org/10.1088/1742-6596/895/1/012013

Farida, F., Hartatiana, H., & Joemsittiprasert, W. (2019). The use of realistic mathematics education (RME) in improving mathematical analogical ability and habits of mind. *Al-Jabar: Jurnal Pendidikan Matematika*, *10*(2), 175-186. https://doi.org/10.24042/ajpm.v10i2.3540

Fitriani, F., Herman, T., & Fatimah, S. (2023). Considering the mathematical resilience in analyzing students' problem-solving ability through learning model experimentation. *International Journal of Instruction*, *16*(1), 219-240. https://doi.org/10.29333/iji.2023.16113a

Gürefe, N., & Akçakin, V. (2018). The Turkish adaptation of the mathematical resilience scale: Validity and reliability study. *Journal of Education and Training Studies*, *6*(4), 38-47. https://doi.org/10.11114/jets.v6i3.2992

Güven, N. D., & Dede, Y. (2017). Examining social and sociomathematical norms in different classroom microcultures: Mathematics teacher education perspective. *Educational Sciences: Theory and Practice*, *17*(1), 265-292. https://doi.org/10.12738/estp.2017.1.0383

Hendriana, H., Sumarmo, U., Carli, C., Ristiana, M. G., & Putra, H. D. (2019). Enhancing students mathematical creative skill and resilience by using problem posing approach. *Journal of Physics: Conference Series*, *1318*(1), 012065. https://doi.org/10.1088/1742-6596/1318/1/012065

Hermanda, A., Sumarwan, U., & Tinaprillia, N. (2019). The effect of social media influencer on brand image, self-concept, and purchase intention. *Journal of Consumer Sciences*, *4*(2), 76-89. https://doi.org/10.29244/jcs.4.2.76-89

Hodiyanto, H., & Firdaus, M. (2020). The self regulated learning, habit of mind, and creativity as high order thinking skills predictors. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(1), 21-30. https://doi.org/10.24127/ajpm.v9i1.2589

Hutauruk, A. J. B., & Priatna, N. (2017). Mathematical resilience of mathematics education students. *Journal of Physics: Conference Series*, *895*(1), 012067. https://doi.org/10.1088/1742-6596/895/1/012067

Ignacio, N. G., Nieto, L. J. B., & Barona, E. G. (2006). The affective domain in mathematics learning. *International Electronic Journal of Mathematics Education*, *1*(1), 16-32. https://doi.org/10.29333/iejme/169

Ishak, N., Yusoff, N., & Madihie, A. (2020). Resilience in mathematics, academic resilience, or mathematical resilience?: An overview. *Universal Journal of Educational Research*, *8*(5), 34-39. https://doi.org/10.13189/ujer.2020.081905

Johnston-Wilder, S., Goodall, J., & Almehrz, H. (2018). Overcoming statistical helplessness and developing statistical resilience in learners: An illustrative, collaborative, phenomenological study. *Creative Education*, *9*(7), 1105-1122. https://doi.org/10.4236/ce.2018.97082

Johnston-Wilder, S., Lee, C., Brindley, J., & Garton, L. (2015). Developing mathematical resilience in school-students who have experienced repeated failure. In ICERI2015 Proceedings.

Kang, S. M., & Kim, M. K. (2016). Sociomathematical norms and the teacher's mathematical belief: A case study from a Korean in-service elementary teacher. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(10), 2733-2751. https://doi.org/10.12973/eurasia.2016.1308a

Karakus, M., Ersozlu, Z., Usak, M., & Ocean, J. (2021). Self-efficacy, affective well-being, and intent-to-leave by science and mathematics teachers: A structural equation model. *Journal of Baltic Science Education*, *20*(2), 237-251. https://doi.org/10.33225/jbse/21.20.237

Kooken, J., Welsh, M. E., Mccoach, D. B., Johnson-Wilder, S., & Lee, C. (2013, 27 Apr - 1 May 2013). Measuring mathematical resilience: an application of the construct of resilience to the study of mathematics. In American Educational Research Association (AERA) 2013 Annual Meeting: Education and Poverty: Theory, Research, Policy and Praxis, San Francisco, CA, USA.

Levasseur, K., & Cuoco, A. (2003). Mathematical Habits of Mind. In Proceedings of PME-NA.

Liew, J., Cao, Q., Hughes, J. N., & Deutz, M. H. F. (2018). Academic resilience despite early academic adversity: A three-wave longitudinal study on regulation-related resiliency, interpersonal relationships, and achievement in first to third grade. *Early Education and Development*, *29*(5), 762-779. https://doi.org/10.1080/10409289.2018.1429766

Maarif, S., Oktarina, N., Sessu, S., Sulistyowati, F., & Utami, W. B. (2022). Sociomathematical norms in online learning in the COVID-19 pandemic period. *International Journal of Evaluation and Research in Education (IJERE)*, *11*(4), 1673-1686. https://doi.org/10.11591/ijere.v11i4.23046

Maarif, S., Perbowo, K. S., Noto, M. S., & Harisman, Y. (2019). Obstacles in constructing geometrical proofs of mathematics-teacher-students based on Boero's proving model. *Journal of Physics: Conference Series*, *1315*(1), 012043. https://doi.org/10.1088/1742-6596/1315/1/012043

Matsuura, R., Sword, S., Piecham, M. B., Stevens, G., & Cuoco, A. (2013). Mathematical habits of mind for teaching: Using language in algebra classrooms. *The Mathematics Enthusiast*, *10*(3), 735-776. https://doi.org/10.54870/1551-3440.1285

Murtafiah, W., Sa'dijah, C., Candra, T. D., & As'ari, A. R. (2018). Exploring the Explanation of Pre-Service Teacher in Mathematics Teaching Practice. *Journal on Mathematics Education*, *9*(2), 259-270. https://doi.org/10.22342/jme.9.2.5388.259-270

Nettles, S. M., Mucherah, W., & Jones, D. S. (2000). Understanding Resilience: The Role of Social Resources. *Journal of Education for Students Placed at Risk (JESPAR)*, *5*(1-2), 47-60. https://doi.org/10.1080/10824669.2000.9671379

Ningsih, A. W., & Maarif, S. (2021). Analysis of sociomathematical norms in mathematics learning at 113 junior high school. *Wacana Akademika: Majalah Ilmiah Kependidikan*, *5*(1), 43-50. https://doi.org/10.30738/wa.v5i1.9966

Roth, S. (2019). The open theory and its enemy: Implicit moralisation as epistemological obstacle for general systems theory. *Systems Research and Behavioral Science*, *36*(3), 281-288. https://doi.org/10.1002/sres.2590

Sánchez, V., & García, M. (2014). Sociomathematical and mathematical norms related to definition in pre-service primary teachers' discourse. *Educational Studies in Mathematics*, *85*(2), 305-320. https://doi.org/10.1007/s10649-013-9516-0

Thornton, S., Statton, J., & Mountzouris, S. (2012). Developing Mathematical Resilience among Aboriginal Students. In the 35th annual conference of the Mathematics Education Research Group of Australasia, Singapore.

Widodo, S. A., Dahlan, J. A., Harini, E., & Sulistyowati, F. (2020). Confirmatory factor analysis sosiomathematics norm among junior high school student. *International Journal of Evaluation and Research in Education*, *9*(2), 448-455. https://doi.org/10.11591/ijere.v9i2.20445

Wong, K. K.-K. (2013). Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing Bulletin*, *24*(1), 1-32.

Wu, Q., Sang, Y., & Huang, Y. (2019). Danmaku: A new paradigm of social interaction via online videos. *Trans. Soc. Comput.*, *2*(2), 1-24. https://doi.org/10.1145/3329485

Xu, S.-R., & Zhou, S.-N. (2022). The effect of students' attitude towards science, technology, engineering, and mathematics on 21st century learning skills: A structural equation model. *Journal of Baltic Science Education*, *21*(4), 706-719. https://doi.org/10.33225/jbse/22.21.706

Yackel, E., & Cobb, P. (1996). Sociomathematical norms, argumentation, and autonomy in mathematics. *Journal for Research in Mathematics Education*, *27*(4), 458-477. https://doi.org/10.5951/jresematheduc.27.4.0458

Yellamraju, T., Magana, A. J., & Boutin, M. (2019). Investigating students' habits of mind in a course on digital signal processing. *IEEE Transactions on Education*, *62*(4), 312-324. https://doi.org/10.1109/TE.2019.2924610

Zembat, I. O., & Yasa, S. A. (2015). Using classroom scenarios to reveal mathematics teachers' understanding of sociomathematical norms. *International Journal of Education in Mathematics, Science and Technology*, *3*(3), 242-261.