MATHEMATICIANS DON'T NEED TO READ MUCH: MYTH OR FACT?

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ABSTRACT

This study aims to determine the direct effect of Reading Comprehension (RC) on Mathematics Problem Solving (MPS), the direct effect of Mathematics Growth Mindset (MGMS) on MPS, and the indirect effect of RC on MPS through MGMS. RC itself is the ability to understand what is read. The level is no longer just knowing letters and being able to spell words but is already able to understand implicit and explicit messages in a reading. The ability to read properly is still homework for the Indonesian people. This is because RC ability is needed in every aspect of life, including in the field of mathematics. One of the mathematical abilities that are expected to be mastered is problem-solving ability. Someone who has good RC skills will find it easier to understand the meaning of a math problem. The difficulty of Indonesian students in solving word problems, one of the reasons is the lack of understanding of the problem. Apart from RC, psychological factors such as MGMS have recently been widely touted as factors that have a major influence on MPS abilities. Someone who has MGMS will not easily give up on facing difficult math problems. Also, they will perceive mistakes as a means to continue learning. There are 110 samples who are willing to complete a series of tests. This study applies Structural Equation Modeling (SEM) processed with AMOS. The result is that there is a direct effect between RC and MPS and there is also a direct effect between RC and MGMS. However, there is no indirect effect between RC and MPS through MGMS.

Keywords: growth mindset, mathematics, problem-solving, reading comprehension, second order, SEM

INTRODUCTION

Some students choose to major in mathematics education so they don't have to face the task of reading lots of books and memorizing various theories. Several other mathematics education students said that mathematics does not require that people who study it have good language skills. Studying mathematics is as if only studying the world of arithmetic (Prastiwi, 2022). Mathematics seems to be on a different side from reading ability (Lyon, 2019). In the end, it is understandable that it is natural for those who like mathematics to not like reading, let alone writing. Is that right?

The fact that mathematics is a science that contains symbolic logic cannot be denied (Russell, 2017). However, the existence of mathematics in life is not to complicate life but to make it easier. As is well known, mathematics can be found in almost all aspects of human life. Gauss stated that mathematics is the queen of science, where number theory is the queen of mathematics (Morus, 2013; Susilawati, 2017). This shows that mathematics is a field of knowledge that needs to be understood and understood, both conceptually and in its application in everyday life (Brune et al., 1967). Hazrul (1999) argues that the myth about mathematics proposed by Buxon (1981), raises the justification that mathematics is an abstract science and is not related to the real world. In fact, mathematics is a science that studies real things (Hers,

1998; Kusuma et al., 2021).

The National Council of Teachers of Mathematics (NCTM) states that problem solving ability is one of the four competencies that must be mastered by mathematics learners (Masri et al., 2018). Other abilities are reasoning and proof, communication, and connection and representation. Mathematical problem-solving abilities are related to cognitive and psychological factors (Tambychik & Meerah, 2010). In terms of cognitive, students with less math skills (mathematics skills) will experience difficulties when solving problems on math problems. Tambychik and Meerah divide math skills into number facts, arithmetic, information, language, and visual spatial skills.

Polya suggests 4 stages needed to be able to solve mathematical problems or Mathematics Problem Solving (MPS), namely understanding the problems, planning, carrying out the plan, and confirming the answer (Polya, 1981). Thus, MPS is the ability possessed by a person in an effort to solve a problem that starts with understanding the problem or math problem, then thinking about the steps to be used. Then, apply these steps in the form of doing questions. Finally, someone who has good MPS skills will double-check whether the steps and answers obtained are correct or not (Agustin, 2016).

Some mathematicians agree that the skill of understanding the information contained in reading texts or math word problems contributes to a person's ability to solve math problems. This is as stated by Boonen (2016) where to be able to solve math problems, one needs mental representation skills and reading comprehension skills. Yadav and Madhubani also stated that "The science of mathematics depends on the mental ability" (2017).

Mathematics does not only consist of numbers, but also symbols and words. Fuentes (1998) states that students who want to improve their math skills must learn to understand texts, especially math texts. Ulu (2017) also states that in an effort to solve problems, it is advisable to master Reading Comprehension (RC) skills by first practicing understanding a text literally and inferentially. Literal understanding of the text is the ability to understand the lowest reading. In the literal ability, a person understands the explicit information contained in a text. Meanwhile, inferential understanding is the ability to understand information that is stated indirectly (implied) in the text (Kholiq & Luthfiyati, 2018). In inferential understanding, one needs to understand word by word and sentence by sentence so that one can understand the implicit ideas contained in the text (Kholiq & Luthfiyati, 2020).

The ability to solve mathematical problems is influenced by the ability to understand a text (Öztürk et al., 2020). If someone has difficulty understanding a text, it will be difficult for him to master what is being studied (Charles & Silver, 1988). In short, RC is a person's ability to understand a text. To understand reading literally and inferentially requires verbal skills, such as having a rich vocabulary, recognizing synonyms and antonyms, being able to choose the right diction, and being able to understand a passage both explicitly and implicitly, even being able to rewrite what is understood. nicely. The results of McDermott's research (1956) explained that one of the causes of students' reluctance to study mathematics was the first impression with mathematics that did not make a good impression during elementary school (SD). While in high school, some students admitted that they had difficulty understanding complex mathematical concepts and abstract algebraic symbols (Aiken, 1970). One of the efforts to overcome learning problems is to improve the mindset. Students who have a growth mindset tend to get good grades in mathematics (Degol et al., 2018).

Someone who has a growth mindset will tend to view obstacles as a means to continue learning. Problems should be considered as something that is challenging to solve, not to be avoided (Hiebert et al., 1996). The process of dealing with problems is termed Hiebert, et al. problematize. Someone problematizes what he learns in order to understand the problem he has to solve. This process will generate curiosity and build sense-making skills in mathematics.

Dweck (2022) states that mindset is a belief or belief that is strong but also something that can still be changed. Dweck divides two mindsets, namely fixed and growth mindsets. The fixed mindset is in someone who believes that strength, intelligence, and all kinds of greatness have been formed from the start, without even needing to be trained and shaped. Someone with a fixed way of thinking will assume that failure is proof that someone is not an expert and will never succeed. Conversely, someone who thinks growth or growth mindset will consider failure as a reason to keep learning and struggling. Some experts agree that in mastering mathematics, the most important thing is mental ability. A growth mindset is needed to pump enthusiasm and motivation in mastering mathematics (Kadir, 2021; Pratiwi & Royanto, 2020; Suh et al., 2011).

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from success of others, take mistakes as opportunities to learn. Based on these indicators, the instrument was modified to produce 6 items in the Mathematics Growth Mindset (MGMS) instrument. This study aims to examine whether RC directly affects MPS ability, whether MGMS directly affects MPS ability, and whether RC indirectly affects MPS ability.

METHODS

This study uses a survey research method. The survey method is a quantitative research method that focuses on collecting data using questionnaires or tests from respondents who are targeted to be able to answer research hypotheses, without giving treatment to the respondents. This is as stated by Visser, et al. (2000) namely "survey research is a specific type of field study that involves the collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire". The time of the research was conducted from September to December 2022. The target of this research were mathematics education students at a private university in East Jakarta. The reason for choosing this campus is that this campus is a tertiary institution that focuses on education and seeks to produce reliable future mathematics teacher candidates.

Respondents of the Research

The test instruments were randomly distributed to mathematics education students at a private university in East Jakarta, but only 129 people were willing to take a complete series of tests. After testing for normality, there were outlier data and had to be discarded. The remaining research samples after the normality test were 110.

The selected research sample is classified as homogeneous because they are students in the same study program and have an age range that is not much different. The sample is also on

average domiciled around Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek). There is no division by gender or level of study because the tests given are comprehension tests for reading, writing, and basic mathematics. All tests allow for all levels of students. Assuming that all levels of students can do it, then the sample is chosen randomly.

Research Variables

There are 3 variables in this study, namely RC as an exogenous variable, MGMS as a moderator variable, and MPS as an endogenous variable. MGMS is used as a moderator to find out whether there is an influence whether or not MGMS is related to RC on MPS.

This study applies Structural Equation Modeling (SEM) with the second order which tries to examine the indicators of each variable studied. The research design can be described in the model below.

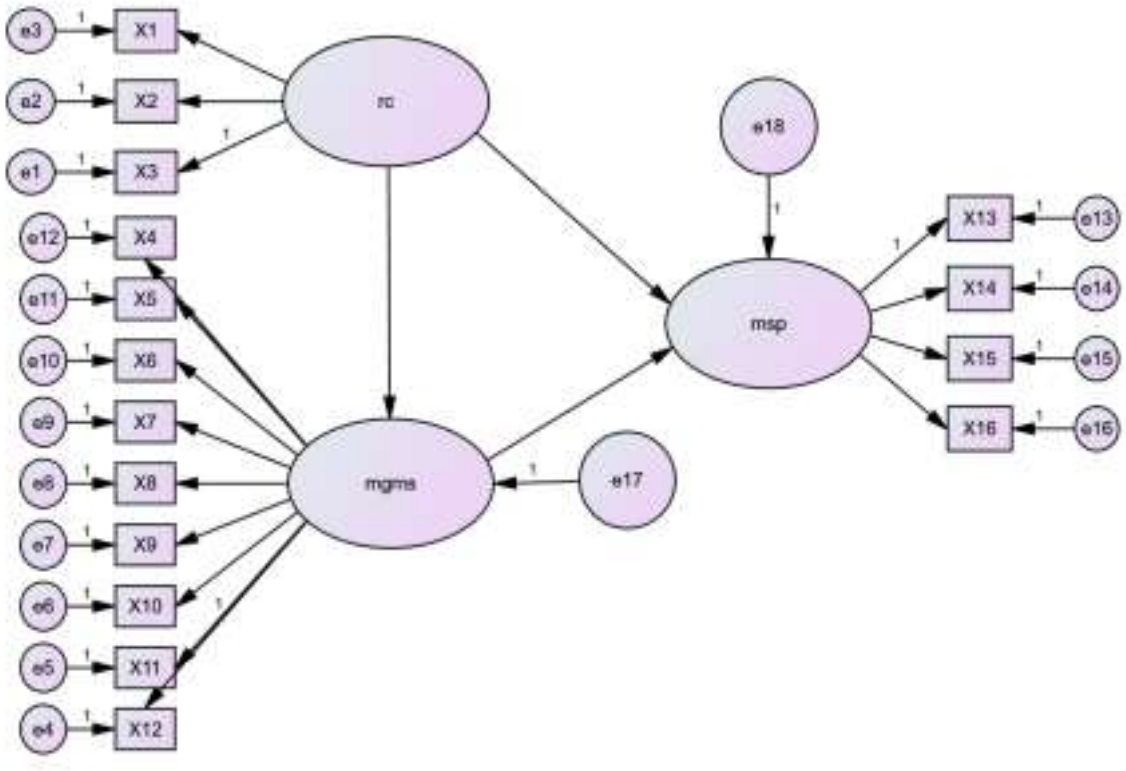

Figure 1. Second Order Constellation between Exogenous, Moderator, and Endogenous Variables

Instruments

Initially, the MGMS variable has 43 indicators. After repeated Confirmatory Factor Analysis (CFA), 9 indicators were obtained with a factor loading above 0.5. Likewise with the RC and MPS variables. After all indicators with a factor loading below 0.5 are removed, the analysis can be continued.

Data was collected through the results of questionnaires or questionnaires and tests that were distributed using Google forms and manuals. Questionnaires or questionnaires about MGMS using the Google form which are distributed using the WhatsApp application. While the MPS and RC test instruments are carried out manually. Researchers visited several classes and asked students to take tests with a predetermined time.

In Figure 1 it can be seen that, initially the RC variable had 3 indicators, namely tests that tested the respondent's ability to understand a text (X1), write short essays (X2), and compose long writing to find out the respondent's vocabulary (X3). Each test has a different time duration. In the MGMS test, respondents answered directly to a questionnaire made using the Google form. The duration of filling out the MGMS questionnaire for 9 items (X4 – X12) is 10 minutes. The MPS ability test contains 5 items with a duration of 30 minutes. The 5 questions were corrected and scored according to the 4 MPS indicators, namely understanding the problem (X13), planning the solution (X14), carrying out the solution (X15), and checking again (X16).

Data Analysis Techniques

The research analysis applied to this research is path analysis. Path analysis was invented by Sewal Wright in 1934. Wright developed correlations. Path analysis itself has a close relationship with multiple regression correlation. Path analysis is also known as causal modeling which later developed into Structural Equation Modeling (SEM) analysis (Sarwono, 2011). The use of SEM aims to build and test, as well as confirm statistical models based on previously constructed theories (Sarwono, 2010).

Data were analyzed using Microsoft (Ms.) Excel and Analysis of Moment Structure (AMOS) version 22. Ms. Excel is used to recap the sample answer results from the Google form and recap the test score results. After being recapitulated, the data was processed using AMOS software.

The first thing to do is find out whether the data is normal or not. The multivariate normality result was 2.201, whereas the multivariate normality test limit was 2.58 (Table 1). If the result is less than 2.58 then the data is said to be normal. Conversely, if the result is above 2.58 then the data is said to be abnormal. Because the data is classified as normal, the analysis can be continued to test the validity and reliability.

Table 1. Normality Test Results

Variable min max skew c.r. kurtosis c.r. X16 25.000 100.000 -.281 -1.157 -.889 -1.833 X15 30.000 90.000 .065 .268 -.799 -1.647 X14 25.000 85.000 .945 3.895 .513 1.058 X13 25.000 100.000 .599 2.469 -.302 -.622 X4 60.000 100.000 -1.127 -4.645 .247 .508 X5 40.000 100.000 -.431 -1.779 -.647 -1.335 X6 80.000 100.000 -1.125 -4.638 -.735 -1.515 X7 20.000 100.000 -1.268 -5.228 1.000 2.062 X8 20.000 100.000 -1.610 -6.640 2.634 5.430 X9 60.000 100.000 -.465 -1.916 -.916 -1.888 X10 40.000 100.000 -1.136 -4.684 1.346 2.775 X11 80.000 100.000 -1.125 -4.638 -.735 -1.515 X12 60.000 100.000 -.907 -3.738 -.253 -.522 X1 20.000 70.000 .028 .116 -.883 -1.821 X2 29.000 95.000 -.193 -.794 -.279 -.575 X3 13.000 100.000 -.161 -.666 -.825 -1.700 Multivariate 10.459 **2.201** Source: AMOS Results

The factor loading value accepted in this study is above 0.5. In accordance with what Santoso (2014) explained, 0.5 can be the minimum limit for factor loading. In the validation results, several indicators whose factor loading values are below 0.5 must be removed. Indicators that have a factor loading above 0.5 are maintained and then re-analyzed using AMOS (see Table 2).

After the validity test was carried out, then the reliability calculation was carried out by calculating the Construct Reliability (CR) and Average Variance Extract (AVE) with the help of Ms. Excel. CR must be above 0.7 in terms of factor loading, while the AVE value must be above 0.5 (Sarwono, 2010). CR and AVE values close to 1 are said to be very reliable.

Convergent validity means that a set of indicators represents one latent variable and that underlies the latent variable (Meiryani, 2021). If the AVE value is below 0.5, this indicates that the indicators created are not in accordance with the latent variables studied.

Table 2. Factor Loading Results

Variables	Estimate
X3 <--- RC	**0.633**
X1 <--- RC	**0.704**
X12 <--- MGMS	**0.594**
X11 <--- MGMS	0.463
X10 <--- MGMS	**0.545**
X9 <--- MGMS	**0.538**
X7 <--- MGMS	**0.553**
X6 <--- MGMS	**0.527**
X5 <--- MGMS	**0.580**
X15 <--- MSP	**0.758**
X16 <--- MSP	**0.927**

Source: AMOS Results

In the results of CR and AVE calculations (Table 3), only the RC variable whose CR and AVE values do not meet the criteria. Meanwhile, the MGMS CR value meets the criteria, but the AVE value is still below 0.5. Only the MPS variable meets both the CR and AVE criteria.

Table 3. CR and AVE results

Variable	CR	AVE
RC	0.617473	0.447124
MGMS	0.728892	0.311762
MPS	0.832978	0.715688

Source: Results of Data Processing with Ms. Excel

RESULTS

The hypothesis test refers to the calculation results issued by AMOS (Table 4). In this table, the P-value is below 0.05 and the Critical Ratio value is above 1.96 (Sarwono, 2010) indicating that the RC variable has a significant direct effect on MGMS and MPS. The strongest influence is shown by the RC variable with MPS. In contrast, MGMS has no significant direct effect on MPS.

Table 4. Results of Hypothesis Testing on Direct Effects

	Variable	Estimate	S.E.	C.R.	P	Label
MGMS	<--- RC	0.227	0.105	2.167	0.03	Correlated
MPS	<--- RC	0.454	0.159	2.861	0.004	Correlated
MPS	<--- MGMS	0.105	0.171	0.614	0.539	Uncorrelated

Source: AMOS Results

In the indirect effect, the calculation results obtained with the Sobel test obtained t_{count} = 0.591

which is smaller than t_{table} = 1.982. Thus, RC has no indirect effect on MPS through MGMS. Simply put, MGMS is not proven to be able to strengthen or weaken one's MPS ability, either directly or indirectly.

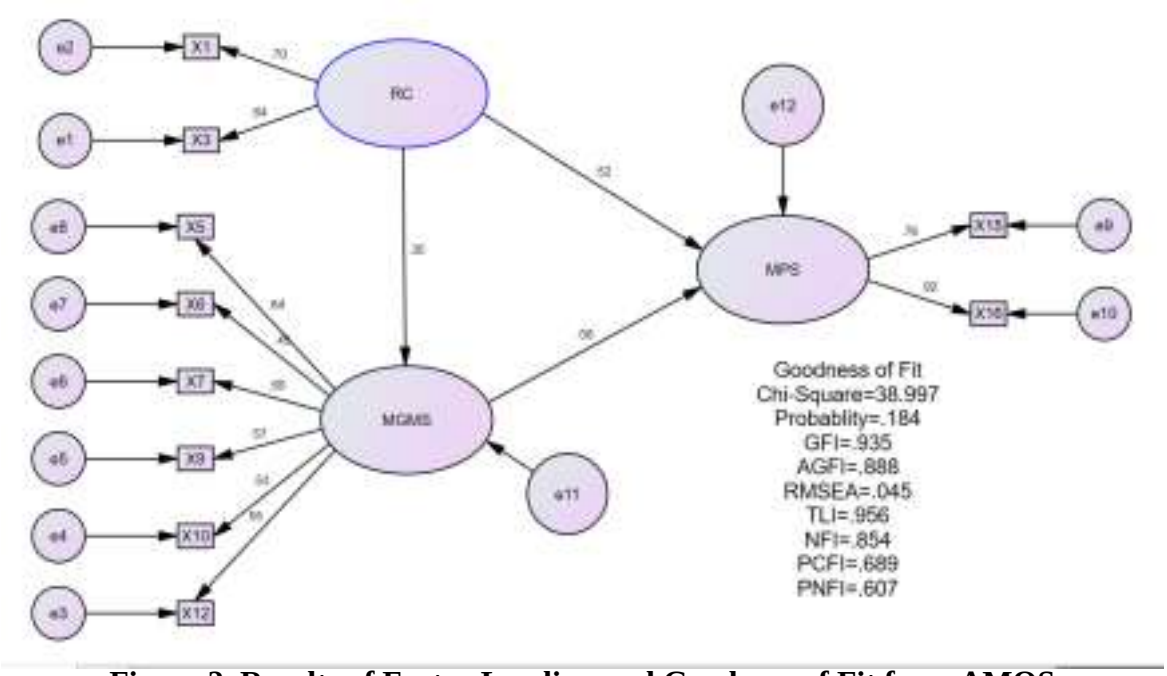

Figure 2. Results of Factor Loading and Goodness of Fit from AMOS

In terms of model fit, Table 5 shows that of the umpteenth fit indices, almost all of them are fit, without the need to make modifications. There are only 2 indices that are categorized as marginal, but are very close to the cut-off value, namely the Adjusted Goodness of Fit Index (AGFI) and the Normed Fit Index (NFI).

Tabel 5. Goodness of Fit

Goodness of Fit Index	Cut-off Value	Model Result	Description
Chi-Square	The bigger, the less fit	38,997	Fit
Probability	≥ 0,05	0,184	Fit
RMSEA	≤ 0,05	0,045	Fit
GFI	≥ 0,90	0,935	Fit
AGFI	≥ 0,90	0,888	marginal fit
TLI	≥ 0,90	0,956	Fit
NFI	≥ 0,90	0,854	marginal fit

Source: processed AMOS data

DISCUSSION

Theoretically and empirically, many researchers have proven that the ability to solve problems, especially in the field of mathematics, is greatly influenced by a person's ability to understand a problem. The richer a person's vocabulary, the easier it will be for that person to understand a text. The more a person reads, the richer the vocabulary he understands. This is the underlying reason why RC has a significant effect on MPS and MGMS.

The results of research conducted by Ulu (2017) show that one's understanding of a reading

context can help one solve problems. Likewise, what was explained by Boonen, et al. (2016) is that "Successfully solving mathematical word problems requires both mental representation skills and reading comprehension skills". Good reading skills can increase students' self-confidence so that they are more independent when solving problems (Ghahari & Basanjideh, 2015). The results of the research by Öztürk et al. (2020) regarding non-routine Mathematics problem solving, proving that RC has a positive relationship with these skills in middle-school students. Research by Akbasli et al. (2016) also showed that RC affects student achievement in mathematics and science. Someone can solve the problems they face because they read a lot (Saleh, 2014). Thus, the ability to read is clearly needed for mathematicians, even though in solving math problems one may only wrestle with numbers and formulas, reading can help them solve problems.

Research that has been conducted regarding RC and mindset, shows that reading ability has an influence on a person's mindset. However, reading is an activity that must be made a necessity. by reading, a person will be more insightful and knowledgeable (Suryanti & Megawanti, 2022). Guthrie (2013) states that children who have a fondness for reading are able to generate motivation and enthusiasm for learning, even being able to surpass those who read for grades, rewards, and recognition (Bridges, 2014). Although many research results discuss that mindset determines RC ability (Cho et al., 2019; Petscher et al., 2017), rather than the other way around, someone who likes to read and has good RC skills can grow their mindset or be able to change their mindset from fixed be growth. As stated by Patiung (2016) that reading can broaden one's thinking (mindset).

This study has several limitations, including the lack of the number of samples involved in this study. This is because it is quite difficult to find respondents who are willing to complete all the tests given. In fact, according to Sarwono (2010) the ideal number of samples in SEM is 200 to 400. However, that does not mean that AMOS cannot process data with less than 100. It's just that according to Santoso (2014) the number of samples of 200 is a representative number in SEM analysis. .

In addition to the number of samples, the instrument factors which are modified results need to be revised. Before being used to test the hypothesis, it is better if the modified instrument has gone through the predetermined stages. If the research results show that there is no relationship between variables, it is not because there is no relation, but because of the researcher's ability to construct research instruments. These things need to be considered by researchers who are interested in similar studies.

CONCLUSION

The implications of RC that directly affect MPS and MGMS break the myth that someone who studies mathematics does not have to like reading. Simply put, reading, writing and arithmetic are basic skills that everyone should have. Mathematics requires the ability to analyze and understand. In real life, numbers are not as clearly displayed as in textbooks, but someone who studies mathematics should be able to 'read' these numbers in every condition. The ability to apply theory to reality to solve problems is a real goal that must be achieved by all students, including mathematics students, and reading a lot is one way to master MPS and MGMS skills.

Reading is not instantly capable of increasing one's MPS and MGMS abilities, because reading itself requires a process to become a habit. Because RC is needed, reading habits need to be cultivated as soon as possible. By reading a lot, RC's ability will increase and can help someone solve problems in their life. Someone who reads a lot and has good RC skills, will have many ways to solve problems. He also does not easily give up, and is

persistent and believes that failure is the beginning of success. All of that will not be owned by someone who is lacking in insight and knowledge.

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