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Mathematical Literacy Abilities: Study on Elementary and Junior High School Students in Lampung Tengah Regency in Term of Gender

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Abstract: Mathematical Literacy Abilities: Study on Elementary and Junior High School Students in Lampung Tengah Regency in Term of Gender. Objectives: This study aimed to describe the mathematical literacy abilities of elementary and junior high school students in Lampung Tengah Regency in term of gender. **Methods:** The population of this quantitative research is all of elementary school students in grade VI and junior high school students in grade IX in Lampung Tengah regency in academic year 2019/2020. The samples were 431 elementary students and 614 junior high school students selected using cluster random sampling. Data were collected using a mathematical literacy test and analyzed descriptively and using the Mann Whitney test. **Findings:** Research's result shows that i) both in elementary and junior high schools, female students have higher mathematical literacy abilities than male students; and ii) the mean scores of students' mathematical literacy both male and female less than 35. **Conclusion:** Both male and female students' mathematical literacy in elementary and junior high school of Lampung Tengah regency is still in the low category.

Keywords: mathematical literacy, elementary school, middle school, gender.

Abstrak: Kemampuan Literasi Matematis: Studi pada Siswa SD dan SMP di Kabupaten Lampung Tengah Ditinjau dari Jenis Kelamin. ***Tujuan:*** *Penelitian ini bertujuan untuk mendeskripsikan kemampuan literasi matematis siswa SD dan SMP di Kabupaten Lampung Tengah ditinjau dari jenis kelamin.* ***Metode:*** *Populasi dari penelitian kuantitatif ini adalah seluruh siswa SD kelas VI dan SMP kelas IX di kabupaten Lampung Tengah pada tahun ajaran 2019/2020. Sampel penelitian adalah 431 siswa SD dan 614 siswa SMP yang terpilih dengan menggunakan teknik cluster random sampling. Data dikumpulkan dengan menggunakan instrumen tes literasi matematis dan dianalisis secara deskriptif dan menggunakan uji Mann Whitney.* ***Temuan:*** *Hasil penelitian menunjukkan bahwa i) baik pada SD maupun SMP, siswa dengan jenis kelamin perempuan memiliki rata-rata kemampuan literasi matematis yang lebih tinggi dari siswa laki-laki; dan ii) rata-rata skor kemampuan literasi matematis siswa baik perempuan maupun laki-laki lebih kecil dari 35.* ***Kesimpulan:*** *Kemampuan literasi matematis siswa perempuan dan laki-laki pada SD maupun SMP di kabupaten Lampung Tengah masih berada pada kategori rendah.*

Kata kunci: *literasi matematis, sekolah dasar, sekolah menengah, jenis kelamin.*

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INTRODUCTION

Mathematical literacy has become the focus of international measurement in the term of mathematics, especially by the OECD. Indonesia as one of the countries contributing to the international survey always gets results below the international average. This was stated by Syahlan (2015) that since 1999 student achievement in Indonesia in the term of literacy has not been developed maximally in International studies such as *Program for International Student Assessment* (PISA). PISA scores are reported along specific scales that are divided into levels, beginning at Level 1 with questions that require only the most basic skills to complete and increasing in difficulty with each level (Stacey, 2011). Indonesia score for mathematical literacy increases for last three measurement in PISA 2009, 2012, and 2015 but the improvement still above the international average. PISA results show that students' thinking ability in Indonesia, especially those who study mathematics, is receiving insufficient attention (Tanujaya, Prahmana, Mumu, 2017) which implies, continues improvement in the quality of education in Indonesia is still needed to develop student's mathematical literacy (Widyastuti & Wijaya, 2019).

Indonesian Government policies that instruct teachers to develop the learning evaluation instruments to measure higher-order thinking skills also relate to the need of the development students' mathematical literacy abilities. Mathematical literacy is the individual's ability to identify and understand the role of mathematics to make strong judgments, use, and engagement with mathematics to conform the needs of individual lives as constructive, caring and reflective citizens (OECD, 2016). This ability reference to the component processes of modelling namely (i) formulating real world problems mathematically, (ii) employing mathematics to solve the mathematically formulated problem and then (iii) interpreting and evaluating the mathematical results in real world terms (Stacey, 2015) and closely related to the learning objectives of mathematics in Indonesia. The Indonesian Minister of Education and Culture Regulations number 35 years 2018 stated that the abilities that should be developed in mathematics learning include understanding concepts, mathematical reasoning, generalization based on phenomena or data, mathematical manipulation, mathematical communication, recognize the use of mathematics, behaving in corresponding with the values in mathematics and learning, and using simple teaching aids or technology results to carry out mathematical activities. The overall ability in the objectives of mathematics learning is related to mathematical processes and fundamental mathematics skills in mathematical literacy. Mathematics is also one of the tools of scientific thinking that are needed to develop the ability of logical, systematic and critical thinking of students (Runisah, Herman, and Dahlan, 2017). Furthermore, Syahlan (2015) states that the opportunity to develop mathematical literacy can deepen students' knowledge of mathematics, conceptual understanding and skills so that national education goals can be reached.

Unfortunately, Indonesia's participation in the measurement of mathematical literacy abilities is only carried out on certain students as selected respondents. The participants were chosen based on a sampling frame, which means that the international measurement not given to all of the students in Indonesia. Therefore, a more comprehensive measurement is needed and reaches other areas which are rarely used as the centers of research studies.

Lampung Tengah Regency is the third largest district in Lampung province, which has the highest number of districts and is crossed by

inter-regency / city and inter-provincial transportation routes. This illustrates the great potential possessed by Lampung Tengah regency. However, the results of a study by the BPS Lampung Province in 2019 about statistics on people's welfare shows that in the educational sector, the illiterate rate for population aged 15 years and over in the Lampung Tengah regency is at 5.05%. This rate is the highest percentage of illiteracy in regencies and cities in Lampung Province. It implies the need of efforts to improve both the government and researchers to describe the potential and problems in various aspects especially in the aspect of education, more specific in learning mathematics.

In addition, studies on the contribution of gender also attracted many researchers. One of them was a study conducted by Lastuti et al (2018) which shows that viewed from gender, there are differences in students' mathematical literacy abilities. Whereas Nur and Palobo (2018) state that gender differences can be a differentiating factor in someone's ability to think and determine the problem solving. Other studies about mathematical literacy that related to gender also conducted by Lailiyah (2017) and Lestari, Juniati, and Suwarsono (2018) which study the prospective teachers as research subject. Venkatakrishnan and Graven (2006) study about Mathematical Literacy in South Africa and England, they found that English policy makers negotiate the 'context of policy text production' and South African teachers grapple with the 'context of practice', and the affordances and constraints that impact on their enactments of policy. In another country, Chen and Chiu (2016) study about 10 to 11 years old Taiwanese pupils enrolled in mathematics classes, and found that no statistically significant differences in the planning aspect of metacognitive self-regulation and lower questions of mathematics literacy achievement between students with and without the scripts. Furthermore, Venkatakrishnan and Graven (2006) also found that in the 'context of practice' of Mathematical Literacy in South Africa working with teachers in a small sample of schools. Studies on mathematical literacy in Lampung Province are still rarely conducted and one of the areas which rarely being the centers of research studies is Lampung Tengah Regency. So that research needs to conducted with the aim of describing the mathematical literacy abilities of elementary and junior high school students in Lampung Tengah regency in terms of gender.

METHODS

This research is a quantitative descriptive study with the population of all grade VI elementary school students and all grade IX middle school students in Lampung Tengah regency in the academic year of 2019/2020. The sample in this study were 431 elementary students and 614 junior high school students who were selected using cluster random sampling.

The data were collected using mathematical literacy test instruments. The instruments were adopted from mathematical literacy questions of the PISA type, National Examinations for elementary and junior high schools, and mathematical literacy test instruments developed by Putra, Zulkardi and Hartono (2016). The test instrument consisted of 30 multiple choice items and 5 essay questions.

The instruments were checked for the content validity by the mathematics teachers at SDN 3 Sawah Brebes and SMPN 12 Bandarlampung. It was stated that the instruments have valid criteria. Then the instruments were tested on students outside the sample and it was obtained that the mathematical literacy test instruments for junior high school level in the multiple choices type had a reliability coefficient of 0.86 (very high) while those in the essay type had a reliability coefficient of 0.72 (high). The

mathematical literacy instruments for the elementary school level in the multiple choices type have a reliability coefficient of 0.95 (very high) while those in the essay type have a reliability coefficient of 0.67 (high).

Using the instruments that have good quality, the research data was collected. Then the Kolmogorov-Smirnov test was carried out at 5% significance level to find out the normality test for students' mathematical literacy ability data with the test results that the value of sig <á = 0.05 so that it were concluded that four groups of students' mathematical literacy ability data came from populations that are not normally distributed so that subsequent data analysis is performed with a non-parametric test. The data were analyzed descriptively and also using the Mann Whitney U test at 5% significance level.

RESULTS AND DISCUSSION

After the data were obtained through the mathematical literacy test, then data were analyzed descriptively and statistically. Descriptive statistics of mathematical literacy abilities of elementary and junior high school students in Lampung Tengah regency are illustrated in Table

Table 1. Descriptive statistics of mathematical literacy abilities data

Educational Unit	Gender	*N*	Minimum Score	Maximum Score	Mean	Standard Deviation
Elementary	Male	193	6	58	27,02	12,59
	Female	238	4	100	30,18	14,07
Junior High	Male	251	6	70	22,65	9,29
	Female	363	4	50	24,69	8,19

Based on Table 1, it is known that both in elementary and junior high school education, the lowest score and the average score for mathematical literacy ability of male students is lower than female students. Whereas for the maximum score in the elementary education, male students had lower maximum score than female students but in the junior high school the maximum score of male students were higher than that of female students. This illustrates the mathematical literacy ability of female students which outperformed that of male students. It indicates that there is the different of mathematical literacy ability in term of the gender differences. The differences in mathematical literacy abilities of female students and male students were performed with the Mann Whitney test at á = 5%. The results of the hypothesis test are summarized in Tables 2.

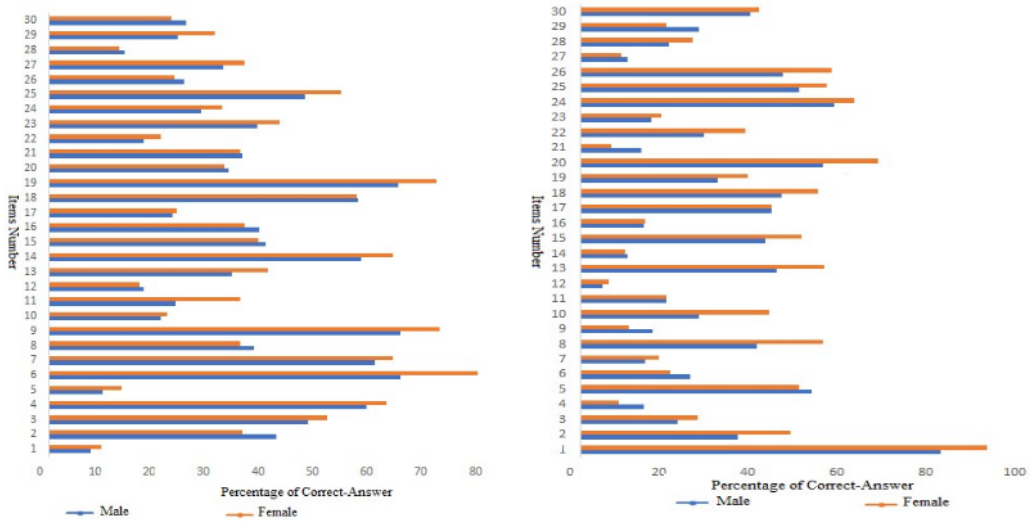
Table 2. Mann-Whitney U test results for mathematical literacy ability of elementary and junior high school students

			Elementary School	Junior High School
Mann-Whitney U			19737.50	38008.000
Wilcoxon W			38458.50	69634.000
Z			-2.516	-3.503
Asymp. Sig. (2-tailed)			0.012	0.000
Monte Carlo Sig. (2-tailed)	Sig.		0.013[b]	0.001[b]
	95% Confidence Interval	Lower Bound	0.010	0.000
		Upper Bound	0.015	0.002

Monte Carlo Sig. (1-tailed)	Sig.		0.006[b]	0.000[b]
	95% Confidence Interval	Lower Bound	0.005	0.000
		Upper Bound	0.008	0.001

Table 2 represents the sig values. (1-tailed) = 0.006 <á = 0.05 so it was concluded that is in the elementary education unit, the average of mathematical literacy ability of female students is better than the average mathematical literacy ability of male students. Table 2 also shows that sig. value (1-tailed) of 0,000 <á = 0.05 so it was concluded that in the junior high school education the average mathematical literacy ability of female students is better than that of male students. The result shows that both in elementary and junior high school level, female students have better abilities than male students in case of mathematical literacy. These results different from the result of study by Tariq, Qualter, Roberts, Appleby & Barnes (2013) that males attained a higher mean test score than females and out-performed the females on most of the individual questions and the associated mathematical tasks.

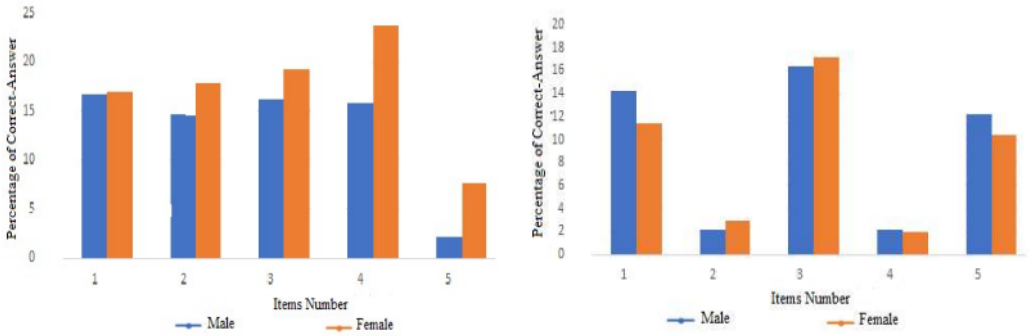
Descriptive and inferential research results represent that the average mathematical literacy ability of male students is lower than female students in both elementary and junior high school education units. The results of this study are in line with the study of Joseph as quoted in Purwanti (2013) that male students had a lower improvement compared to female students in the literacy achievements of Indonesian students. Furthermore, the percentage analysis is carried out to the correct-answer on each item of mathematical literacy test. The results of the analysis are illustrated in Figures 1 and 2.



(a) Elementary School (b) Junior High School

Figure 1. Diagram of percentage correct-answer of multiple choices test for mathematical literacy test in elementary and junior high school

Based on Figure 1, it is known that both in the Elementary and Junior High Education unit, female students have an average percentage of achievement that is slightly higher than male students for the majority of items in the form of multiple choices. The percentage of correct-answer still dominated in the scale of under 50% for majority number of items both in elementary and also in junior high school. This means most students got difficulties in dealing with mathematical literacy test in the form of multiple choices. The research conducted by Zikla, Havlíèkováb, Holoubkovác, Hrníèkovád, and Volfová (2015) confirmed that worse results in the area of mathematical literacy of pupils with mild intellectual disabilities namely ca by 50% in contrast with intact population and pupils with mild intellectual disabilities had a great impact the multiple choice. Even the research conducted for mild intellectual disabilities pupils, it can be informed that the use of open questions could be suggested to form the instrument of mathematical literacy. The result of student's achievement for mathematical literacy in the form of essay test, described in Figure 2.



(a) Elementary School (b) Junior High School

Figure 2. Diagram of percentage correct-answer of essay test for mathematical literacy test in elementary and junior high school

Based on Figure 2, it is known that female students have an average percentage of achievement that is higher than male students for each item in the essay type test. From Figure 2 it is also known that the percentage of correct answers for both female and male students does not exceed 25% for each item. That is, the majority of elementary students have not been able to answer perfectly questions in the form of essay. It is also known that in the junior high school level, both female and male students have an average percentage of achievement that is not much different for each item in the form of essay test. From Figure 2 it is also known that the percentage of correct answers for both female and male students does not exceed 18% for each item. That is, the majority of middle school students have difficulty in communicating the application of mathematical procedures / facts / concepts in contextual problems to answer perfectly questions in the form of essay test. This research result in contrast with research conducted by Benölkena (2015) which found that huge mathematical potentials might be identified more infrequently with girls than with boys because girls more often show such dysfunctional characteristics.

Tabulation of the percentage of achievement of fundamental mathematical skills achievement is interpreted in Table 3.

Table 3. The average percentage of fundamental mathematics skills achievement in mathematical literacy of elementary school students

Fundamental Mathematics Skills	Mathematical Process	Male (%)	Female (%)
Mathematising	*Formulating situationsmathematically*	52.46	59.45
	Employing mathematical concepts, facts, procedures and reasoning	0.61	2.09
Communication	*Formulating situationsmathematically*	25.61	29.35
	Employing mathematical concepts, facts, procedures and reasoning	41.90	43.46
Using symbolic, formal and technical language and operations	*Employing mathematical concepts, facts, procedures and reasoning*	23.06	24.58
Representation	*Formulating situationsmathematically*	27.85	27.84
	Employing mathematical concepts, facts, procedures and reasoning	30.89	35.82
Reasoning and argument	*Formulating situations mathematically*	22.80	23.53
	Employing mathematical concepts, facts, procedures and reasoning	29.72	32.67
Devising strategies for solving problems	*Employing mathematical concepts, facts, procedures and reasoning*	38.86	36.13
	Average	**29.38**	**31.49**

Based on Table 3, for elementary education, it is known that the average percentage of achievement in Fundamental Mathematics Skills does not reach 32% so that it can be categorized as sufficient. The average percentage of achievement of male students is lower than that of female students in almost all aspects of fundamental mathematics skills. Male students outperformed female students only in the aspects of devising strategies for solving problems. The highest achievement in fundamental mathematics skills is in the mathematizing aspect while the lowest achievement is in the aspect of reasoning and argument. These results are consistent with research results both descriptively and inferentially. The highest achievement in the average percentage of fundamental mathematics skills is in the aspect of mathematising. This condition shows that elementary students are more capable in transforming real world problems into mathematical models. While the lowest achievement lies in the aspect of reasoning and argument, which means that elementary students do not have the ability to think logically while doing mathematical exploration and communication when solving problems.

Other research result for mathematical literacy skills of the prospective teacher in term of gender differences give result that male students have good of each indicator in mathematical literacy skills while female students have good of mathematical literacy skills (the first indicator, the second indicator, the third indicator, the fourth indicator and the sixth indicator), except for the

fifth indicators that are enough (Lailiyah, 2017). This illustrates that at the elementary level of education female students have better performance than male students while at the higher level of education, male students are able to outperform female students. Research that conducted by Lestari, Juniati, and Suwarsono (2018) reinforce that female prospective teachers are more capable of logical reasoning, using concepts, facts and procedures and algebraic operations to draw conclusions; make an interpretations and evaluations.

Table 4. The average percentage of fundamental mathematics skills achievement in mathematical literacy of junior high school students

Fundamental Mathematics Skills	Mathematical Process	Male (%)	Female (%)
Mathematising	*Formulating situations mathematically*	26.69	42.70
	Employing mathematical concepts, facts, procedures and reasoning	37.65	43.38
Communication	*Formulating situations mathematically*	39.18	43.80
	Employing mathematical concepts, facts, procedures and reasoning	21.04	26.19
Using symbolic, formal and technical language and operations	*Employing mathematical concepts, facts, procedures and reasoning*	14.34	8.82
Representation	*Formulating situations mathematically*	34.06	36.64
	Employing mathematical concepts, facts, procedures and reasoning	15.14	14.46
	Interpreting, applying and evaluating mathematical outcomes	25.66	25.84
Reasoning and argument	*Employing mathematical concepts, facts, procedures and reasoning*	12.25	10.40
	Average	**25.11**	**28.02**

Based on Table 4, for junior high school education it is known that the average percentage of achievement in Fundamental Mathematics Skills does not reach 30% so it is categorized as low. The average percentage of achievement of male students is lower than that of female students in terms of both total and majority aspects of fundamental mathematics skills. Male students outperformed female students only in terms of using symbolic, formal and technical language and operations as well as reasoning and argument. The highest achievement of fundamental mathematics skills in both female and male students is in the communication aspect while the lowest achievement is in the reasoning and argument aspects. That is, in junior high school, students are better at communicating mathematical concepts in a variety of ways. For the lowest achievement, the phenomenon that occurs similar to elementary students is in the

aspect of reasoning and argument. This phenomenon also indicates that students in Lampung Tengah regency both elementary and junior high schools have not had enough experience through the learning process to develop their ability to provide arguments and reasons. Hendroanto, Istiandaru, Syakrina, Setyawan, Prahmana, & Hidayat, (2018) stated that "students demonstrated good performance on problems with the interpretation process, but in the process of formulating and process of employment, students still found difficulties". That is, it needs to be accustomed to learning mathematics in class that contains femoms, facts, or problems that accustom students to doing mathematical modeling well. This is needed to improve students' mathematical literacy skills because with good mathematical literacy skills, students can understand, and apply mathematics in determining the solutions of mathematical problem and students are invited to think critically about the instructions (Syahlan, 2015).

The findings about the mathematical literacy abilities of elementary and junior high school students in Lampung Tengah regency indicate the need for serious efforts from teachers in developing students' mathematical literacy abilities. So that it is expected to have an impact on improving the acquisition of Indonesian student scores in international measurements such as TIMSS and PISA. Wardhani and Rumiati (Putra, Zulkardi & Hartono, 2016) stated that one of the factors causing the low TIMSS and PISA results for students in Indonesia was the lack of opportunities to practice solving problems with characteristics such as the questions on TIMSS and PISA. Furthermore, Simalango, Darmawijoyo, and Aisyah (2018) found that the difficulties experienced by students in determining solutions to PISA type problems were more dominant when understanding problems and determining the mathematical form of real problems. Spangenberg (2012) found that both learners and teachers should be more aware of thinking styles in order that the learners are able to make the right subject choice when selecting Mathematical Literacy as a subject.

Correlation analyses by Tariq, Qualter, Roberts, Appleby & Barnes (2013) revealed that males and females attaining higher mathematical literacy test scores were more confident and persistent, exhibited lower levels of mathematics anxiety and possessed higher mathematics qualifications. It is important to conduct mathematical classroom which could reduce the anxiety and entertained student with math facts to reveal student's optimum ability in mathematical literacy. Moreover, to apprentice students into mathematical literacy, teachers need to work hard to connect students' existing knowledge to academic knowledge, learning how to include students in a discipline's discourse, studying how experts communicate for sharing the understanding with students, and need to know how to reach learners that relate to existing standards (Hilmann, 2013).

■ CONCLUSIONS

Based on the data analysis, it was concluded that both in elementary and junior high schools, female students have higher mathematical literacy ability than male students. Based on the fundamental mathematics skills, mathematizing is an aspect with the highest average acquisition for elementary students while for junior high students, communication is the highest, and the aspect with the lowest acquisition for both students in elementary and junior high schools is reasoning and argument.

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GENERAL COMMENTS

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