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Towards Gender Equality in STEM Fields: Gender Similarities in Students' Mathematical Literacy

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ABSTRACT

Understanding core concepts in STEM fields requires strong mathematical literacy to solve complex problems, think analytically, and reason methodically. However, Indonesian students continue to score low in international assessments such as PISA, with gender disparities favoring boys reported in some countries. This study investigates gender differences in mathematical literacy performance among public middle school students in Kupang, a region with limited prior research on this topic. Using secondary data from a school-based survey involving 377 students selected through two-stage cluster random sampling, we analyzed test scores across overall performance, content domains, and process domains. After confirming assumptions of normality and homogeneity, gender-based comparisons were conducted using one-way ANOVA. Results indicate no statistically significant gender differences in overall mathematical literacy, nor in any content (quantity, change and relationship, space and shape, uncertainty and data) or process domains (formulating, employing, interpreting). Effect size calculations also confirmed the absence of a gender gap. These findings support the gender similarities hypothesis and suggest that both boys and girls are equally capable in mathematical reasoning. Promoting this equality can help counter gender stereotypes and foster balanced participation in STEM fields. Educators and policymakers should leverage these insights to design equitable math instruction and encourage greater female representation in mathematics-intensive careers.

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1. INTRODUCTION

Mathematical literacy is one of the basic skills of our time, rooted in certain competences in the 21st century, such as problem solving, critical thinking, creativity, collaboration, and communication. It is fundamental not only to learning principles in the STEM area but also to addressing real-world problems in both academic and industrial contexts. It is vital for all — irrespective of their background or gender — to master mathematical literacy by the end of compulsory education and preparation for the job market. Nevertheless, gender asymmetry in math performance can result in the under-representation of certain groups, including females, in science, technology, engineering, and mathematics careers (Hyde, 2014).

Like other countries, Indonesia has concerns over low performance with respect to mathematical literacy for 15-year-olds in comparison to a number of other countries which participate in international assessments (OECD, 2014b, 2016b, 2019a). The PISA data also exposed a male advantage in a selection of countries, which was evident in both content and process sectors. Some retrospective studies conducted in Indonesia have tried to trace the mathematical literacy of their students through the adaptation of PISA items, although the gender-related performance in these studies is less observed (Rifai & Wutsqa, 2017; Fointuna et al., 2020; Fointuna, 2021). These studies reinforced the low overall performance, which further broke places children's competences into low or very low levels, and in the two levels if analyzed the domains of content and process.

Although average performance is low, it is equally important to examine whether gender is associated with disparities in achievement. While some research finds minimal gender differences in mathematics, persistent gender stereotypes—particularly perceptions of girls being less capable—continue to influence student self-concept and teacher expectations (Cavanagh, 2008; Hidayatullah & Csíkos, 2022, 2023). Recent

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studies in Indonesia show that boys report stronger self-beliefs in math and greater confidence in solving difficult tasks than girls (Hidayatullah & Csíkos, 2022, 2023). In modern economies where the human capital is highly prized, any gender disparity in the ability to solve math problems and the like has implications for a country's development status (Borgonovi et al., 2018). This concern is evident in the low proportion of women in high-value STEM vocations such as engineering, mathematics, computer science, and physics (Anker, 1997; Flabbi, 2012; OECD, 2015; Hyde, 2014). Cultural stereotypes about girls' lack of ability in math are not unique to Indonesia. In the United States, these stereotypes have been found to erode girls' confidence and dissuade them from pursuing math-heavy careers (Hyde, 2005). For example, in Chile, Portugal, and Hungary, almost half of parents expected their sons — but fewer than one in five of their daughters — to have a career in science, technology, engineering, or mathematics (OECD, 2019b). Such biases are then typically compounded by social and parental expectations, thereby exacerbating the gender gap in math-related fields.

Notwithstanding current stereotypes, empirical research is confronting the concept of male mathematics superiority. A longitudinal study in the U.S. employing the use of the National Educational Longitudinal Study (NELS) revealed no significant gender differences on maths test scores across race, Sosioeconomic Status (SES), and ability (Scafidi & Bui, 2010). Similarly, Hyde et al. (2008) and Hyde & Linn (2006) consistently found gender similarities in mathematics achievement across grades and states. These results are consistent with the gender similarities perspective and indicate that differences are often small in magnitude and highly contextual.

In Indonesia, PISA 2012 data showed that no significant gender difference was found in mathematical literacy overall or in most areas of content and processes, but in "space and shape" boys did register slightly higher scores (OECD, 2014a, 2014b). Arora & Pawlowski (2017) continued this work using PISA 2003 and PIAAC 2012 data and found that the gender differences were small in size and significant to a marginal degree, particularly in adolescence. While these results suggest gender equality, studies pertaining to gender trend in Indonesian students' mathematical literacy performance are rather scarce. The previous ones were concluded by qualitative statement, or there was no universalization (Lailiyah, 2017; Prabawati & Herman, 2017). Therefore, the present study aims to bridge this gap by exploring gender differences in students' mathematical literacy performance of public junior high schools students in Kupang based on the indicators of overall achievement and content and process. Kupang was chosen because of the lack of previous studies in this area. Results By presenting disaggregated results at regional level this paper aims to offer empirical evidence to support equitable educational policies and to challenge enduring gender stereotypes (Fointuna et al., 2020; Fointuna, 2021).

2. MATERIAL AND METHOD

Research Design and Data Source

This study employed a quantitative using secondary data analysis approach using an existing dataset from a retrospective study conducted during the 2018/2019 academic year. The original study aimed to map, describe, and analyze the mathematical literacy of 15-year-old students enrolled in public middle schools in Kupang, East Nusa Tenggara (ENT) Province, Indonesia (Fointuna et al., 2020; Fointuna, 2021). The data collection was conducted between March 21 and April 16, 2019, and the research was funded by the provincial government of East Nusa Tenggara.

Population and sampling methode

The population of this study consisted of all ninth-grade students enrolled in public middle schools across six districts within Kupang Municipality. Ninth-grade students were selected for the sample because most participants were 15 years 3 months to 16 years 2 months old at the time of data collection, which is the target age range of students taking the PISA based on the OECD guideline (Stacey, 2011). The total population was 6,029 students, comprising 2,993 males and 3,036 females.

Based on Krejcie and Morgan's (1970) sample size table, at least 364 respondents were needed for this population. Therefore, we used a two-stage cluster random sampling method to select 377 students as samples. In the first phase, all public middle schools were clustered in six clusters by district. One school was then chosen at random from the schools in each cluster to stand for its district. In the second stage, 2-3 ninth-grade cohorts in each sampled school were drawn at random and selected to participate in the study, and this was done for each of the six geographic clusters. The sample used in the present study was centred on the geographical distribution of schools in the six districts and to ensure representativeness and appropriateness of the sample, a

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convenience sampling technique was adopted guarding against too many complications in the logistical design of the study.

Instrumentation

The questionnaire included both the students' mathematics literacy test achievement and background information (e.g., date of birth and gender). In this study, the dependent variables of whether students interested in mathematics achievement at both content and process in PISA mathematical literacy assessment framework (OECD, 2013). The test consisted of 15 items and was administered using a paper-and-pencil format. Students were given 120 minutes to complete the test, allocating approximately 8 minutes per item. The test item formats included open constructed-response, simple selected-response, and complex selected-response questions (OECD, 2016a). The measurement instrument used in this study was a test consisting of 12 items adopted directly from PISA 2003 and 2005 (OECD, 2005, 2013), and 3 other items adapted from previous research and development's tests according to local context and valid for measuring mathematical literacy among Indonesian students (Nizar et al., 2018; Jannah et al., 2018; Yansen et al., 2018). The items were grouped into topics to encourage inferencing. The data collection process consisted of administering the questionnaires to the participants, scoring sheet data using the official rubrics and scoring guide, and logging the test scores for analysis. The purpose of the study was to investigate gender differences in mathematical literacy with a focus on overall, content, and process-specific performance. Thus, in this context gender was the independent variable. Sex was presented to participant was sex was recorded as sex assigned at birth (males or females) and was reorganised as a dichotomized variable (males=1, females=2).

Data Analysis

There were three stages in the data analysis. For the first step, the respondents' *mathematical literacy* test score was treated with descriptive statistics to describe the characteristics and also to explain generally the ability of the students in solving *mathematical literacy* problems. This phase included the estimation of measures of central tendency and dispersion of the total score students obtained, and the scores on the *content* and *process* level. Second, to prevent sensitivity of Kolmogorov-Smirnov and Shapiro-Wilk tests due to the large sample size, a normality test of *skewness* and *kurtosis* was performed (Kim, 2013). The sample was drawn from a population whose distribution is *normal distribution* or close to it only when the absolute value of *skewness* is less than two or that of *kurtosis* is less than seven (Kim, 2013). In the third step, a *homogeneity of variances* test was conducted to verify if variances were homogeneous between gender groups. Step two and three were generally necessary for *One-Way ANOVA* tests. For the fourth level of analyses, we focused on the research questions. The aim of this stage was to investigate if there were any overall differences between boys and girls in overall *mathematical literacy* performance and in the *content-required* and *process dimension-effects*. While *t-tests* would have been applicable in this stage, because there was one independent variable with fewer than three categories, this project adopted *One-Way ANOVA* because of the potential for the further extension of research to two or more groups or independent variables. With only two categories, any *One-Way ANOVA* would yield identical results to *t-tests* (Field, 2000; Welkowitz et al., 2006). The first *One-Way ANOVA* was administered to determine if the overall mean *mathematical literacy* test scores were significantly different across gender. Subsequently, a series of three *One-Way ANOVA* were conducted to analyze whether there were statistically significant differences among males and females in students' mean *mathematical literacy* across the three *process* categories, which were: (a) formulating situations mathematically; (b) employing mathematical concepts, facts, procedures, and reasoning; and (c) interpreting, applying, and evaluating mathematical outcomes. An additional four *One-Way ANOVA* were also performed in order to determine whether there are gender differences in students' average *mathematical literacy* in the four *content* areas; namely: *Quantity*, *Change and Relationships*, *Space and Shape*, and *Uncertainty and Data*. Finally, if results were significant, effect sizes (*eta-squared* or *Cohen's d*) should be reported (Cohen, 1992).

3. RESULTS

Descriptive Statistics of Mathematical Literacy Scores

The data were preliminarily analyzed in terms of measures of central tendency and dispersion before

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the *normality* and the *homogeneity* tests. The boxplots of students' holistic mathematical literacy scores in the three process domains (formulate, employ and interpret) are shown in Figure 1.

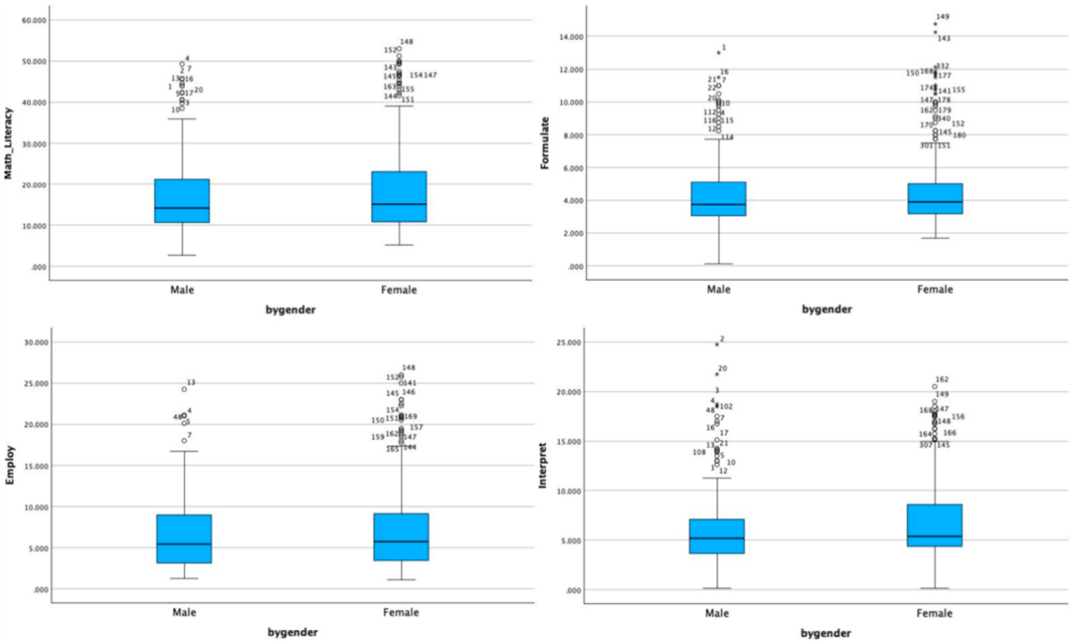

Figure 1. Boxplots for Overall Math Literacy and Performance in Process Domain

As shown in Figure 1, that the male and female median scores for total mathematical literacy and each mathematical literacy process domain seem to be similar. Indeed, female students generally showed slightly higher medians than male students in all categories, although the variation is minor in visual terms. The distribution of student achievement scores on the four theoretical domains: quantity, change & relationship, space & shape, and uncertainty & data, are depicted in Figure 2..

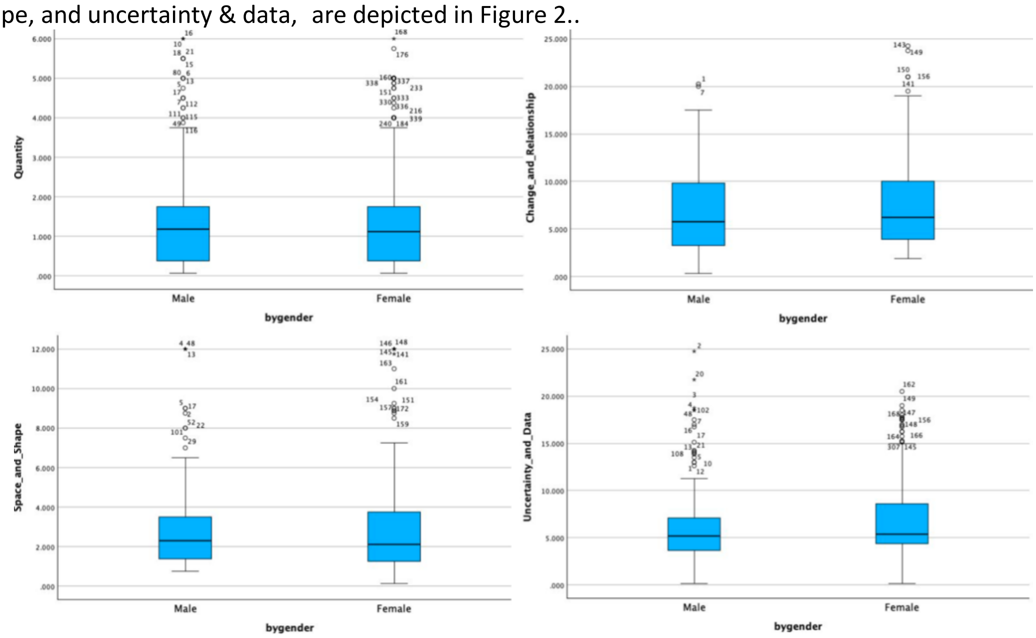

Figure 2. Boxplots for Students' Performance in Content Domain

Consistent with the domains of process, Figure 2 suggests that the male-to female performance profiles of grades 5 through 8 students in all four content areas are similar. Once more, female students displayed slightly higher medians in almost all of the areas. In addition, to complement the visual data, the descriptive statistics

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of all dependent variables by gender are included in Table 1. gender assigned at birth (1 = male, 2 = female) was used to split the dataset before computing the statistics.

Table 1. Descriptive Statistics of Overall Mathematical Literacy, Process, and Content Areas

Descriptive Statistics

bygender		N	Minimum	Maximum	Mean	Std. Deviation	Variance
1.00 Male	Math_Literacy	140	2.688	49.250	17.43984	10.248469	105.031
	Formulate	140	.125	13.000	4.45854	2.396852	5.745
	Employ	140	1.250	24.250	6.72510	4.722266	22.300
	Interpret	140	.125	24.750	6.25632	4.446774	19.774
	Quantity	140	.063	6.000	1.56972	1.511816	2.286
	Change_and_ Relationship	140	.313	20.250	6.64338	4.120472	16.978
	Space_and_ Shape	140	.750	12.000	2.97057	2.229554	4.971
	Uncertainty_ and_Data	140	.125	24.750	6.25632	4.446774	19.774
	Valid N (listwise)	140					
2.00 Female	Math_Literacy	237	5.250	53.000	19.11939	11.071948	122.588
	Formulate	237	1.688	14.750	4.68438	2.487862	6.189
	Employ	237	1.125	26.000	7.43627	5.462372	29.838
	Interpret	237	.125	20.500	6.99883	4.444690	19.755
	Quantity	237	.063	6.000	1.57206	1.541336	2.376
	Change_and_ Relationship	237	1.875	24.250	7.56705	4.621882	21.362
	Space_and_ Shape	237	.125	12.000	2.98155	2.416932	5.842
	Uncertainty_ and_Data	237	.125	20.500	6.99883	4.444690	19.755
	Valid N (listwise)	237					

In terms of the raw mean scores, female students scored slightly better than male students did in overall mathematical literacy, process domains, and content areas. Females also had a slightly higher set of deviations, indicating more variable scores.

However, as confirmed in Section ***Inferential Statistics: One-Way ANOVA Results*** (3.3), One-Way ANOVA tests indicated that these gender differences were not statistically significant, suggesting no meaningful performance gap between male and female students across any domain.

Normality Test, Homogeinity Test, and Data Distribution

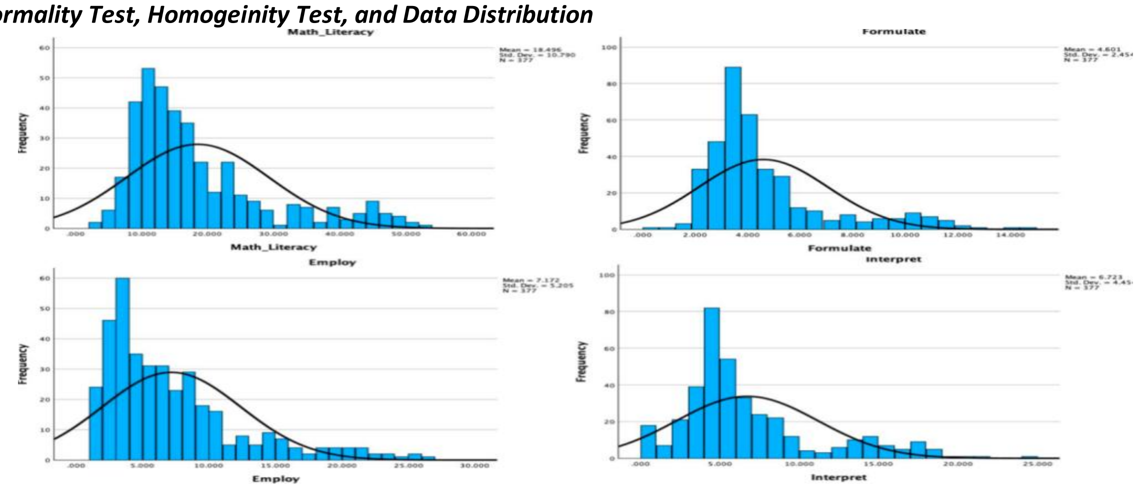

Figure 3. Histograms for Overall Math Literacy and Performance in Process Domain

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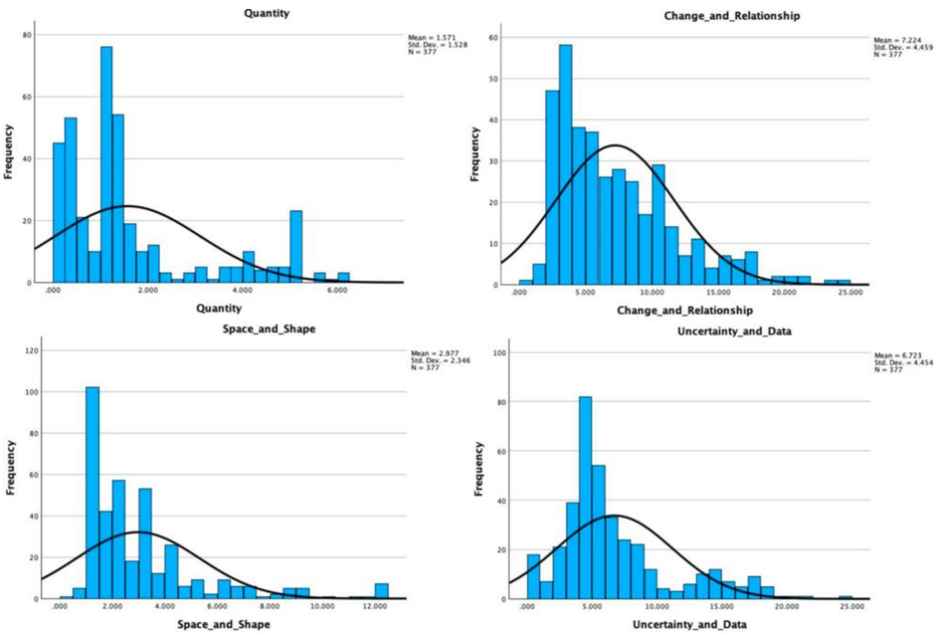

Figure 4. Histograms for Students' Performance in Content Domain

The next stage of data analyses was to test the assumptions of normality and homogeinity of students' mathematical literacy scores. This step was necessary for *One-Way ANOVA* tests. As stated previously, the normality test used in this study was assessed by *skewness* and *kurtosis* (Kim, 2013). Table 2 presents the mean and *standard deviation* of *skewness* and *kurtosis* of students' performances, which is overall and in the process and content microscopy domain item by gender.

Table 2. Skewness and Kurtosis Values of Students' Performance

Descriptive Statistics

		N	Skewness		Kurtosis	
bygender		Statistic	Statistic	Std. Error	Statistic	Std. Error
1.00 Male	Math_Literacy	140	1.379	.205	1.316	.407
	Formulate	140	1.467	.205	1.814	.407
	Employ	140	1.349	.205	1.644	.407
	Interpret	140	1.698	.205	3.319	.407
	Quantity	140	1.334	.205	.861	.407
	Change_and_Relationship	140	.947	.205	.464	.407
	Space_and_Shape	140	2.079	.205	5.052	.407
	Uncertainty_and_Data	140	1.698	.205	3.319	.407
	Valid N (listwise)	140				
2.00 Female	Math_Literacy	237	1.347	.158	1.006	.315
	Formulate	237	1.767	.158	2.777	.315
	Employ	237	1.414	.158	1.539	.315
	Interpret	237	1.082	.158	.418	.315
	Quantity	237	1.350	.158	.590	.315
	Change_and_Relationship	237	1.187	.158	1.028	.315
	Space_and_Shape	237	1.890	.158	3.568	.315
	Uncertainty_and_Data	237	1.082	.158	.418	.315
	Valid N (listwise)	237				

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According to Table 2, the *skewness* for overall mathematical literacy performance and for process and content areas for students were smaller than two. In addition, the *kurtosis* values of their overall and content and process factors were all less than seven. Accordingly, we may conclude that the public middle school students in the survey were sampled from a normally distributed population (Kim, 2013). Besides, Figure 3 and 4 show students' mathematical literacy's histograms with normal curve, respectively, in order to provide an image of the data regarding performance, both in general, and in the process and contents areas.

After the normality test had been implemented, next come the test of homogeinity of variances. Table 3 indicated the results of homogeinity test.

Table 3. The Results of Homogeinity Tests

		Levene Statistic	**df1**	**df2**	**Sig.**
Math_Literacy	Based on Mean	1.216	1	375	.271
Formulate	Based on Mean	.048	1	375	.826
Employ	Based on Mean	1.820	1	375	.178
Interpret	Based on Mean	1.747	1	375	.187
Quantity	Based on Mean	.057	1	375	.811
Change_and_Relationship	Based on Mean	.588	1	375	.444
Space_and_Shape	Based on Mean	1.143	1	375	.286
Uncertainty_and_Data	Based on Mean	1.747	1	375	.187

Based on Table 3, homogeneity of variances Test showed that the within the male and female group, the variances were homogeneous as it shows from the *Levene Statistics* based on mean indicating the level of significance >. 05 for both the total mathematical literacy and the students' performance in the procedural and content domains. Last but not least, since the test of homogeneity of variances was used and the normality and homogeinity of variances assumptions in students' mathematical literacy test scores were fulfi lled, the further steps of *One-Way ANOVA* could be conducted to compare between students performance in general as well as the process and content domain accross gender

Inferential Statistics: One-Way ANOVA Results

Results from a series of One-Way ANOVA had confirmed that there was no statistically significant difference in the overall performance as well as in the average mathematical literacy in the process and the content domain between male and female students as shown in Table 4.

Table 4. The Results of One-Way ANOVAs Comparing Students' Performance by Gender

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Math_Literacy	Between Groups	248.267	1	248.267	2.139	.144
	Within Groups	43530.102	375	116.080		
	Total	43778.368	376			
Formulate	Between Groups	4.489	1	4.489	.745	.389
	Within Groups	2259.253	375	6.025		
	Total	2263.742	376			
Employ	Between Groups	44.512	1	44.512	1.646	.200
	Within Groups	10141.324	375	27.044		
	Total	10185.836	376			
Interpret	Between Groups	48.522	1	48.522	2.455	.118
	Within Groups	7410.802	375	19.762		
	Total	7459.323	376			
Quantity	Between Groups	.000	1	.000	.000	.989
	Within Groups	878.366	375	2.342		
	Total	878.367	376			
Change_and_	Between Groups	75.087	1	75.087	3.804	.052

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Relationship	Within Groups	7401.364	375	19.737		
	Total	7476.452	376			
Space_and_ Shape	Between Groups	.011	1	.011	.002	.965
	Within Groups	2069.565	375	5.519		
	Total	2069.575	376			
Uncertainty_and_ Data	Between Groups	48.522	1	48.522	2.455	.118
	Within Groups	7410.802	375	19.762		
	Total	7459.323	376			

The descriptive statistics presented in Table 2 the descriptive statistics of the raw means and standard deviations of male and female did not differ greatly in terms of their mathematical literacy scores overall or within the process and content domains. However, none of these differences reached statistical significance when determined by a series of One-Way ANOVAs (displayed in Table 3).

A One-Way ANOVA revealed no significant gender difference in overall mathematical literacy performance, $F(1, 375) = 2.139$, $p = .144 > .05$. Similarly, gender differences were not statistically significant across the three process domains:

- Formulating situations mathematically: $F(1, 375) = 0.745$, $p = .389$
- Employing mathematical concepts and procedures: $F(1, 375) = 1.646$, $p = .200$
- Interpreting and evaluating mathematical outcomes: $F(1, 375) = 2.455$, $p = .118$

In the four content domains, no statistically significant gender differences were observed either:

- Quantity: $F(1, 375) = 0.000$, $p = .989$
- Change and relationship: $F(1, 375) = 3.804$, $p = .052$
- Space and shape: $F(1, 375) = 0.002$, $p = .965$
- Uncertainty and data: $F(1, 375) = 2.455$, $p = .118$

Although all ANOVA results were non-significant, it is still valuable to examine effect sizes for educational implications. Table 5 presents the eta-squared values for each variable, along with the 95% confidence intervals.

Table 5. Calculated Effect Sizes for One-Way ANOVAs

ANOVA Effect Sizes[a,b]

		Point Estimate	95% Confidence Interval Lower	Upper
Math_Literacy	Eta-squared	.006	.000	.030
Formulate	Eta-squared	.002	.000	.021
Employ	Eta-squared	.004	.000	.027
Interpret	Eta-squared	.007	.000	.032
Quantity	Eta-squared	.000	.000	.000
Change_and_Relationship	Eta-squared	.010	.000	.039
Space_and_Shape	Eta-squared	.000	.000	.002
Uncertainty_and_Data	Eta-squared	.007	.000	.032

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.

As shown in Table 5, the estimated *eta-squared* values were all very small, thus contributing more evidence on the absence of gender differences in mathematics literacy that are substantial. The findings described above extend the ANOVAs by confirming that male and female students are once again performing comparably to each other, not only in terms of their general performance, but also across specific content and process areas.

4. DISCUSSION

Interpretations of Findings

The One-Way ANOVA tests show that there were no statistically significant gender differences on overall mathematical literacy of public middle school students in Kupang Municipality. There were no gender

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differences either with respect to students' average scale scores by the four domains covered (quantity, change and relationship, space and shape, uncertainty and data) and three processes (formulating situations mathematically, using mathematical content and reasoning) or by the five strands related (physical/mathematical dimensions or quantities; mathematical dependence or reasoning; cognitive level or process; source of the math content; communication or mathematical justification). These results are in line with an increasing body of international research that confirms the gender similarities hypothesis of mathematical literacy. For instance, some participating countries did not observe statistically significant gender differences in overall mathematical literacy, or in content and process area scores (OECD, 2014b PISA 2012 report). Although the OECD report did observe a gender gap favoring boys within space and shape, it did not reflect the findings of the present study in which no gender differences were observed in any content area.

The research also tallies with the work of Dao Samo et al. in Kupang Regency. (2020), who reported that mathematical literacy among high school students did not vary between genders. In addition, longitudinal work by Arora and Pawlowski (2017) examined the development of gender differences from fifteen year olds in PISA 2003 through to 23–25-year olds in PIAAC 2012 and found there were no gender differences in countries like Australia, Japan, the Netherlands, Norway, or Poland. Some but not all countries (Denmark, Finland, France, Spain and Sweden) reported gender gaps, with small ($0.2 \leq$ Cohen's $d \leq 0.5$) and negligible (Cohen's $d \leq 0.2$) effect sizes. The results of this study are consistent with the gender similarities hypothesis (Hyde, 2005; Hyde & Linn, 2006; Hyde et al., 2008), which postulates that boys and girls generally perform at equivalent levels in mathematical achievement. This is consistent with Scafidi and Bui (2010), who also reported that gender had little impact on math achievement across different sociodemographic factors in the US. Therefore, this study provides among the international and Indonesian evidence that both gender equalisation has taken place in mathematical literacy among 15-years-old students.

Educational and Policy Implications

The present study has significant pedagogical implications for students as well as teachers, parents and policymakers. Students need to get the message that what is valued is not routine calculations in a vacuum, but using previously learned ideas, facts, and procedures to solve problems in the world outside the classroom. Classroom assessments should privileg critical thinking and problem-solving with authentic tasks, as they support procedural fluency and conceptual understanding (National Research Council, 2001).

The results highlight the need for teachers to create equitable mathematics classrooms that are free from gender bias. Such are ways of a positively reinforcing attitude when girls show competence in mathematics and use cognitively challenging strategies, which in turned are beneficial to girls in mathematics (OECD, 2015). This could involve contextualizing real-world problems based on students' interests (e.g., cooking or dancing examples) to increase motivation towards mathematics. Based on the evidence for gender similarities in mathematical literacy, all students may now be considered for such learning, regardless of gender. It is on the shoulders of both teachers and parents to inspire and encourage girls' achievement in math including changing preconceived ideas that boys are just better at math than girls (Cavanagh, 2008). More generally, we add to a growing body of work that challenges sociocultural stereotypes of girls' mathematics inferiority in Indonesia (Hidayatullah & Csíkos, 2022; 2023). It also contributes to filling a relevant gap in literature, giving empirical evidence of gender equivalences in mathematical literacy at a regional level, which was a neglected aspect in other studies established from empirical work (Rifai & Wutsqa, 2017; Fointuna et al., 2020; Fointuna, 2021). Results corroborate that girls and boys are equally able to use mathematics to make sense of real-world problems in the two curricular domains of content and process.

As long as girls remain underrepresented in most of the STEM fields, it is essential that adults promote girls' involvement in the sciences. Parents and teachers are also key to establishing early interest and confidence, particularly before middle school. Models of the above kind are offered, for example, by Germany and Belgium, where National Girls' Day exposes young women to university-level STEM study and careers in which they are typically underrepresented (OECD, 2015). These programs are particularly important in countries like Indonesia, where lifting women up into STEM related jobs (mining, construction, industrial/ manufacturing/technology) can take a significant stride towards ensuring gender equality and addressing the labor shortage (Central Bureau of Statistics of Indonesia, 2019). Additionally, increased women representation in high paying, math-intensive jobs may also contribute to the growth of family income and national economy (Bureau of Labor Statistics, 2009).

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Study Limitations and Future Directions

While this study addressed the gaps in literature of gender similarities on mathematical literacy in Indonesia, it still has some limitations. First, whereas this study is conducted to a relatively larger sample based on rigorous sampling statistically in the effort to generalize the result to the entire population of ninth grade public middle school students in Kupang municipality, further study should include a bigger sample of participants, i.e., on those from other school control such as Catholic, Christian, Islamic, boarding schools, or other private schools since there are some difference in teaching method, curriculum, or cultural expectation could affect students' performance by gender. Add more respondents' form all school districts in general and across the province or even the country in particular. Another important factor that should be taken into account in future studies is the use of questionnaires to gather background information of students in terms of motivations and attitudes of students towards learning mathematics (self efficacy, self regulated learning, motivation, independence in learning, self confidence in mathematics), facilities available for learning in school, use of technology on learning mathematics in school and that at home, parental, teacher and school influences. By integrating additional and broader dimension of students´ learning environment, the government and decision makers might introduce a more effective educational policies down to the municipality and province, and up to the national level.

5. CONCLUSION

This research aimed to examine gender gap in mathematical literacy of Indonesian public middle school students in Kupang for fifteen-year-old students in Kupang in Indonesia based on gender on the overall, content, and process. The results provided no significant gender differences in any of the investigated dimensions. Male and female students did not differ in their use of mathematical reasoning for problem solving and their interpretation of the outcomes—providing evidence for the gender similarities hypothesis. These findings have crucial implications for equity in mathematics teaching. Promoting girls' interest and self-efficacy in mathematics could hold potential for dissolving the persistent gender gap in STEM careers. "The promotion of gender-equitable learning environments can begin to address labor shortages in high-skill, math-intensive fields, and serve as a catalyst for economic growth on a broader scale. It is therefore the obligation of teachers and policy makers to ensure that all children, irrespective of gender, have equal access to the kind of mathematical skills that will be required for workforce participation in the 21st century.

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