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The effect of reading literacy to mathematics comprehension of elementary school students in Indonesia and Malaysia

Anggit Prabowo[1], Suparman Suparman[1], Chong Su Li[2], Dahlia Janan[3], Tri Dessy Damayanti[1]
[1]Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
[2]Department of Management and Humanities, Faculty of Science and Information Technology, Universiti Teknologi Petronas, Seri Iskandar, Malaysia
[3]Department of Malay Language and Literature, Faculty of Languages and Communication, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia

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ABSTRACT

This article aims to measure the effects of reading literacy to mathematical comprehension of fifth grade elementary students both in Indonesia and Malaysia. This article used quasi-experiment with factorial design. Samples included 398 students that consisted of 173 elementary students in Indonesia and 216 elementary students in Malaysia. The data were taken by using three instruments: a test and three questionnaires. A test was used to assess the students' mathematical comprehension. Meanwhile, the questionnaires were used to measure their reading literacy and motivation to study mathematics. They have been validated by two experts and estimated the reliability coefficient by using the Cronbach Alpha formula. Experts judged the instruments were valid based on the content validity. The reliability coefficient of all of the instruments was more than 0.5 so they were reliable. A descriptive statistical analysis was used to describe the data, while the analysis variant was used to examine the different mathematical comprehension levels of the students based on reading literacy and the motivation to study mathematics. The result showed that there is a difference in mathematical comprehension levels between students that have a high reading literacy level and those with a lower level. Besides that, this study also shows that there is a distinction in mathematical comprehension levels between students which have a higher motivation to study mathematics with students that have less motivation. This study concluded that reading literacy and the motivation to study mathematics have an effect toward mathematical comprehension ability of elementary students.

Corresponding Author:

Suparman Suparman
Department of Mathematics Education, Faculty of Teacher Training and Education,
Universitas Ahmad Dahlan
Umbulharjo, Yogyakarta, Special Region of Yogyakarta 55166, Indonesia
Email: suparman@pmat.uad.ac.id

1. INTRODUCTION

Both mathematical thinking and problem-solving abilities are acknowledged as crucial 21st-century capabilities [1]. There are numerous studies about mathematical reasonings in the literature [2]. The fundamental goal of many curricula and a crucial component of the mathematics education research community is the development of students' mathematical reasoning [3]. As it enables them to exercise their thought process in order to answer mathematical problems, pupils' reasoning abilities should be closely monitored [4]. This capacity for mathematical thinking serves as a foundation for assessing pupils' math

achievement, including in international competitions like Trends in International Mathematics and Science Study (TIMSS) and Program for International Student Assessment (PISA) [4].

The inclusion of mathematical literacy as a required competence in all disciplines was made official in the Norwegian curriculum in 2006 [5]. Daily application of mathematical knowledge was also regarded as essential [6]. There are numerous studies about mathematical literacy in the literature [7]. There were three categories of metacognition in mathematical literacy, namely elementary, intermediate, and advance. The obvious features of metacognition in an elementary math group were [7]: i) Aware that the strategic solution is incorrect but do not improve it; ii) Planning to develop strategic solution but uncertain; iii) Failure to conduct a thorough due diligence process; and iv) Do not believe what is thought and do not understand its concept. Meanwhile, the metacognitive characteristics of the intermediate group of mathematical knowledge are: i) Being aware of one's own thoughts; ii) Consciously planning various strategies to improve the accuracy of thinking, but not always using such plans; iii) Tend to monitor thought processes; and iv) Tend to be able to prove basic mathematical concepts based on given problems. Finally, the metacognitive features of the advanced math group, include: i) Use different strategies to demonstrate or improve the accuracy of thinking (sketch, draw); ii) Analyze the problem before solving it; and iii) Understand and master the mathematical concept of the given problem [7].

Mathematical literacy is an essential skill in school curriculums [6]. As the demand increases for universities to be able to create graduates that possess numerical and scientific skills, it is important to determine the effective method to involve university students so they can obtain such literacy or skills [8]. However, there are three discovered primary obstacles: researches and teachers are not convinced on how to develop students' mathematical literacy; a special effort to directly work on mathematical literacy only through mathematics has yet to be successful, and in order to teach mathematical literacy, there seems to be a need for a non-traditional method in teaching mathematics [9].

There are many studies conducted by research to develop students' mathematical literacy. A study explored the effect of teaching strategy for students' mathematical literacy in countries with outstanding and unexceptional achievements [10]. By using structural equation modeling, the study of Gabriel, Buckley, and Barthakur [11] showed that instrumental motivation and self-concept influence mathematical anxiety, which negatively affects mathematical literacy, perseverance and self-efficacy. Meanwhile, another study looked into how various strategies of learning mathematics can influence students' mathematical literacy [12]. Also, previous research [13] revealed that the opportunity to learn with procedural task tends to improve mathematical literacy directly and indirectly through internal perception control.

Mathematics is an important subject due to its practical role for an individual and for the society in general [14]. Mathematical competence has rapidly become an important requirement for most occupations as well as a practical skill in daily activities [15]. Many studies have been conducted by research to improve students' mathematical comprehension. The study indicates that reading comprehension has a significantly high impact on a student's mathematics ability [16]. It is a critical challenge in the math education community to assess levels of mathematical literacy of students who have limited capability in test language [17]. Previous study [18] showed that all relevant factors such as reading comprehension, perceived self-efficacy in mathematics, and attitudes towards mathematics were important. Therefore, reading literacy is linked to math achievements. Studies about reading literacy can be found in many literatures [19]–[21]. The correlation between computer literacy level and mathematical literacy of selected students from various regions was determined, and the difference based on levels among schools were also identified [20].

Trakulphadetkra *et al*. [22] provides the specific contribution of reading comprehension to math achievements in England. The subjects in those studies are limited from one country. However, there is yet to be research in regard to reading literacy and the motivation to study mathematics linked to mathematical comprehension that involves subjects from two different countries, specifically Indonesia and Malaysia. Moreover, search results using the Publish or Perish software from 2015 until 2022 which are sourced from 500 Google Scholar database, from 2,983 items, there are 132 items that met the threshold with the minimum item appearance of five times. Figure 1 shows that there is no research found that connects the topics of reading, motivation, and mathematics. This shows that the connection between topics of reading, motivation, and mathematics is a recent topic.

This article aims to measure the effects of reading literacy and the motivation to learn mathematics toward the mathematical concept comprehension of fifth grade elementary school students both in Indonesia and Malaysia. Reading literacy is divided into two categories, which are the national language and the English language. Both Indonesia and Malaysia have national languages of their own as their native language, and the English language as their second language. Malaysia uses the Malay language, while Indonesia uses the Indonesian language (*Bahasa Indonesia*). Besides that, Google Trends search results from 2004 until 2022 shows, both in Indonesia Figure 2 and Malaysia Figure 3, that the amount of math topics searches is larger than searches about reading. Figure 2 and Figure 3 reveal that both Indonesia and Malaysia have a similar pattern of searches either in reading topics or math topics.

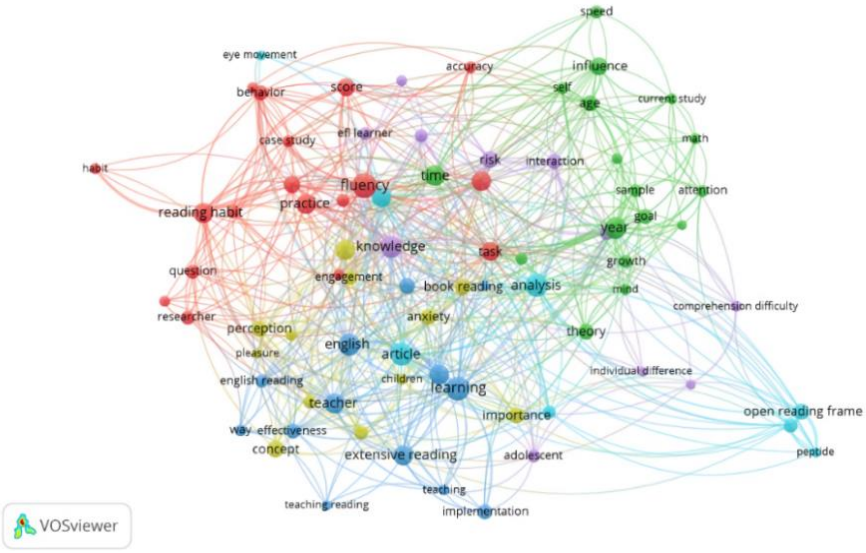

Figure 1. Research topics mapping by using Vos viewer software

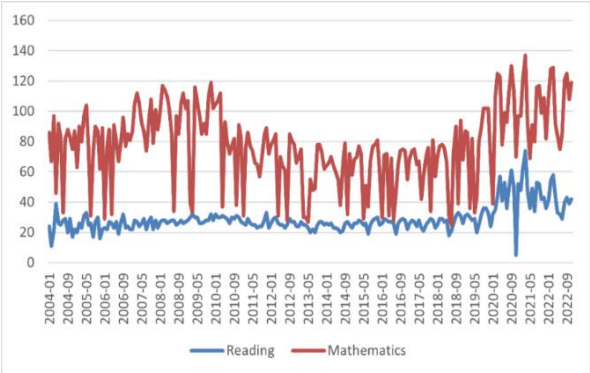

Figure 2. Topic searches about reading and mathematics in Indonesia

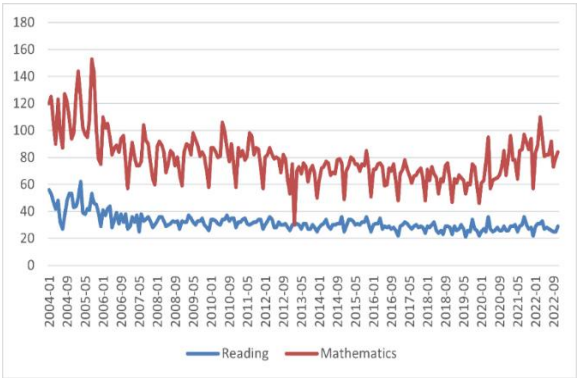

Figure 3. Topic searches about reading and mathematics in Malaysia

The purpose of this research is formed into research hypothesis. The following are the hypotheses in this study. First, the reading literacy in national language (RLNL) affects the mathematical comprehension (MC) of the fifth-grade elementary school students in Indonesia and Malaysia. Second, there is an influence of reading literacy in English (RLE) to the fifth-grade elementary students" MC in Indonesia and Malaysia. Third, there is an influence of RLNL and RLE to the fifth-grade elementary students' MC in Indonesia and Malaysia. Fourth, the motivation to learn mathematics influences the fifth-grade elementary students' MC in Indonesia and Malaysia. The motivation type addressed in this study is intrinsic motivation. Some of its indicators are interests, aspirations, skills, habits of following lectures, and browsing using the internet that directly affect learning [23].

2. RESEARCH METHOD

This research is utilizing factorial design [24]. It is also categorized as quasi-experiment. This research was conducted in three elementary schools in Yogyakarta, Indonesia and three other elementary schools in Perak, Malaysia during the second quarter (Q2) of the year 2021-2022. The subjects were 389 students taken from the population. The subjects themselves consisted of 173 Indonesian students (47.8%) and 216 Malaysian students (52.2%). Based on the gender, the sample consisted of 51.7% female and 48.3% male.

In this research, there are three used instruments: a test (mathematical comprehension) and three questionnaires (reading literacy in national language, reading literacy in English, and motivation level in learning math). All the instruments are valid [25]. Their appropriate contents have been assessed in by experts by using content validation procedure [26], the common procedure to assess the validity [27]. The instruments' reliability coefficient was estimated by using the Cronbach Alpha formula. It is the most common internal measure of consistency in social, behavioral, and educational sciences and usually interpreted as the average of all possible coefficient of split-half [28]. The test was used to measure the subjects' mathematical comprehension. The MC test consisted of ten items with a reliability coefficient of 0.59. As for the RLNL, it comprised of three items with a reliability coefficient of 0.55. The RLE test also has three items with a reliability coefficient of 0.60. The topics presented in the mathematical comprehension test, include: i) Addition and subtraction of fractions; ii) Multiplication and division of fractions and decimals; iii) Velocity; iv) Scale; v) Volume in geometry; vi) Radius in geometry; and vii) Data collection and presentation. The questionnaires were used to measure the students' motivation level in learning math with a total of five items and a reliability coefficient of 0.70. All instruments have a reliability coefficient of more than 0.5, the minimum criterion for stating an instrument is reliable [29].

The data collection process was done by providing a test and questionnaires to the students. The students then worked on the test and filled out the questionnaires. Subsequently, the test score and the questionnaires were analyzed by using descriptive statistics (mean, mode, median, and variance) and inferential statistics (Kolmogorov-Smirnov test and Kruskal-Wallis H. test). The descriptive statistic was used to describe the data while the inferential statistic was used to determine whether there is a significant difference in the effects of mathematical comprehension in students based on reading literacy level and motivation level to learn math. The analysis was done by utilizing the SPSS program package.

3. RESULTS AND DISCUSSION

3.1. Results

Descriptive and inferential statistics are used to analyze the data. Descriptive statistics such as mean, mode, median, and variance are calculated to describe the data. While statistical inference is used to determine the effect of a variable on other variables.

3.1.1. Mean, mode, median, and variance

The score of RLNL, RLE, and MC are presented in Figure 4, while the mean, mode, median and variance score is presented in Figure 5. Based on Figure 4, it appears that the majority of students achieved a score of 10 for RLNL, a score of zero for RLE, and a score of three for MC. From Figure 5, the students' RLNL score average is the highest compared to the average score of RLE and MC.

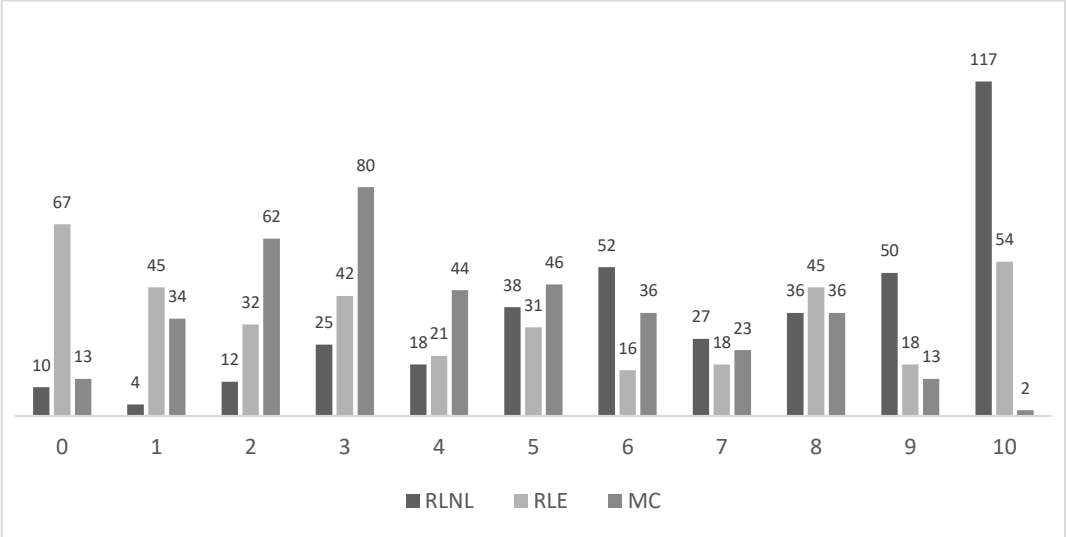

Figure 4. RLNL score, RLE score, and MC score Skor RLNL

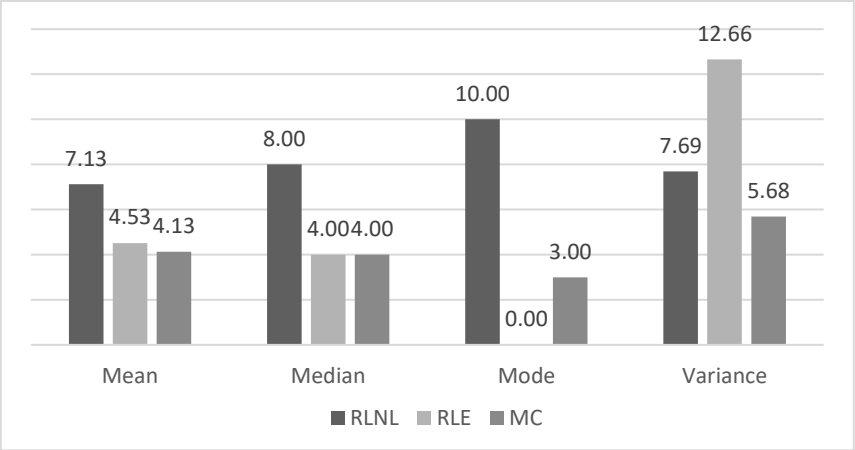

Figure 5. Mean, mode, and median

3.1.2. RLNL vs MC

In this sub-section, the MC score is grouped into two categories which are MC score for students with low RLNL and MC score for students with high RLNL. For example, x stated the RLNL score, $\bar{x}$ stated the average score of RLNL, and s_x stated the standard deviation of the RLNL. The RLNL score is in the low category if $x < \bar{x} + 0.5\ s_x$ and in the high category if $x \geq \bar{x} + 0.5\ s_x$.

Each group was tested by utilizing the Kolmogorov-Smirnov test to find out whether or not the group in question came from a normally distributed population. Because the value of sig.=0.00<0.05; therefore, each group was not from a normally distributed population. The result of the normality test is presented in Table 1. The table shows that both groups were not from a normally distributed population. Therefore, both groups are then compared by using non-parametric statistic. By using Mann-Whitney U, it is then obtained that Asymp. Sig (2-tailed)=0.00<0.05. Thus, there are differences in MC scores between high RLNL students and low RLNL students. The mean rank of the lower group=149.4 and the mean rank of the higher group=256.10, hence it can be concluded that students with higher RLNL have better MC than students with lower RLNL.

Table 1. Tests of normality using Kolmogorov-Smirnov in SPSS

Variables	df	Sig.	Conclusion
MC score with high RLNL score	167	0.00	Not normal
MC score with low RLNL score	222	0.00	Not normal

3.1.3. RLE vs MC

In a similar way, the MC score is divided into two categories: students with high RLE and students with low RLE. For example, y stated the RLE score, $\bar{y}$ stated the average RLE score, and s_y stated the standard deviation RLE score. The RLE score is considered low if $y < \bar{y} + 0.5\ s_y$ and considered high if $y \geq \bar{y} + 0.5\ s_y$. Each is group was tested by using the Kolmogorov-Smirnov test to determine whether or not they come from a normally distributed population. Because the value sig.=0.00<0.05 therefore both groups were not from a normally distributed population. The result of the normality test is presented in Table 2.

Table 2 shows that both groups were not from a normally distributed population. Subsequently, both groups are compared to each other by using non-parametric statistic. By using the Mann-Whitney U, it is obtained that Asymp. Sig. (2-tailed) =0.00<0.05 therefore there is a difference in mathematical comprehension score between the low RLE group and the high RLE group. The mean rank of the low RLE group=142.30 and the mean rank of the high RLE group=294.16 hence it can be concluded that students with high RLE score have a better MC compared to students with low RLE.

Table 2. Tests of normality using Kolmogorov-Smirnov in SPSS

Variables	df	Sig.	Conclusion
MC score with high RLE	135	0.00	Not normal
MC score with low RLE	254	0.00	Not normal

3.1.4. MC vs motivation to learn math

The MC score is divided into groups based on the answers from the questionnaire on motivation to learn math which was developed based on the indicators of intrinsic motivation [23], including questions such as: I feel the subject of math is very important for me (Q1); I like to learn math (Q2); I am good at solving mathematical problems (Q3);: I spare enough time to practice mathematics (Q4); I use the internet to practice mathematics (Q5). The given responds that can be chosen are Strongly Disagree (SDA), Disagree (DS), Agree (A), and Strongly Agree (SA). Each group was tested by using the Kruskal-Wallis H. test. The result of the test is presented in Table 3. The table shows that for item Q1-Q4 there is a distinction in MC score from students who responded SDA, DA, A, and SA. For Q5, there is no difference in MC from students who responded SDA, DA, A, and SA.

Table 3. Tests of Kruskal-Wallis H in SPSS

	Answers	N	df	Asymp. Sig.	Kruskal-Wallis H
Q1	SDA	3	3	0.003	13.726
	DA	18			
	A	142			
	SA	226			
Q2	SDA	9	3	0.005	12.664
	DA	74			
	A	193			
	SA	112			
Q3	SDA	27	3	0.000	26.713
	DA	156			
	A	136			
	SA	35			
Q4	SDA	16	3	0.030	8.941
	DA	92			
	A	199			
	SA	79			
Q5	SDA	32	3	0.524	2.239
	DA	111			
	A	145			
	SA	98			

3.2. Discussion

From Figure 4 and 5, it appears that RLNL is relatively easier to compare than RLE. Meanwhile, MC is relatively the most difficult. This is shown by the RLNL mode which obtained a score of ten, the largest compared to RLE and MC. Similarly, the RLNL mean is higher compared to MC. On the other hand, the RLE score is relatively more dispersed compared to the RLNL and MC scores.

Generally, national language is the native language for most students in this research. It is the first source of information for learners to understand how the language works [30]. Considering that native language is taught to students very early, it makes sense that students have a better literacy in that native language compared to a newer language which they will learn later in life. Guimba *et al.* [31] showed that children have the tendency to have difficulties in learning a second language and therefore require extra effort to be able to learn it.

Table 1 presents that the MC score with a high RLNL and the MC score with a low RLNL do not distribute normally, hence the parametric testing assumption is not fulfilled. Therefore, both groups are compared by using non-parametric statistic. With similar reason, Table 2 shows that the MC score with a high RLE and the MC score with a low RLE do not distribute normally, hence both groups are compared with non-parametric testing.

Mathematics can be learned by students of many levels of reading literacy. However, when it comes to have an optimal mathematical comprehension, this research discovered that students who have higher reading literacy have better mathematical comprehension than students with lower reading literacy. This result is supported by previous studies. There is a significant correlation between individual differences in reading and mathematics skills [32]. In other words, mathematical problem-solving skill has a significant connection with reading literacy.

Table 3 reveals that students who answered “strongly agree” or “agree” in response to the Q1 question about the importance of learning mathematics have a better mathematical comprehension score compared to the students who answered “strongly disagree” or “disagree”. Similarly, students who answered “strongly agree” and “agree” to the Q2 question about their love in learning math have a better score in mathematical comprehension than those who answered “strongly disagree” or “disagree”. Likewise, students who responded with “strongly agree” or “agree” to the Q3 question in regard to sparing some time to practice

math problems have a better mathematical comprehension score than those who responded with "strongly disagree" or "disagree". Consistently, students who answered, "strongly agree" or "agree" to Q4 about their confidence in their math skills have a better mathematical comprehension score in opposite to students who answered, "strongly disagree" or "disagree". However, students who answered, "strongly agree" or "agree" to question Q5 about using the internet to learn math have a similar score in mathematical comprehension with students who answered, "strongly disagree" or "disagree". Because Q1-Q4 questions are indicators of motivation in learning mathematics, this discovery indicates that students who have higher motivation to learn math have a much better level in mathematical comprehension than students with lower motivation.

Some studies have been conducted to see the effect of motivation to students' comprehension level. The result shows that motivation generally affects students' academic ability [33], [34], as well as learning effectiveness [35]. The result of this study reveals the effect of motivation to students' mathematical comprehension. This is in line with the study conducted by Tambunan [36]. Motivation is able to provide a strong prediction to a student's learning output [37]. Besides of mathematical comprehension, motivation also has a positive influence to students' understanding in other subjects [23]. Considering that language and mathematics are subjects that are taught in almost all developing and developed countries, further studies may be conducted by taking population from more than two countries, whether developed or developing.

4. CONCLUSION

This article discovered a connection between reading literacy and motivation to learn math toward mathematical comprehension of elementary students in Indonesia and Malaysia. There is an impact of reading literacy toward mathematical comprehension level of fifth grade elementary students in Malaysia and Indonesia. A student who possesses a high reading level has a better mathematical comprehension than a student with lower reading level. Therefore, reading literacy needs to be improved in elementary school level.

Based on several indicators of motivation to learn math, there is an influence of the importance to study math, the love to learn math, and the skill in learning math toward the mathematical comprehension level of fifth grade elementary students in Malaysia and Indonesia. Students who consider the subject of math as important have stronger mathematical comprehension compared to students who perceive math as an unimportant subject. The same result also applies for indicators such as the love of learning math, sparing some time to work on some math problems, and the ability in learning math. However, there seems to be no effect between students who study math using the internet and those who do not. This research is limited only to two developing countries in Asia. Further research can be developed in population from more than two countries that involves countries from other continents (Asia, America, Europe, Australia, and Africa) whether developing or developed.

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BIOGRAPHIES OF AUTHORS

Anggit Prabowo is an Assistant Professor and lecture at the Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia. He graduated from bachelor's and master's degree of Mathematics Education from Yogyakarta State University. He is studying the Doctor's program of mathematics education at Indonesian University of Education. His research focuses on mathematics education, teaching media and test development, and literacy. He can be contacted at: anggit.prabowo@pmat.uad.ac.id.

Suparman is a professor in applied mathematics at the Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia. His research focuses on mathematics education and applies mathematics. He can be contacted at email: suparman@pmat.uad.ac.id.

Chong Su Li is a senior lecturer at Department of Management and Humanities, Universiti Teknologi Petronas, Malaysia. Her research focuses on aliteracy, reading as a social practice, literacy for inclusive education, qualitative research methodology. She can be contacted at email: chong_suli@utp.edu.my.

Dahlia Janan is a lecturer at Universiti Pendidikan Sultan Idris, Malaysia. Her research focuses on readability, reading process, reading pedagogies, literacy, and assessing text. She can be contacted at email: dahlia@fbk.upsi.edu.my.

Tri Dessy Damayanti is a student of Master Program of Mathematics Education, the Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Yogyakarta, Indonesia. Her research focuses on teaching in elementary school. She can be contacted at email: damayanti2008050028@webmail.uad.ac.id.