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A Comparative Study of Three Indonesian Islands on The Performance in Mathematics

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Abstract

The level of performance among Indonesian students in Mathematics is still critical. This study aims at comparing provinces within each of three islands, and then all three Islands in general, the comparison focused on the performance in mathematics during 2014/2015 national examination. Islands involved in the current research are Java, Sumatera, and Kalimantan. For each province from every island, the researchers selected urban districts by using formula of Krecie & Morgan (1970), with .05 degree of accuracy, and then systematic sampling to select schools. On Java Island, the researchers selected 669 out of 1065 schools, 508 out of 621 schools on Sumatera Island, and 203 out of 235 schools on Kalimantan Island. Gathering data involved documentation. The researchers analyzed the data by using NCSS 11 and JASP 0.8.3.1. The findings indicated a significant difference among provinces and even Islands on the performance in Mathematics, $p<.01$, and Sumatera is the most performing island in Mathematics.

Keywords: Comparing, Degree of Accuracy, Performance, Rural and Urban Schools

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INTRODUCTION

Mathematics has been considered a compulsory subject in the elementary, junior and senior high schools. Leonard (2012) stated that mathematics is one of the important subjects and an indicator of success is student learning. This However, there are always problems raised by the way Mathematics is taught, this can be indicated by the ever-low achievement of students in Mathematics on almost every examination, including the final year national examination conducted by the government. There was revision of 1994 curriculum, but school do not have information yet about how this revision is affecting students' performance in Mathematics (Hadi & Plomp, 2001). The government has

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revised the curriculum three times so far, but students' performance in mathematics is still low comparing to other countries in the region.

Realistic Mathematics Education (RME) is expected to be a promising teaching approach that meets the Indonesians need in order to improve the teaching of Mathematics. With RME concept, Mathematics seems to be a human activity and should be linked to things that are real (Hadi & Plomp, 2001). Therefore, it is necessary to explore whether RME is a suited approach to solve problems that frequently occur in Mathematics education and there should be partnership among citizens.

Parents should be concerned with the issue of academic performance of their children. This is the reason why the child's future career can be ensured through his/her academic performance of today. Inheritance and the environment of school have been considered. Governments' distribution of social amenities, such as electricity, water, hospital and educational institutions, always relies on the factors discussed before. It is a common knowledge that many of these social amenities are hugely concentrated in urban areas. These amenities sometimes act as a factor that pulls the educated and rich families to the urban areas. The inappropriate environment and lack of infrastructure hugely contribute to unsuccessful teaching which can lead to poor academic performance (Wilkins & Ma, 2002).

Students' performances in mathematics can also be dependent on the location of his/her school. As it is believed by many, students from rural schools mostly receive an education that is inferior comparing to their counterparts in the urban localities. Because urban students are provided with better quality in education. They have many facilities and advantages in their education compared to students from rural schools (Faisal & Mateen, 2016). Faisal & Mateen (2016) compared performance in academic activities of the rural and urban students; there was significant difference between both groups in terms of their academic performances.

Adepoju, T. L., & Oluchukwu (2011) conducted a study in Oyo state of Nigeria from 2005 to 2007. The result revealed the remarkable difference between the students from both localities, with remarkable mean scores that urban students obtain rather than rural students. Similarly, another study was undertaken in Pakistan to evaluate the comparative academic performance of rural and urban students at undergraduate level. Result showed that overall performance of urban students was better than rural ones (Onoyase, 2015). All in all, all the findings by the researchers in this paragraph support the remarkable difference between urban and rural localities students' performance.

According to Crane (2010), the goals of schooling are countless, and including not only academic objectives, but also social ones as well. Some authors consider performance in mathematics a better indicator for school effects because they think that it is less influenced by the background of family and home than other subjects (Heyneman, 2005). Having a solid mathematical background helps students develop sophisticated perspective and provides more career alternatives and opportunities.

Qualification of teachers is another factor that impacts on the performance of students in mathematics (Indonesia). Upgrading teaching qualification of teachers, based on 2005 Teacher Law (bachelor degree (S1 required), has resulted in big number of unqualified teachers especially at elementary level. There are a short number of both mathematics and science teachers, particularly in remote areas, who do not have a bachelor degree in mathematics or science concentrations because there is lack of mathematics and science majors in most of local institutions are responsible for training teachers (Hendayana, Asep, & Imansyah, 2010). For the case of qualification, the question that can be asked about quality education in Indonesian schools is: "is there a

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significant improvement on students' performance in mathematics as long as many teachers are bachelor degrees graduates now?"

There is another dangerous factor that can harm and undermine students' performance, not only in mathematics but also in other subjects in general. The more a teacher is absent from his/her job, the less students' performance is. The table below contains information about teachers' absenteeism across three islands of Indonesia.

Table 1. Teacher Absence by Region (2015)

Region (Island)	Absence Rate (%)	SE
Kalimantan	14.1	1.6
Java	9.1	1.7
Sumatera	8.4	1.7

Source: Analytical, E.S (2015)

Based on table 1 information, Kalimantan is the most affected island of the three. This means that this absence in Kalimantan must result in students' low performance in mathematics.

TIMSS is an international study that aims at comparing its country-members on their performance in both mathematics and science. Its study in 2007 indicated that Indonesia is number 36 for mathematics (out of 48 countries). What Indonesia needs today is to work hard in mathematics and science in order to pass over other countries in the region because still now Indonesia is classified in the least dominating countries.

The current study wants to compare the urban schools from each province of the three islands and then compare the three islands (Kalimantan, Sumatera, and Java). In the same study, the most and least performing provinces and islands were determined.

METHOD

The researchers in this survey used the data from Puspendik 2015 about National examination. Only mathematics scores for the target schools located on each island were recorded. The study involved 1380 junior high schools from three Indonesian islands; 203 schools from Kalimantan, 508 schools from Sumatera, and 669 schools from Java Island. Purposive sampling was used to choose public urban schools. Thereafter, systematic sampling was used to determine the sample size after looking for the matching number of schools from the Research Advisors (2006). The latter was used because the population was known; 235 junior high schools from Kalimantan, 537 junior high schools from Sumatera, and 1065 junior high schools from Java. To analyze the data, one way ANOVA was chosen because the study is comparing the mean and there is only one dependent variable. The statistical hypothesis of this study is mentioned below in detail:

1. Provinces
   a. Kalimantan
      $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$
      H_a : At least one group has observations that tend to be greater than those of the other groups
   b. Sumatera
      $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9 = \mu_{10}$
      H_a : At least one group has observations that tend to be greater than those of the other groups
   c. Java
      $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$

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H_a : At least one group has observations that tend to be greater than those of the other groups

2. All The Three Islands
   $H_0 : \mu_1 = \mu_2 = \mu_3$
   $H_a : \mu_1 \neq \mu_2 \neq \mu_3$ or $\mu_1 = \mu_2 \neq \mu_3$ or $\mu_1 \neq \mu_2 = \mu_3$

FINDINGS AND DISCUSSION

As the purpose of paper makes it clear, the findings and discussion are organized from descriptive statistics accompanied with plot, ANOVA, and Post-Hoc. For descriptive statistics, the researchers put focus on the central tendencies, mean and median. For ANOVA, the researchers tested the hypothesis (*p-value* < α = .01). For central tendencies, the researchers stressed more on the highest and lowest mean and median, sometimes effect size. For Post-Hoc comparison, three computational techniques were adapted; Tukey, Scheffe, and Bonfenie. Finally, the plots were graphed for supporting what descriptive statistics and Post-Hoc comparison revealed.

Table 2. Descriptive Statistics for Kalimantan Island

Group	Count	Mean	Effect	Median	Standard Deviation	Error √(MSE/ni)
All	203	52.71	51.37			
A: Kalimantan						
Central Kalimantan	29	47.81	-3.55	47.19	13.34	1.923
East Kalimantan	73	44.46	-6.91	41.82	8.293	1.212
North Kalimantan	11	39.69	-11.68	36.72	8.979	3.122
South Kalimantan	49	64.02	12.66	67.5	10.27	1.479
West Kalimantan	41	60.85	9.483	64.39	11.65	1.617

Table 2 contains the information about the highest and lowest mean score on Mathematics across all the provinces of Kalimantan. The highest mean and median with yellow color (64.02 and 67.5) show the province whose junior high schools have the most performing students on mathematics. In contrast, the lowest mean and median with red color (39.69 and 36.72) indicate different information.

Table 3. One-Way ANOVA for Kalimantan Island

Cases	Sum of Squares	df	Mean Square	F	p
Province_Kalimantan	16523	4	4130.8	38.52	< .001
Residual	21232	198	107.2		

The information that can be read from Table 3, the hypothesis testing supports the rejection of H_0 because $p < .01$, it means at least one province in Kalimantan has schools whose students' performance on mathematics differ from that of students schooling in other provinces. Therefore, there is a significant difference among students' mathematics performances all over the island.

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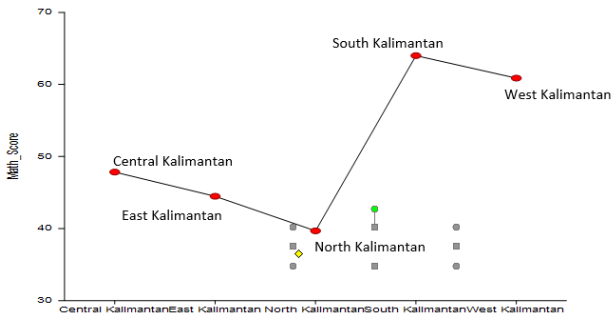

Graph 1. Means Plot of Math Score of Kalimantan Island

The plot illustrates the ordering of provinces in Kalimantan Island based on the mean score in mathematics. South Kalimantan is the most performing province while North Kalimantan is the least performing one.

Table 4. Post Hoc Comparisons–Province for Kalimantan Island

		Mean Difference	SE	t	p tukey	p scheffe	p bonf
Central Kalimantan	East Kalimantan	3.358	2.273	1.477	0.566	0.702	1.000
	North Kalimantan	8.127	3.667	2.216	0.169	0.300	0.278
	South Kalimantan	-16.211	2.426	-6.682	< .001	< .001	< .001
	West Kalimantan	-13.036	2.513	-5.188	< .001	< .001	< .001
East Kalimantan	North Kalimantan	4.769	3.349	1.424	0.601	0.731	1.000
	South Kalimantan	-19.569	1.912	-10.232	< .001	< .001	< .001
	West Kalimantan	-16.394	2.021	-8.112	< .001	< .001	< .001
North Kalimantan	South Kalimantan	-24.337	3.455	-7.044	< .001	< .001	< .001
	West Kalimantan	-21.162	3.516	-6.019	< .001	< .001	< .001
South Kalimantan	West Kalimantan	3.175	2.192	1.449	0.585	0.718	1.000

To read Table 4, we look at mean difference. In the table, the highest positive mean difference is between Central and North Kalimantan (8.127). The highest negative mean difference is between North and South Kalimantan (-24.337).

Table 5. Descriptive Statistics for Sumatera Island

Group	Count	Mean	Effect	Median	Standard Deviation	Error √(MSE/ni)
All	508	64.244	59.885			
B: Sumatera						
Aceh	69	76.72	16.84	79.92	12.71	1.736
Bangka Belitung	11	46.48	-13.41	40.95	12.50	4.347
Bengkulu	27	42.21	-17.68	38.84	9.835	2.775
Jambi	41	77.62	17.74	83.62	13.28	2.252
Kepulauan Riau	10	46.72	-13.17	40.62	13.83	4.559
Lampung	46	58.47	-1.42	56.3	12.26	2.126
North Sumatera	110	68.42	8.538	73.975	14.54	1.375
Riau	53	68.51	8.621	75.04	15.17	1.980
South Sumatera	56	50.72	-9.166	42.07	16.63	1.927
West Sumatera	85	62.995	3.111	63.06	16.44	1.564

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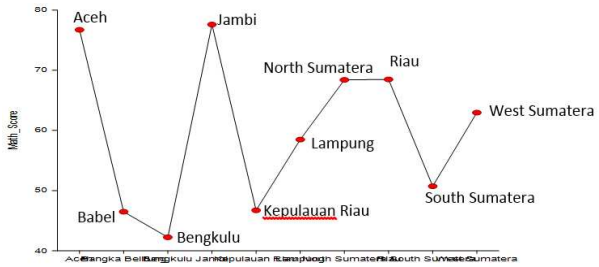
Table 5 contains the information about the highest and lowest mean score on Mathematics across all the provinces of Sumatera. The highest mean and median with yellow color (77.62 and 83.62) shows the province whose junior high schools have the most performing students on mathematics. In contrast, the lowest mean and median with red color (42.21 and 38.84) denote different information.

Table 6. One-Way ANOVA for Sumatera Island

Cases	Sum of Squares	df	Mean Square	F	p
Province_Sumatera	52534	9	5837.1	28.08	< .001
Residual	103517	498	207.9		

Table 6 is about testing the hypothesis concerning performances on Math along all provinces of Sumatera. The hypothesis testing supports the rejection of H_0 because $p < .01$, it means at least one province on Sumatera has schools whose students' performance on mathematics differ from that of students schooling in other provinces. Therefore, the comparison of mean proves a significant difference in terms of students' performance in mathematics for all junior high schools located in the provinces involved in this study.



Graph 2. Means Plot of Math Score of Sumatera Island

If we look at the plot drawn above with naked eye, there is interesting information. The mean score on Mathematics in Aceh and Jambi is not proving the significant difference. The same case appears for North Sumatera and Riau, and Bangka Belitung and Kepulauan Riau.

Table 7. Post Hoc Comparisons – Provinces for Sumatera Island

		Mean Difference	SE	t	p tukey	p scheffe	p bonf
Aceh	Bangka Belitung	30.243	4.681	6.461	< .001	< .001	< .001
	Bengkulu	34.517	3.273	10.547	< .001	< .001	< .001
	Jambi	-0.902	2.843	-0.317	1.000	1.000	1.000
	Kepulauan Riau	30.004	4.878	6.150	< .001	< .001	< .001
	Lampung	18.253	2.744	6.651	< .001	< .001	< .001
	North Sumatera	8.297	2.214	3.747	0.006	0.124	0.009
	Riau	8.214	2.633	3.119	0.053	0.375	0.086
	South Sumatera	26.001	2.593	10.027	< .001	< .001	< .001
	West Sumatera	13.725	2.336	5.875	< .001	< .001	< .001

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		Mean Difference	SE	t	p_{tukey}	$p_{scheffe}$	p_{bonf}
Bangka Belitung	Bengkulu	4.274	5.157	0.829	0.998	1.000	1.000
	Jambi	-31.145	4.896	-6.362	< .001	< .001	< .001
	Kepulauan Riau	-0.239	6.299	-0.038	1.000	1.000	1.000
	Lampung	-11.990	4.839	-2.478	0.260	0.725	0.610
	North Sumatera	-21.946	4.559	-4.813	< .001	0.007	< .001
	Riau	-22.028	4.777	-4.611	< .001	0.013	< .001
	South Sumatera	-4.242	4.755	-0.892	0.996	1.000	1.000
	West Sumatera	-16.518	4.620	-3.576	0.012	0.176	0.017
Bengkulu	Jambi	-35.419	3.573	-9.912	< .001	< .001	< .001
	Kepulauan Riau	-4.513	5.337	-0.846	0.997	1.000	1.000
	Lampung	-16.264	3.495	-4.653	< .001	0.011	< .001
	North Sumatera	-26.220	3.097	-8.468	< .001	< .001	< .001
	Riau	-26.303	3.409	-7.716	< .001	< .001	< .001
	South Sumatera	-8.516	3.378	-2.521	0.238	0.703	0.540
	West Sumatera	-20.792	3.185	-6.528	< .001	< .001	< .001
Jambi	Kepulauan Riau	30.906	5.085	6.078	< .001	< .001	< .001
	Lampung	19.155	3.097	6.186	< .001	< .001	< .001
	North Sumatera	9.200	2.638	3.487	0.016	0.208	0.024
	Riau	9.117	2.999	3.040	0.067	0.417	0.112
	South Sumatera	26.903	2.963	9.079	< .001	< .001	< .001
	West Sumatera	14.627	2.741	5.336	< .001	< .001	< .001
Kepulauan Riau	Lampung	-11.751	5.030	-2.336	0.342	0.792	0.895
	North Sumatera	-21.707	4.762	-4.558	< .001	0.015	< .001
	Riau	-21.790	4.971	-4.384	< .001	0.025	< .001
	South Sumatera	-4.003	4.950	-0.809	0.998	1.000	1.000
	West Sumatera	-16.279	4.820	-3.377	0.024	0.252	0.035
Lampung	North Sumatera	-9.956	2.532	-3.933	0.003	0.082	0.004
	Riau	-10.038	2.905	-3.455	0.018	0.220	0.027
	South Sumatera	7.748	2.869	2.701	0.160	0.607	0.322
	West Sumatera	-4.528	2.639	-1.716	0.766	0.966	1.000
North Sumatera	Riau	-0.083	2.411	-0.034	1.000	1.000	1.000
	South Sumatera	17.704	2.367	7.480	< .001	< .001	< .001
	West Sumatera	5.427	2.082	2.607	0.198	0.658	0.424
Riau	South Sumatera	17.787	2.763	6.438	< .001	< .001	< .001

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		Mean Difference	SE	t	p tukey	p scheffe	p bonf
	West Sumatera	5.510	2.523	2.184	0.442	0.853	1.000
South Sumatera	West Sumatera	-12.276	2.481	-4.947	< .001	0.004	< .001

In Sumatera, there is a remarkable difference between provinces. The highest positive and negative mean difference is between Aceh-Bengkulu, and Bengkulu-Jambi with 34. 517 and 35.419 respectively. However that, there are some other provinces between which the mean difference is not highly significant e.g. North Sumatera-Riau, Bangka Belitung-Kepualaun Riau and Aceh-Jambi.

Table 8. Descriptive Statistics for Java Island

Group	Count	Mean	Effect	Median	Standard Deviation	Error √(MSE/ni)
All	669	63.209	63.99			
C: Java						
Banten	83	50.881	-13.09	45.65	16.62487	1.390519
Central Java	102	57.691	-6.277	55.08	16.43636	1.254341
DKI Jakarta	184	73.075	9.106	72.835	7.471444	0.9339141
East Java	128	67.673	3.705	69.87	14.20396	1.119724
West Java	155	56.410	-7.559	53.41	10.82055	1.017537
Yogyakarta	17	78.079	14.111	80.09	12.70483	3.072496

Two rows from table 8 are colored to deliver specific information about mean score, median, and effect size based on mathematics performance on Java Island. The island is known, in the whole country, to be develop in different domains including education. The capital city of Indonesia is located on the same island. Moreover, there are other provinces which host a lot of schools. Coming back to table 8, the province on Java Island whose mean score, median and effect are the highest, is DI Yogyakarta with 78.079, 80.09, and 14.111 respectively. In contrast, Banten Province has the lowest mean, median, and effect scores; 50.881, 45.65, and -13.09 respectively. The Capital city, DKI Jakarta, has most schools comparing to other provinces located on the same island (184 schools), it comes after DI Yogyakarta if we consider the scores for variables stated above.

Table 9. One-Way ANOVA for Java Island

Cases	Sum of Squares	df	Mean Square	F	p
Province_Java	47104	5	9420.9	58.70	< .001
Residual	106401	663	160.5		

Table 9 is just about testing the hypothesis concerning performances on mathematics along all provinces of Java. The hypothesis testing supports the rejection of H_0 because $p < .01$, it means at least one province on Java has schools whose students' performance on mathematics differ from that of students schooling in the rest of provinces. Therefore, the comparison of mean proves a significant difference in terms of students' performance in mathematics for all junior high schools based in the provinces involved in this study.

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Graph 3. Means Plot of Math Score of Java Island

The plot above confirms the information in table 6. Here, it can be seen that all provinces are different, this can be easily detected by looking at the position of red dots. Yogyakarta comes the first with the highest mean score on mathematics. Banten is in the critical region on the plot because it is not far from the lowest score (50).

Table 10. Post Hoc Comparisons–Provinces of Java Island

		Mean Difference	SE	t	p tukey	p scheffe	p bonf
Banten	Central Java	-6.810	1.873	-3.636	0.003	0.022	0.004
	DKI Jakarta	-22.193	1.675	-13.250	< .001	< .001	< .001
	East Java	-16.792	1.785	-9.406	< .001	< .001	< .001
	West Java	-5.528	1.723	-3.208	0.016	0.069	0.021
	Yogyakarta	-27.198	3.373	-8.065	< .001	< .001	< .001
Central Java	DKI Jakarta	-15.384	1.564	-9.837	< .001	< .001	< .001
	East Java	-9.982	1.681	-5.937	< .001	< .001	< .001
	West Java	1.281	1.615	0.793	0.966	0.987	1.000
	Yogyakarta	-20.388	3.319	-6.144	< .001	< .001	< .001
DKI Jakarta	East Java	5.401	1.458	3.704	0.003	0.018	0.003
	West Java	16.665	1.381	12.066	< .001	< .001	< .001
	Yogyakarta	-5.005	3.211	-1.559	0.608	0.787	1.000
East Java	West Java	11.264	1.513	7.445	< .001	< .001	< .001
	Yogyakarta	-10.406	3.270	-3.182	0.017	0.073	0.023
West Java	Yogyakarta	-21.670	3.237	-6.695	< .001	< .001	< .001

Across Java Island, the highest positive and negative mean difference is between DKI Jakarta-West Java, and Banten-Yogyakarta with 16.665 and -27.198 respectively. Remembering that when the mean difference is positive the first province mean score on mathematics is higher than its counterpart, e.g. West Java-Yogyakarta, the mean difference equals -21.670. It means West Java has the lower mean score. This technique of interpreting means difference can be applied to other pairs of provinces.

Table 11. Descriptive Statistics for Three Islands of Indonesia

Group	Count	Mean	Effect	Median	Standard Deviation	Error √(MSE/ni)
All	1380	62.046	60.06			
A: Java	669	63.209	3.154	65.01	15.15909	0.6140159
B. Kalimantan	203	52.712	-7.343	50.91	13.6714	1.114666
C. Sumatera	508	64.244	4.189	69.88	17.54404	0.7046295

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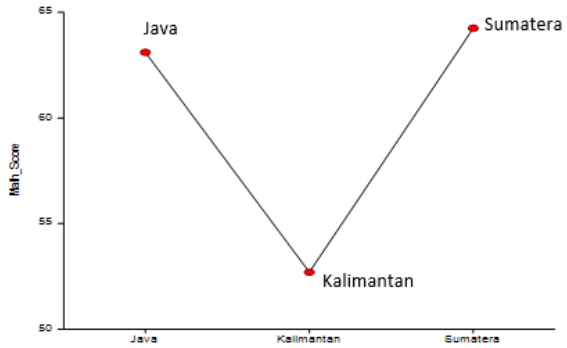
Table 11 englobes the information about the highest and lowest mean scores on Mathematics among all three islands; Kalimantan, Sumatera and Java. The island with the highest mean, median and effect scores (yellow) is Sumatera (64.24364, 69.88 and 4.189022, respectively). The latter depicts the island whose junior high schools have the most performing students on mathematics. In contrast, the lowest mean, median and effect is Kalimantan (red) with 52.71192, 50.91 and -7.342699 respectively.

Table 12. One-Way ANOVA for Three Islands

Cases	Sum of Squares	df	Mean Square	F	p
Island	21044	2	10521.8	41.72	< .001
Residual	347312	1377	252.2		

By comparing mean among the three islands, it was found that the idea of rejecting H_0 is worthwhile. The *p-value* < *.01*, which means that there is a significant difference on mathematics performance by students from all junior high schools located on Java, Sumatera, and Kalimantan islands. This also demonstrates that at least one group has observations that tend to be greater than those of the other groups. We no longer assumed that at least one group but all provinces are different in terms of students' performance in mathematics.



Graph 4. Means Plot of Math Score of Three Indonesian Islands

The graph drawn above explains well how the three islands differ based on mathematics mean score. There is a long distance from dot standing for Kalimantan to the dots for Sumatera and Java. It is clear that the mean score in mathematics for all schools located in Kalimantan varies between 50 and 55. On the other hand, Sumatera and Java are not hugely different because both of them are above 60. In brief, Kalimantan is still far to reach the other two islands.

Table 13. Post Hoc Comparisons for the Three Islands

		Mean Difference	SE	t	p tukey	p scheffe	p bonf
Java	Kalimantan	10.496	1.273	8.248	< .001	< .001	< .001
	Sumatera	-1.035	0.935	-1.108	0.505	0.542	0.804
Kalimantan	Sumatera	-11.532	1.317	-8.758	< .001	< .001	< .001

The information from table 13, is not far from what can be read from the plot, but it gives further explanation with numbers. If you look at the mean difference between Java-Kalimantan (10.496) and Kalimantan-Sumatera (-11.532), the difference is not big just -1.035. Having a look at all *p-values* in table 13, the differences between Java and

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Sumatera is not significant because $p > .01$. Summarily, Sumatera comes the best in students' performance on mathematics national test 2014/2015.

CONCLUSION

By concluding this report, it is necessary to look through all the results and achievement of the objectives the research was conducted for. On each island, the schools by province, shows significant difference among them towards their students' performance on mathematics. The latter, was not only found for provinces comparison but also the islands in general. There are some provinces on each island that are showing a good step in promoting outstanding performance in mathematics, e.g. Yogyakarta Province on Java, Jambi Province on Sumatera, and South Kalimantan on Kalimantan Island. However, there are other provinces which are far left behind in performing well on Mathematics test, e.g. Banten Province on Java, Bengkulu Province on Sumatera, and North Kalimantan Province on Kalimantan. It can be recommended that:

1. The government of Indonesia through the Ministry of Education should make empirical and periodic follow up on mentioned Provinces;
2. Javanese junior high schools should revise the teaching strategies because it was found that Sumatera already passed over while people have mind that Java is the most developed in all domains;
3. Central government through the local government should motivate the teachers in order to revise their professionalism;
4. Indonesian schools, especially junior high schools are highly recommended to schedule study tours within and outside the island;
5. All people concerned with education should make sure of quality facilities, collaboration staff-teachers, teacher-student, parent-staff-teacher, and avoiding unreasonable absence.

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