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Mathematics Achievement of Indonesia Eighth Grade Students And Characteristics of Mathematics Curriculum

Desi RAHMATINA

Mathematics Education Department, Universitas Maritim Raja Ali Haji, Indonesia
email: desirahmatina@gmail.com

Abstract

This paper considers the result of the trends in international mathematics and science study (TIMSS) 2011 assessment conducted in Indonesia. The average mathematics achievement in Indonesia eighth grades have made average scale score of 386 points and with this achievement have indicated that students in Indonesia have typically scored below international averages. Mathematics assessment consisted of content and cognitive domains. There are four content domains, numbers, algebra, geometry, data and chance, whereas knowing, applying and reasoning were assessed in the cognitive domain. The best average score was achieved in the content domain of "Algebra" and the lower score of "Number". And the best average score was achieved in the cognitive domain of "Reasoning" and the lower score of "Knowing". Therefore, analyses were undertaken using the SPSS software to examine mathematics achievement and characteristics of mathematics curriculum. The variables consisted of the content domain value calculated for each student as a measure of mathematics achievement.

Keywords: content domain, cognitive domain, mathematics achievement

1. Introduction

The TIMSS 2011 database contains achievement data and student, home, teacher and school background data collection in the 63 countries and 14 benchmarking participants including three Canadian provinces, nine US states and two emirates from the United Arab Emirates. Fifty-two countries and seven benchmarking participants administered the fourth grade assessment and 45 countries and 14 benchmarking participants administered the eighth grade assessment. In each country, representative samples of approximately 4000 students from 150-200 schools participated in TIMSS 2011 at each grade assessed. In total, more than 300,000 students participated in the TIMSS 2011 fourth grade assessment and a further 300,000 in the eighth grades assessment. For this study, the following database from TIMSS 2011 for eighth grade were used their mathematics achievement. Indonesia did not participate in TIMSS 1995, 1999 and 2003.

The poor quality of mathematics education in Indonesia can be traced in the low achievement level reached by the students in other countries. In the 2011 Trends in International Mathematics and Science Study, Indonesia ranked 38th out of the 63 countries participating in this study. The Indonesian performance was significantly lower than ASEAN countries as Singapore, Malaysia and Thailand (Rahmatina, 2014). The mathematics content and skill tested in TIMSS represent what the participating countries considered important to be learned at school up to eighth grade. The curriculum refers to the provision of differentiated instruction to accommodate students with different abilities. Curriculum is a set of tools to achieve educational goals, as well as guidance in the implementation of education. Curriculum can show the system plans and arrangements regarding the content and learning materials are guided in learning activities. The Government is obliged to establish and organize a national education system for all Indonesian citizens. Since 1945, the national curriculum has changed; started in 1947, 1952, 1964, 1968, 1975, 1984, 1994, 1999, 2004, 2006, and most recently in 2013. Like other countries, education system in Indonesia are managed or under the jurisdiction of the government. The information about age of entry, promotion and retention in TIMSS 2011 that children must be 7 years old by the end of June to begin on July 12th, although parents have some choice in starting children at age 6. Students are required to sit for the national examination; this examination is called *Ujian Nasional* (UN) before they could proceed to high education.

2. Methodology

This paper uses Trends in International Mathematics and Science Study (TIMSS) 2011 data. TIMSS contains international results in mathematics presents extensive information on student performance in mathematics. TIMSS was originally conducted in 1995 and continues every four years, in 1999, 2003, 2007, and most recently in 2011. The variable used in this analysis includes content domain of the mathematics achievement, there are Algebra, Geometry, Number, data and Chance by the average of



five value in the content domain. The study continues of the curriculum on mathematics achievement. This study will employ the t-test to analyze significant differences based on the sex of the students. It also used ANOVA to relate each of these content domains. In the study, the targeted sample at the eighth grade in Indonesia country. Total the participants were 5795 students showed in table below.

Table 1. Summary of the samples included in the study

Country	Number of student			Number of schools
	Total	Female	Male	
Indonesia	5795	2972	2823	153

3. Result

At the grade level has a range of 0 – 1 (although student performance typically ranges between 300 and 700). The scale center point of 500 was set to correspond to the mean of the overall mathematics achievement and 100 points on the scale was set to correspond to the standard deviation. According to the TIMSS 2011 report, mathematics assessment consisted of content and cognitive domains. There are four content domains, numbers, algebra, geometry, data and chance, whereas knowing, applying and reasoning were assessed in the cognitive domain.

Table 2. Average score achievement in mathematics content domain for student's Indonesia

Overall mathematics	Average score			
	Number	Algebra	Geometry	Data and chance
386	375	392	377	376

Source: TIMSS 2011

Table 3. Average score achievement in mathematics cognitive domain for student's Indonesia

Overall mathematics	Average score		
	Knowing	Applying	Reasoning
386	378	384	388

Source: TIMSS 2011

Table 2 above presents the average score achievement in mathematics content domain shown that Algebra has the average score higher than other content domain and the lowest achievement in the content domain of Number. Analyzing student's achievement through cognitive domain, we can see in table 3 shown that the Indonesia students were the most successful of Reasoning.

In table 4 show the result for the 4 countries that statistics descriptive for the eighth grade included Indonesia, Malaysia, Singapore and Thailand. The result shows that Singapore which had higher average mathematics achievement than all ASEAN counties.

Table 4. Statistics descriptive of mathematics achievement in ASEAN country 2011

Country	Algebra		Data and chance		Number		Geometry	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Indonesia	405.5145	77.11866	390.1982	79.94800	390.7927	84.95021	393.1353	90.99990
Malaysia	430.9154	85.58763	429.9734	86.52171	451.7141	95.07406	432.9860	104.46935
Singapore	610.8772	87.43590	603.1265	95.23595	607.9082	76.71987	606.0014	80.79848
Thailand	439.2915	89.64875	443.9083	81.22564	440.7781	96.14792	429.8392	92.55418

Trend in mathematics achievement at the eighth grade in 1995, 1999, 2003, 2007 and 2011 can be seen in figure 1. One of the main reasons for lowest average achievement mathematics of the Indonesia students in content domain comes from the subject matter to these domains is insufficiently of mathematics curriculum for Indonesia high school.

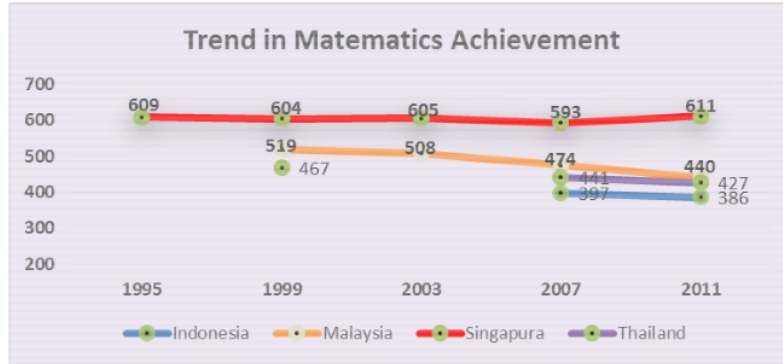


Figure 1. Trend in Mathematics Achievement

4. Gender difference in Mathematics Achievement

There are some differences between boy's and girl's achievement of the contain domain, In table 5 present that girl's average score higher than boy's students or girls have better results than boy's in the eighth grade students of the Indonesia. The gender differences, we can perceive on statistically significant gender differences in Table 6. Based on the analyze shown in those contain domain subject as Number, Algebra, Geometry and data and chance with significant value ($\text{sig} = 0,000 < 0,05$). We can conclude that there are difference significant between girls and boys in achievement mathematics.

Table 5. Group Statistics

	SEX OF STUDENTS	N	Mean	Std. Deviation	Std. Error Mean
Number	GIRL	2972	396.1345	83.79627	1.53709
	BOY	2823	385.1689	85.80448	1.61493
Algebra	GIRL	2972	415.5746	76.19482	1.39766
	BOY	2823	394.9235	76.67933	1.44319
Geometry	GIRL	2972	397.4278	89.03467	1.63318
	BOY	2823	388.6163	92.82551	1.74708
Data and Chance	GIRL	2972	394.8683	78.03399	1.43139
	BOY	2823	385.2818	81.64032	1.53656

Table 6. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	95% Confidence Interval of the Difference	
							Lower	Upper
Number	Equal variances assumed	.020	.887	4.921	5793	.000	6.59759	15.33357
	Equal variances not assumed			4.918	5760.506	.000	6.59493	15.33624
Algebra	Equal variances assumed	.135	.713	10.281	5793	.000	16.71323	24.58888
	Equal variances not assumed			10.279	5773.721	.000	16.71258	24.58952
Geometry	Equal variances assumed	4.118	.042	3.688	5793	.000	4.12820	13.49486
	Equal variances not assumed			3.684	5743.260	.000	4.12317	13.49989

Data and Chance	Equal variances assumed	3.825	.051	4.570	5793	.000	5.47452	13.69845
	Equal variances not assumed			4.565	5739.519	.000	5.46974	13.70324

To analyze differences between the Indonesian students achievement across content domain can be analyzed by used Tukey test in Analyze of Variance (ANOVA).

Table 7. Test of Homogeneity of Variances

Levene Statistic	df1	df2	Sig.
46.680	3	23175	.000

The Levene's test of equality of error variances tests the assumption of ANOVA that the variances of mathematics achievement variables are equal across the content domain. As can be seen in Table 7 mathematics achievement are significant (sig = 0.00 < 0.05), the indicates that tests the null hypothesis that the error variance of the mathematics achievement variables is no equal content domain, whereas ANOVA is robust so next analysis can be continue.

Table 8. ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	896202.717	3	298734.239	42.927	.000
Within Groups	1.613E8	23175	6959.188		
Total	1.622E8	23178			

Mathematics achievement differed significantly among the four content domain , the value of the test F = 42,927 is greater that the critical value of F =2,605 and sig value is 0,000 < 0,005. We conclude that the mean achievement mathematics by each of the four contains domain is not the same. In other words, at least one of the four means is different from the other three. The result from the analyze ANOVA test do not indicate which of the four differ from one another, it is of interest to follow the analysis multiple comparisons with a post hoc test . The Tukey post hoc test in Table 10 indicated that mathematics achievement of the contain domain in the Algebra differed significantly from contain domain "Number "(sig = 0.000) less than significant 0,05 level. And Algebra different significantly from the other three Number, Geometry, Data and Change. Based on the above result above can be concluded as present in Table 9.

Table 9. Conclusion of the significant

CONTENT DOMAIN	NUMBER	ALGEBRA	GEOMETRY	DATA AND CHANCE
NUMBER	Not related	*	-	-
ALGEBRA	*	Not related	*	*
GEOMETRY	-	*	Not related	-
DATA AND CHANCE	-	*	-	Not related

*: different significant
- : no different significant

Table 9. Multiple Comparisons

(I) 1	(J) I	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
NUMBER	ALGEBRA	-14.7092019*	1.5498380	.000	-18.691074	-10.727330
	GEOMETRY	-2.3300060	1.5498380	.435	-6.311878	1.651866

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