A Comparative Study of International Mathematics Curriculum Materials and Standards

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Abstract

This comparative study analyzed probability and statistics in the 2013 Indonesian Curriculum, the 2013 Singapore Syllabus and the 2010 Common Core State Standards for Mathematics. The study focused on the benefits and limitations related to the content and expectations of what students in grades 9-12 should learn, and the guidance provide to teachers for teaching the content. The purpose of this document analysis is to determine what different countries indicate as the most valuable content, skills and strategies for teaching statistics and probability, and determining the best practices for teaching to achieve the content goals. To achieve this project goal, key questions were formulated that helped focus on comparing the documents from the three countries. Findings show that all three documents have the same vision, but differ in supporting students' level of understanding of statistics and probability content. It is hoped that the results will inform curriculum designers in Indonesia as they review and update the mathematics standards for the teaching of probability and statistics to their high school students.

Documents

Ministry of Education Indonesia. (2013). *Ministry of Education Indonesia: Mathematics Curriculum 2013*

Ministry of Education Singapore. (2013). Mathematics higher 2 (syllabus 9740). *Ministry of Education Singapore: Mathematics Syllabus*

National Governors Association Center for Best Practices (NGACBP) & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics* (CCSSM)

Methods

This comparative analysis was accomplished by:

- Translating the 2013 Indonesian documents in order to have an English version so others could understand the content.
- Constructing the key questions that would guide the examination of the documents and reduce informational bias.
- Reading thoroughly the documents focusing on the similarities and differences in the statistics and probability sections of each curriculum.
- Constructing a chart for determining the commonalities in the organization of each document and noting mathematical expectations.
- Identifying similarities and differences of the content of each document.
- Searching for evidence of teacher support in each document.
- Conducting an analysis of similarities and differences by subcategory in the major content areas.
- Gathering feedback from five mathematics teachers to do an expert evaluation that increases the reliability of the researcher's findings.

Results

◆ **Comparison of Organization**

Curriculum	Organization	Standard/Expectation count (Grade 9-12 Statistics and Probability)
Indonesian Curriculum	Competency Standard*, Basic Competency**	3 Competency Standard, 6 Basic Competency
Singapore Syllabus	Topic, Sub-Topic*, Content**	4 Topic, 7 Sub-Topic, 40 Content
Common Core State Standard (CCSSM)	Domain*, Cluster, Standard**	4 Domain, 9 Cluster, 32 Standard

◆ **Comparison of Content**

-	Major Content	Indonesia	Singapore	United States
Probability	**Permutations and combinations**			
	Principles of counting	1.4	6.1	S-CP1-9
	Concepts of permutations & combinations	1.4	6.1	S-CP1-9
	Arrangement of objects	1.4	6.1	S-CP1-9
	Cases of repetition and restrictions	1.4	6.1	S-CP1-9
	Probability			
	Computing probability	1.6	6.2	S-CP1-9
	Exclusive and independent events	1.6	6.2	S-CP1-9
	Tables of outcomes, Venn diagrams & tree diagrams	1.6	6.2	S-CP1-6
	Conditions of probabilities	1.6	6.2	S-CP6-9
Statistics	**Binomial, Poisson, & normal distribution**			
	Concepts pf binomial & Poisson distributions	-	7.1	-
	Mean & variance of distributions	-	7.1	-
	Problem solving involving distributions	-	7.1	-
	Additive property of Poisson distribution	-	7.1	-
	Concepts of normal distributions	1.3	7.2	SM-D1-7
	Finding P-value	-	7.2	SM-D1-7
	Using symmetry of normal distributions	1.3	7.2	SM-D1-7
	Relationships between mean, μ and δ	1.3	7.2	SM-D1-7
	Normal approximation to binomial & Poisson distributions	-	7.2	-
	Sampling			
	Concepts of population and sample	1.5, 1.2	8.1	S-IC1-6
	Random, stratified, systematic & quota samples	1.5	8.1	S-IC1-6
	Sampling methods	1.5	8.1	S-IC1-6
	Distribution of sample means from normal population	1.5	8.1	S-IC1-6
	Use of Central Limit Theorem	-	8.1	S-IC5
	Calculate un-bias estimate	-	8.1	S-IC1-6
	Hypothesis Testing			
	Concept of null & alternative hypothesis	-	8.2	-
	Testing for population mean	-	8.2	-
	Use of T-test	-	8.2	-
	Correlation and Regressions			
	Presenting data using histograms, dot plots, box plots	1.1, 1.2	-	S-ID6-9
	Concepts of scatter diagram, correlation coefficient & linear regression	1.2	9.1	S-ID6-9
	Correlation coefficient of the equation of least square regression line	1.2	9.1	S-ID6-9
	Concepts of interpolation and extrapolations	1.2	9.1	S-ID6-9
	Use of square, reciprocal or logarithmic transformation to achieve linearity	-	9.1	S-ID6-9

Example of wording in organization

Indonesia: Statistics Rules*
1.2 Calculating measure of central tendency, measurement of data location and measurement of dispersion data, and its interpretation.**

Singapore: Correlation and Regression*
9.1 Calculation and interpretation of the product moment correlation coefficient and of the equation of the least squares regression line.**

United States: Interpretation Categorical & Quantities Data*
S-ID8 Compute and interpret the correlation coefficient of a linear fit.**

Similarities and Differences

- Singapore Syllabus: Covers a higher level of statistics compare to Indonesia and CCSSM such as Hypothesis Testing, Binomial and Poisson Distribution, Central limit Theorem. Indonesia does not have, CCSSM has only the Normal Distribution.
- Indonesia & CCSSM: Focuses on summarizing and interpreting data using box plots and histograms. Singapore has a more mathematical approach.
- Singapore: Treats permutations and combinations with specific formulas. Indonesia: Only mentions the basic concepts of permutations and combinations.
- CCSSM: Labels some permutations and combinations ideas with (+) which means students should only study those concepts in order to take advanced classes.
- Both Singapore and CCSSM provide guidelines for teachers by giving formulas and simple examples. Indonesia has less information to assist teachers.
- Singapore: Requires students to master a higher level of statistics and probability. The CCSSM: Not all students are required to participate in optional standards. Indonesia: Focuses on students' understanding the basic concepts of statistics and probability.

Conclusions

- The three documents have the same vision but differ in supporting students' level of understanding probability and statistics content.
- Singapore syllabus treatment of statistics and probability includes a broad, advanced and sophisticated levels of statistics and probability conceptual categories.
- The CCSSM has high expectations of learning statistic and probability, but gives options for teaching some of the more sophisticated concepts.
- the Indonesian Curriculum has the most limited presentation of required concepts for teaching statistics and probability and the most limited amount of support for teachers.

Recommendations

◆ The consistency of both the Singapore syllabus and the CCSSM should be adapted in order to guide both teachers and students.

◆ The Indonesian curriculum system could implement how CCSSM builds students' conceptual understanding of mathematical thinking.

◆ The Indonesian curriculum should look at how the Singapore Syllabus offers statistics and probability beginning at a young age, and continues building on the concepts through secondary school.

◆ The CCSSM should consider probability and statistics content for a wider variety of students, not just those who are college bound.

References

Ministry of Education Indonesia. (2013). *Ministry of Education Indonesia: Mathematics Curriculum 2013.*

Ministry of Education Singapore. (2014). Mathematics higher 2 (syllabus 9740). *Ministry of Education Singapore*. Retrieved from http://www.moe.gov.sg/education/ syllabuses/sciences/files/ordinary-and-normal-academic-level-maths-2013.pdf

National Governors Association Center for Best Practices & Council of Chief State School Officers. (2010). *Common Core State Standards for Mathematics.* National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C. Retrieved from www.corestandards.org