

# **Lack of Focus in the Mathematics Curriculum: A Symptom or a Cause**

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# General Topic Trace Mapping

- Part of TIMSS Data Collection Procedure for Curriculum Analysis
- Each country reported when, how long each topic was included in the K-12 curriculum
  - When topic was introduced
  - When topic was focused
- International Grade Placement Index
  - “Average” or composite curriculum

# Methodology

- **Instruments are developed based on**
  - **the IEA Tripartite Model of Curriculum**
    - **Intended curriculum**
    - **Implemented curriculum**
    - **Attained curriculum**
  - **the TIMSS Curriculum Frameworks**
    - **Comprehensive list of content topics in**
      - **Mathematics**
      - **Science**

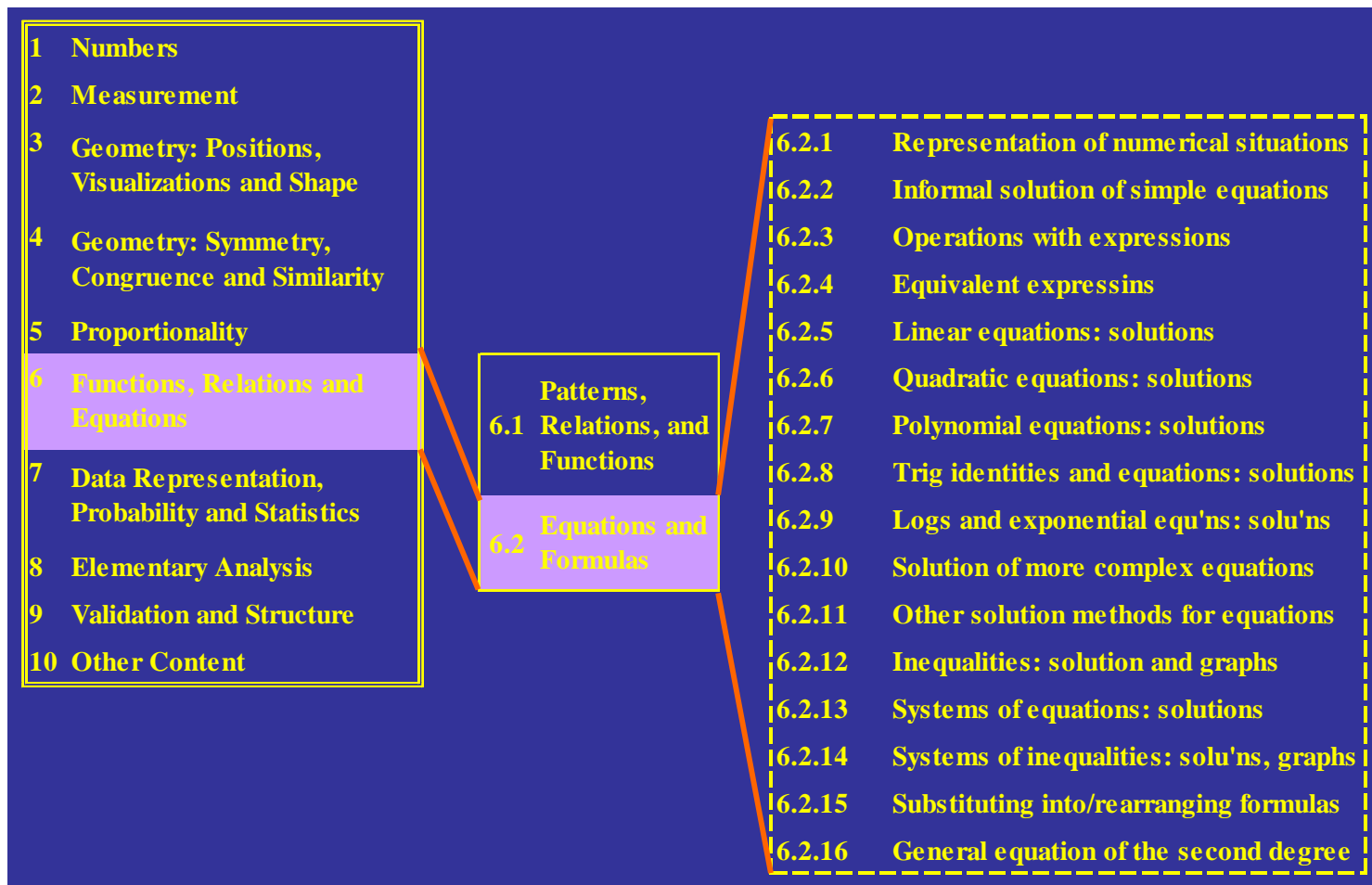
# IEA Tripartite Model of Curriculum

*Attained curriculum:*  
pupil knowledge, skills,  
& attitudes

*Implemented curriculum:* goals, strategies, &  
practices carried out in classrooms

*Intended Curriculum:* system-wide policies, plans,  
& goals

# TIMSS Mathematics Framework - An Example



# Measuring the Intended Curriculum - Mapping Curriculum Topics

- **Used in TIMSS 1995**
- **More than 40 countries participated in the International Curriculum Analysis Study**
- **Each jurisdiction reported when and how long each topic was included in the K-12 curriculum**
  - **When topic was introduced**
  - **When topic was focused**
- **For PROM/SE, Mathematics and Science Topics will be linked to the TIMSS Extended Curriculum Frameworks**

# Measuring the Intended Curriculum - Examples

- **Examples of Summaries and Displays**
  - **Topic Trace Map** - displays the coverage (covered and focused) of topics across ages or grades of different jurisdictions
  - **Number of Topics Intended at different grades** - summarizes the number of topics by different jurisdictions
  - **Curriculum Standard** - a composite display of coverage of topics as specified in the curriculum guides of multiple jurisdictions

# Intended Curriculum - Example - Two Topic Trace Maps from TIMSS-95 Int'l Curriculum Analysis

These data are typical topic trace maps for a sample of countries selected to show representative diversity.

Congruence and Similarity												
Grades												
	1	2	3	4	5	6	7	8	9	10	11	12
Argentina									+			
Canada	-	-	-	-	-	-	-	-	-	-	-	-
Cyprus							+		-	+		
Denmark							+	-	-	+	+	-
Hungary			-	-	-	-	-	+	-	-	+	-
Iceland								+	-	-	+	-
Iran						+	-	-	+	-	-	
Ireland								+	+	+		-
Japan					+	+		+	-			
New Zealand								-	-	-	-	-
Spain						+	+					
Tunisia								+	-	-	-	-
USA						-	-	+	-	+		

Equations and Formulas												
Grades												
	1	2	3	4	5	6	7	8	9	10	11	12
Argentina									+	+	-	
Canada				-	-	-	-	+	+	+	+	-
Cyprus								+	+	+	+	+
Denmark							+	+	+	+	+	-
Hungary					+	-	-	+	-	-	+	
Iceland								-	-	+	-	+
Iran								+	-	-	-	+
Ireland								-	+	+	+	+
Japan					+	+	+	+	+	+	+	+
New Zealand								-	-	+	+	+
Spain								-	-	-	-	-
Tunisia									-	+	+	+
USA								+	+	+	-	+

# Instructional Content Constructs

## ❖ Curricular Coherence

- ▣ Curricular Structure

## ❖ Curricular Focus

- ▣ Exposure Time (OTL)

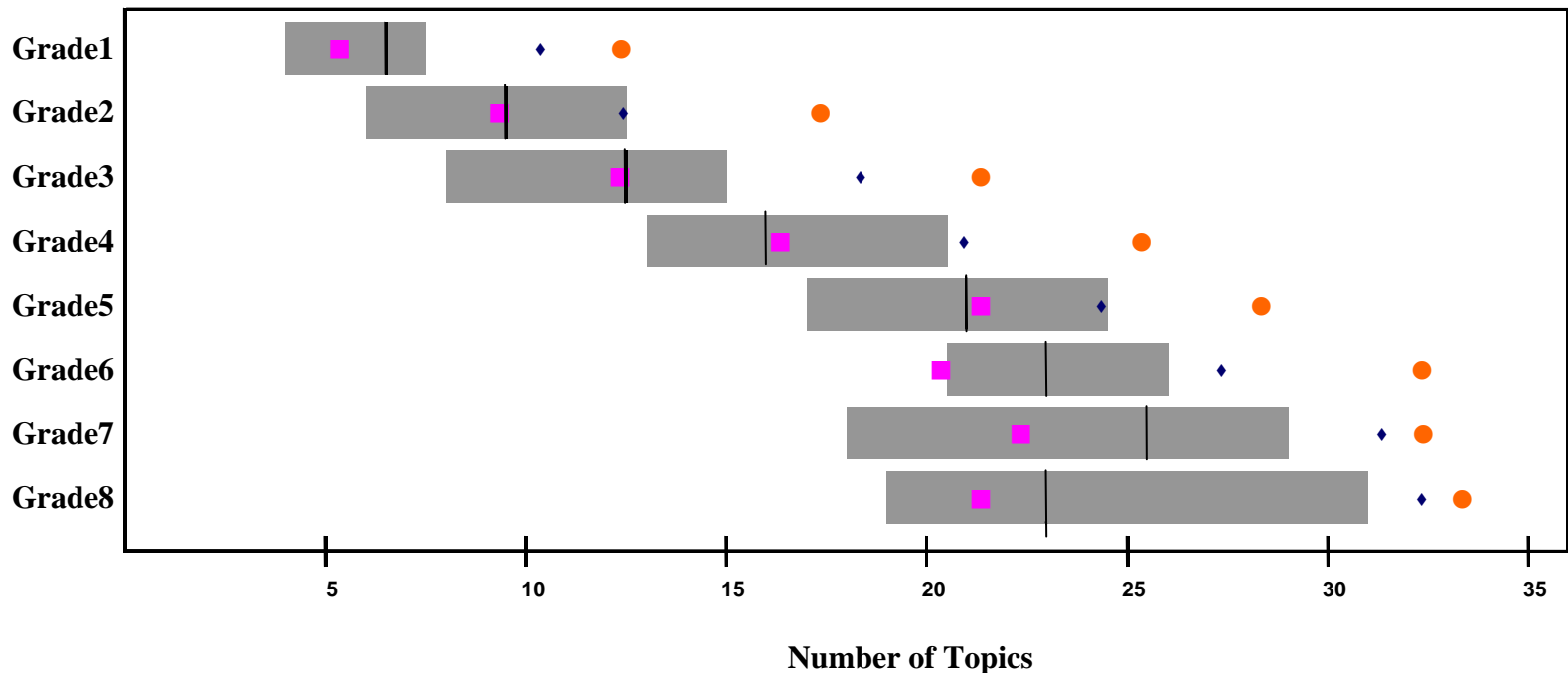
## ❖ Curricular Rigor

- ▣ Level of Cognitive Complexity

# Intended Curriculum - Example - Number of Mathematics Topics Intended by Jurisdictions

The number of topics to be covered exceeded the 75th percentile internationally for grades 1-8. The gray bars show how many mathematics topics were intended to be covered at each grade in the TIMSS countries. The bars extend from the 25th percentile to the 75th percentile among countries. The black line indicates the median number of topics at each grade. The U.S., 7 districts composite, and the Top Achieving TIMSS Countries are marked individually.

- = U.S.
- ◆ = 7 Districts Composite
- = Top Achieving Countries' Composite

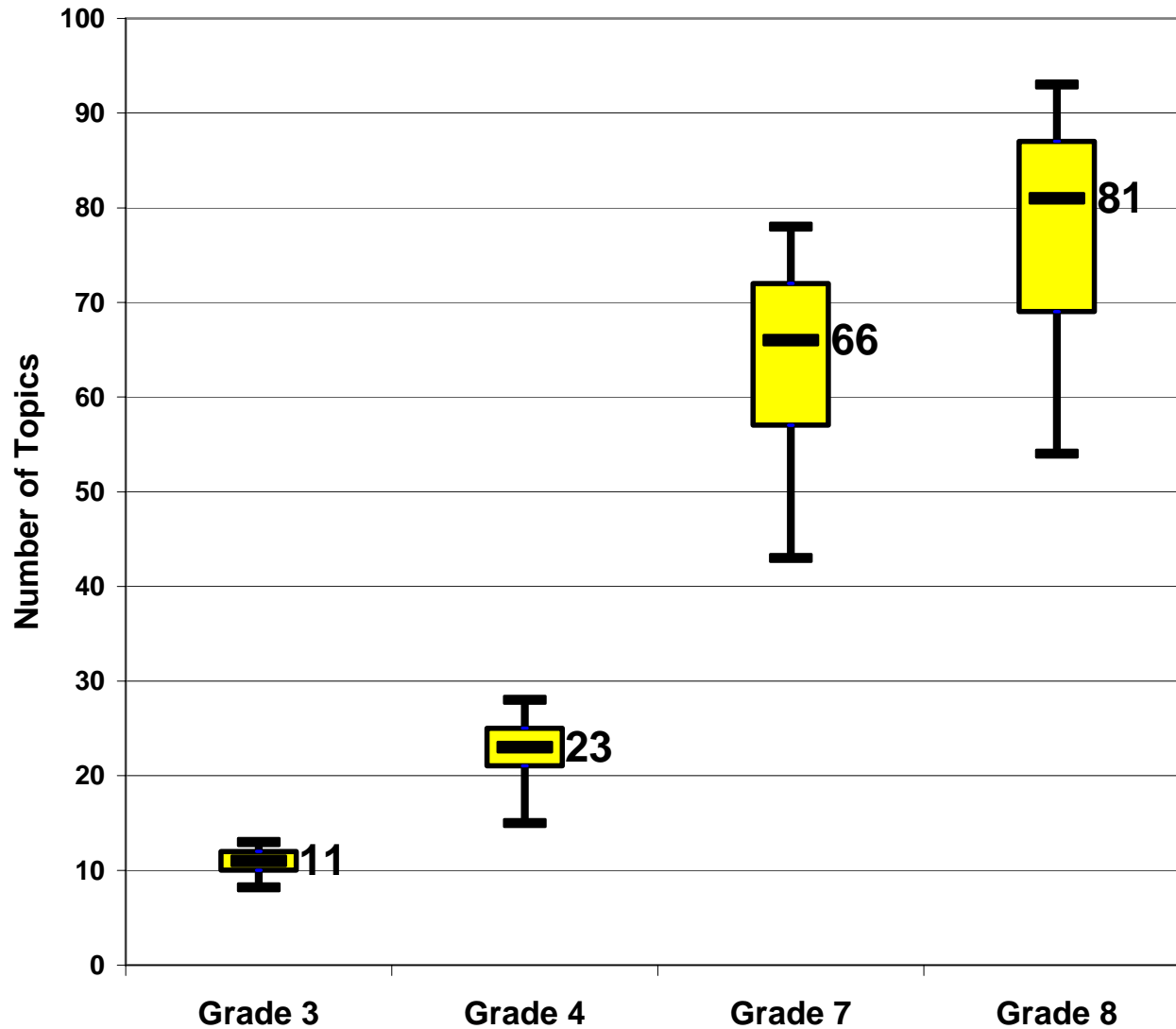


# High Achieving Countries' Mathematics Standards

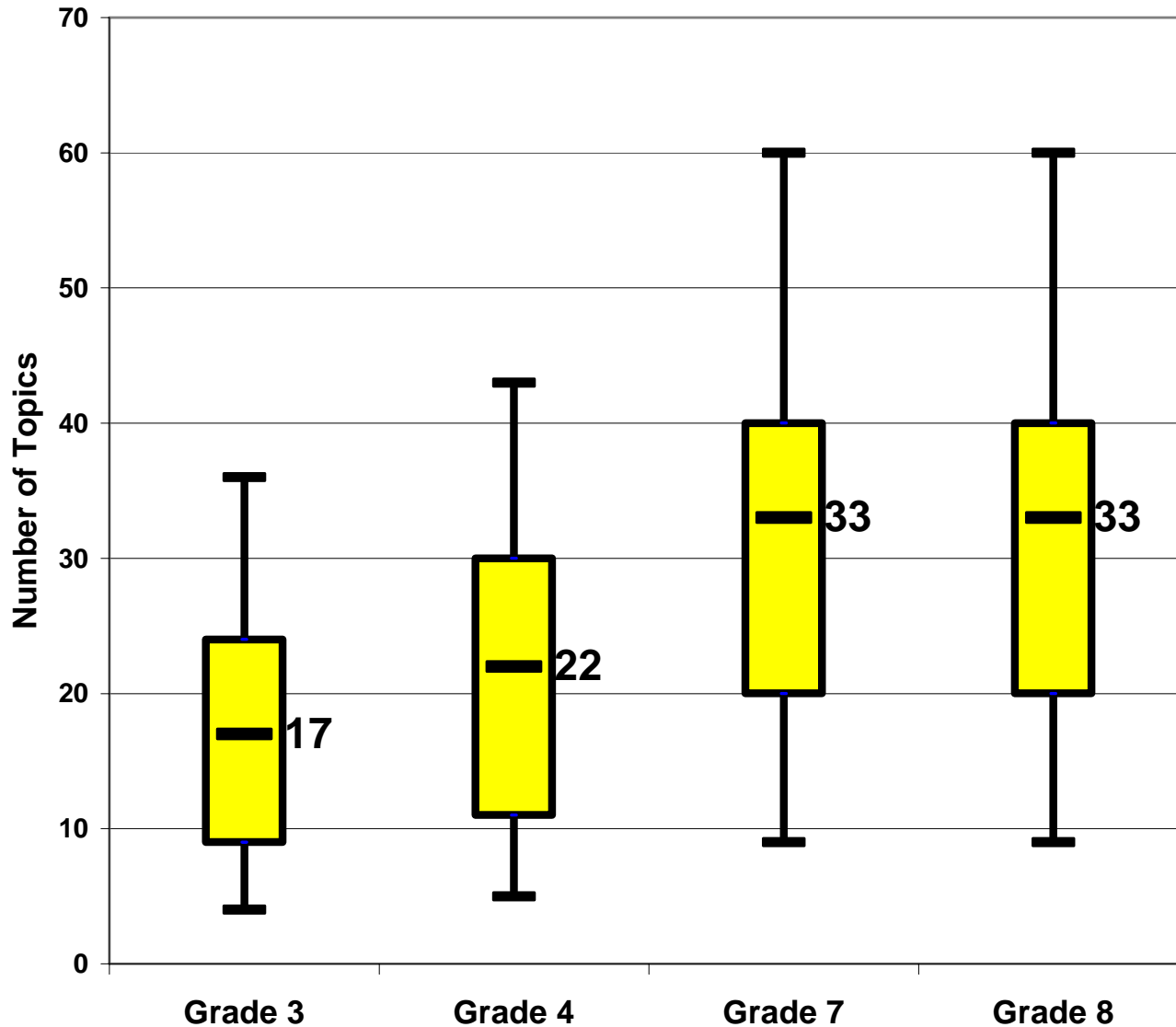
Mathematics Topics								
Topic	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Whole Number Meaning	●	●	●	●	●			
Whole Number Operations	●	●	●	●	●			
Measurement Units	●	●	●	●	●	●	●	
Common Fractions			●	●	●	●		
Equations & Formulas			●	●	●	●	●	●
Data Representation & Analysis			●	●	●	●		●
2-D Geometry: Basics			●	●	●	●	●	●
Polygons & Circles				●	●	●	●	●
Perimeter, Area & Volume				●	●	●	●	●
Rounding & Significant Figures				●	●			
Estimating Computations				●	●	●		
Properties of Whole Number Operations				●	●			
Estimating Quantity & Size				●	●			
Decimal Fractions				●	●	●		
Relationship of Common & Decimal Fractions				●	●	●		
Properties of Common & Decimal Fractions					●	●		
Percentages					●	●		
Proportionality Concepts					●	●	●	●
Proportionality Problems					●	●	●	●
2-D Coordinate Geometry					●	●	●	●
Geometry: Transformations						●	●	●
Negative Numbers, Integers & Their Properties						●	●	
Number Theory							●	●
Exponents, Roots & Radicals							●	●
Exponents & Orders of Magnitude							●	●
Measurement Estimation & Errors							●	
Constructions w/ Straightedge & Compass							●	●
3-D Geometry							●	●
Congruence & Similarity								●
Rational Numbers & Their Properties								●
Patterns, Relations & Functions								●
Slope & Trigonometry								●



# Number of Topics Aligned with Ideal Scenario



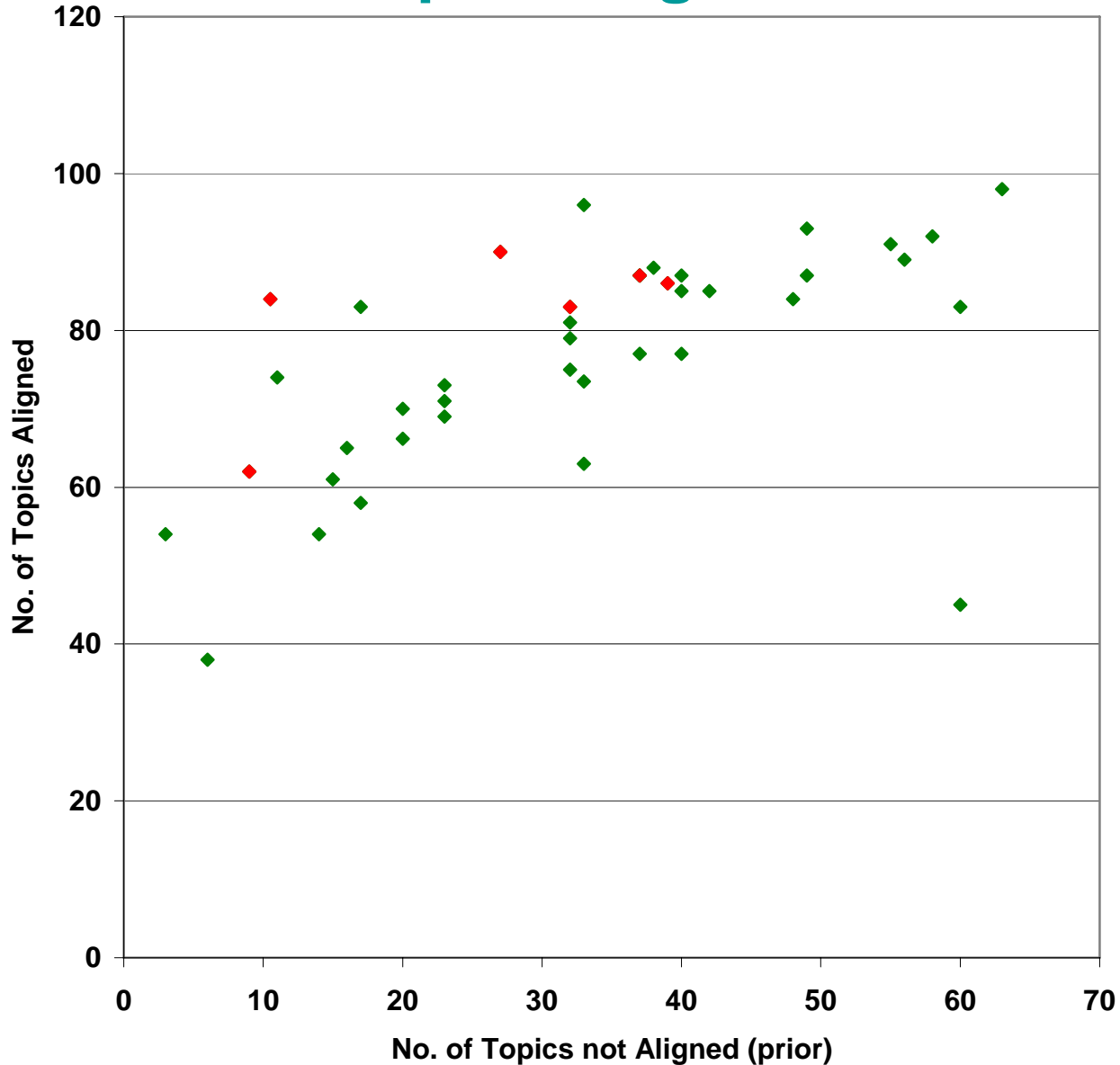
# Number of Topics Not Aligned (Introduced Prior to Ideal Scenario)



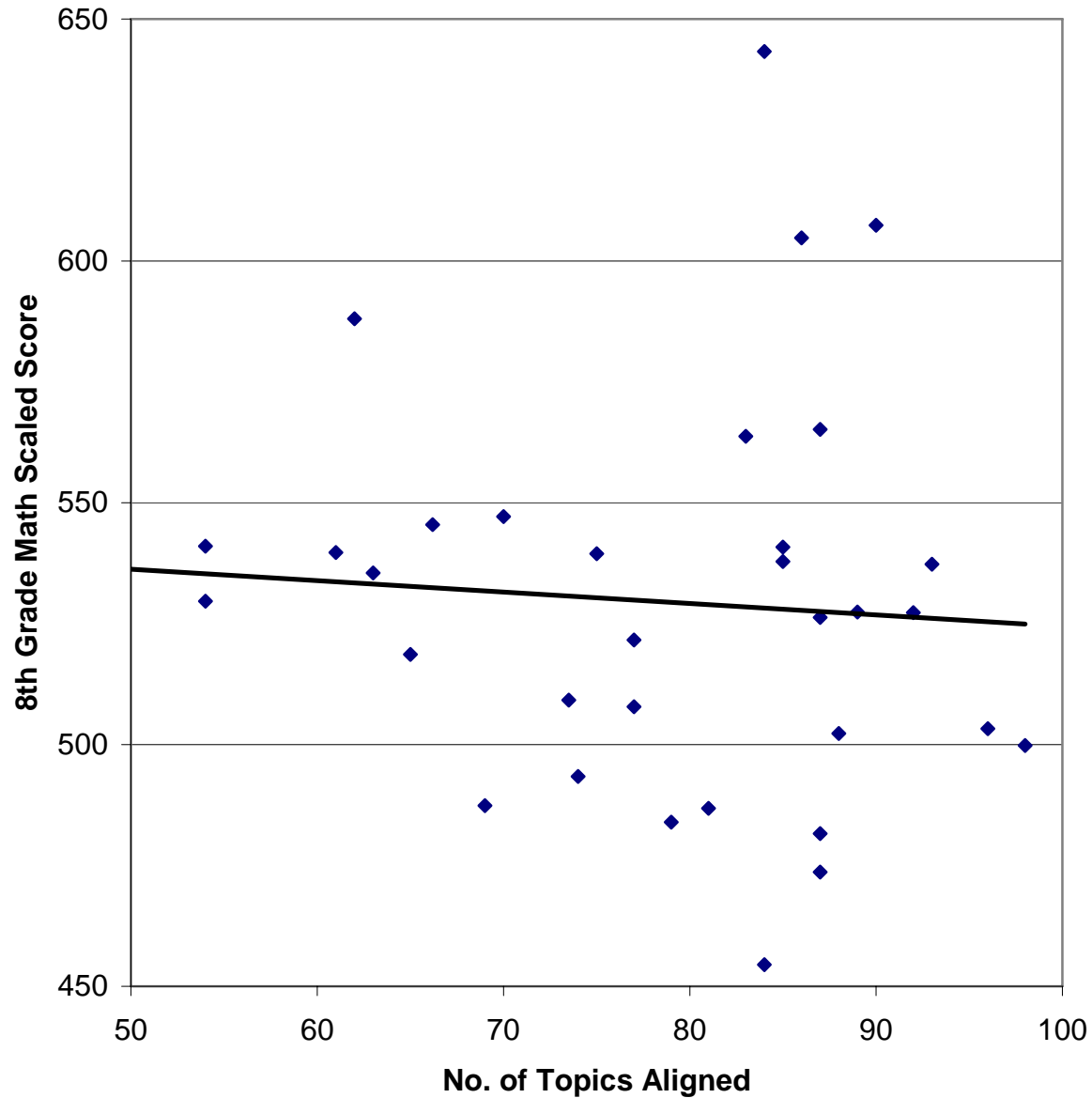
# Alignment with Ideal Scenario

<b>Country</b>	<b><i>Total Number of Topics in Curriculum</i></b>	<b><i>Number of Topics Not Aligned (Introduced Prior to Ideal Scenario)</i></b>	<b><i>Number of Topics Aligned with Ideal Scenario</i></b>	<b><i>Number of Topics Not Aligned (Introduced Following the Ideal Scenario)</i></b>
<b>Argentina</b>	<b>81</b>	<b>3</b>	<b>54</b>	<b>24</b>
<b>Australia</b>	<b>136</b>	<b>32</b>	<b>75</b>	<b>29</b>
<b>Belgium (Fl)</b>	<b>155</b>	<b>37</b>	<b>87</b>	<b>31</b>
<b>Canada</b>	<b>181</b>	<b>58</b>	<b>92</b>	<b>31</b>
<b>Cyprus</b>	<b>162</b>	<b>49</b>	<b>87</b>	<b>26</b>
<b>Czech Republic</b>	<b>119</b>	<b>32</b>	<b>83</b>	<b>4</b>
<b>France</b>	<b>156</b>	<b>40</b>	<b>85</b>	<b>31</b>
<b>Germany</b>	<b>117</b>	<b>33</b>	<b>74</b>	<b>10</b>
<b>Hong Kong</b>	<b>79</b>	<b>9</b>	<b>62</b>	<b>8</b>
<b>Hungary</b>	<b>158</b>	<b>49</b>	<b>93</b>	<b>16</b>
<b>Iceland</b>	<b>137</b>	<b>32</b>	<b>81</b>	<b>24</b>
<b>Japan</b>	<b>128</b>	<b>39</b>	<b>86</b>	<b>3</b>
<b>Korea</b>	<b>125</b>	<b>27</b>	<b>90</b>	<b>8</b>
<b>Netherlands</b>	<b>97</b>	<b>14</b>	<b>54</b>	<b>29</b>
<b>Norway</b>	<b>159</b>	<b>33</b>	<b>96</b>	<b>30</b>
<b>Portugal</b>	<b>144</b>	<b>48</b>	<b>84</b>	<b>12</b>
<b>Singapore</b>	<b>115</b>	<b>11</b>	<b>84</b>	<b>21</b>
<b>Spain</b>	<b>109</b>	<b>23</b>	<b>69</b>	<b>17</b>
<b>USA</b>	<b>186</b>	<b>63</b>	<b>98</b>	<b>25</b>

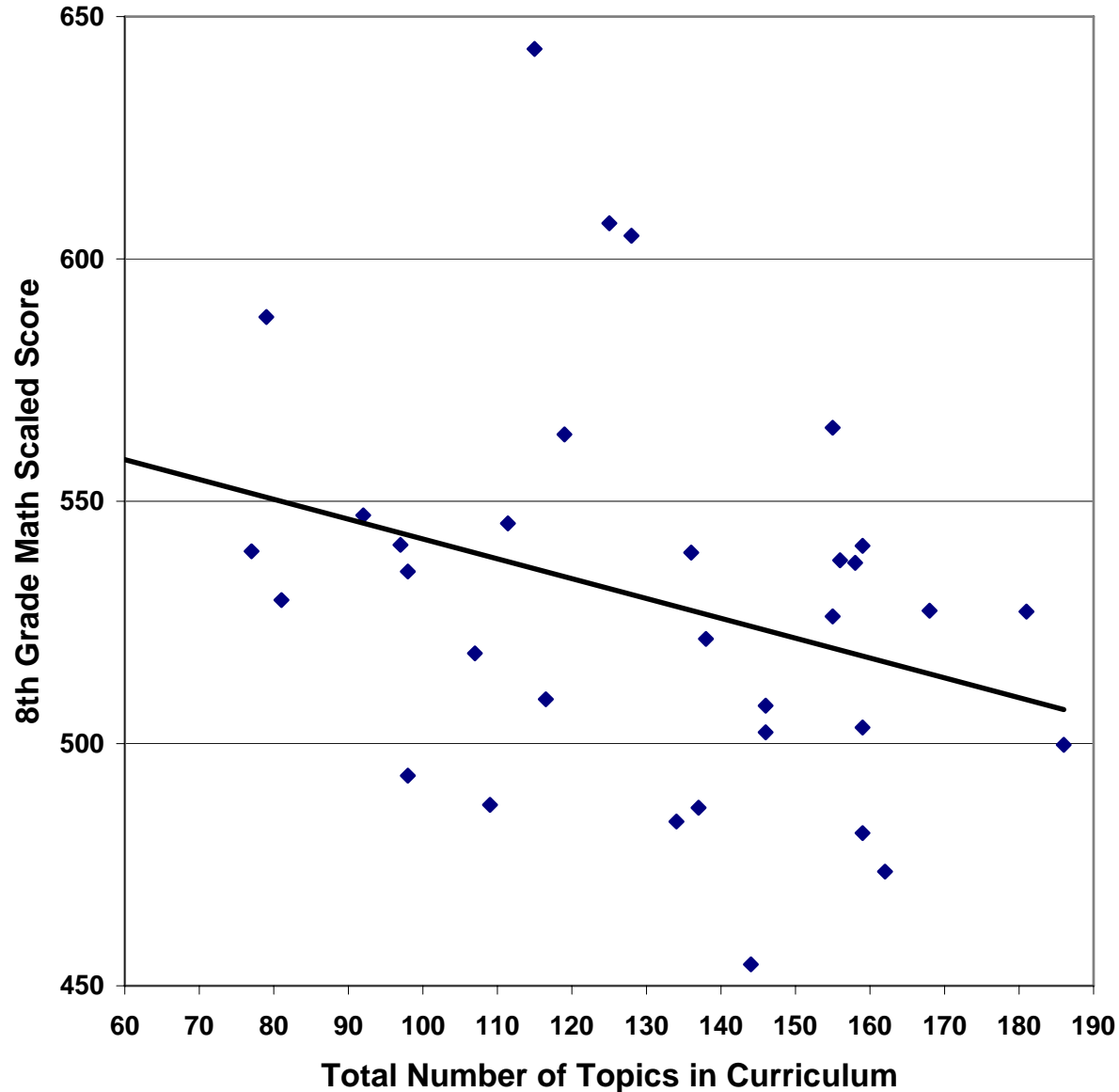
# Number of Topics not Aligned (prior) vs. Number of Topics Aligned with Ideal Scenario



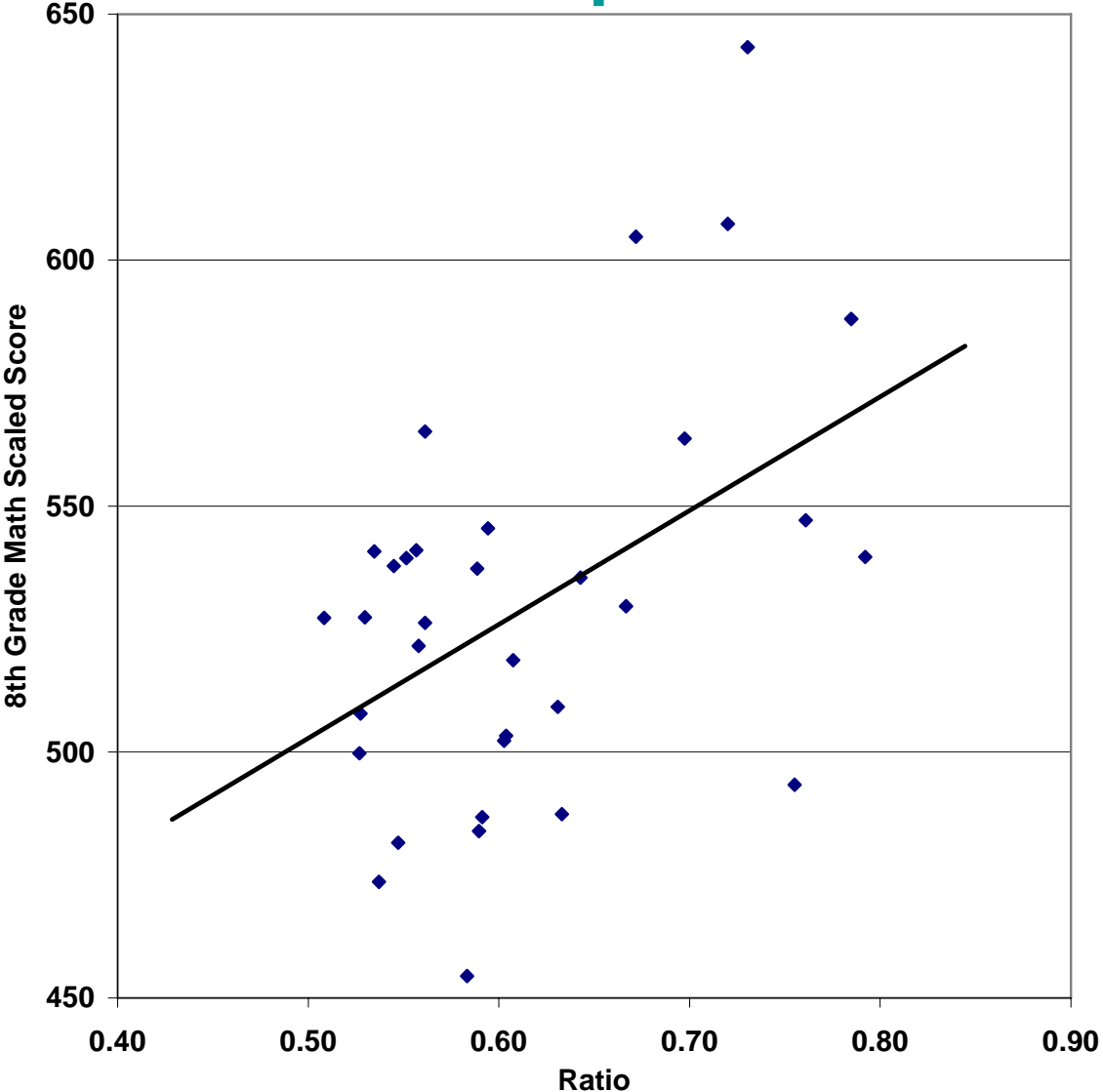
# 8th Grade Math Scaled Score vs. No. of Topics Aligned



# 8th Grade Math Scaled Score vs. Total No. of Topics in Curriculum



# 8th Grade Math Scaled Score vs. the Ratio of No. of Aligned topics to the Total No. of Topics in Curriculum



# Table 1: Regression Analyses relating Achievement to Coherence and Focus Measure

<i>Model</i>	<i>Grade 3</i>	<i>Grade 4</i>	<i>Grade 7</i>	<i>Grade 8</i>
<i>Predictor</i>	Estimate ( StdError, p )	Estimate ( StdError, p )	Estimate ( StdError, p )	Estimate ( StdError, p )
<i>Number of Topics Aligned with Ideal Scenario</i>	<b>9.94</b> ( 7.38 , 0.196 )	<b>7.48</b> ( 4.04 , 0.081 )	<b>3.57</b> ( 1.48 , 0.023 )	<b>2.83</b> ( 1.12 , 0.017 )
<i>Total Number of Topics in Curriculum</i>	<b>-2.42</b> ( 1.13 , 0.047 )	<b>-2.58</b> ( 1.05 , 0.025 )	<b>-1.64</b> ( 0.57 , 0.008 )	<b>-1.39</b> ( 0.45 , 0.004 )
<i>Model Fit</i>				
<i>R-Square</i>	<b>0.2191</b>	<b>0.2574</b>	<b>0.2205</b>	<b>0.2490</b>
<i>Residual Mean Sq.</i>	<b>1652.9</b>	<b>1489.0</b>	<b>1476.0</b>	<b>1331.4</b>
<i>p&lt;</i>	0.1222	0.0687	0.0270	0.0136
<i>No. of Countries</i>	20	21	32	33
<i>Standardized Coefficient</i>				
<i>Number of Topics Aligned with Ideal Scenario</i>	<b>0.4374</b>	<b>0.7331</b>	<b>0.8481</b>	<b>0.8240</b>
<i>Total Number of Topics in Curriculum</i>	<b>-0.6969</b>	<b>-0.9703</b>	<b>-1.0044</b>	<b>-1.0204</b>

## Table 2: Regression Analyses relating Achievement to Coherence and Specific Focus Measure

<i>Model</i>	<i>Grade 3</i>	<i>Grade 4</i>	<i>Grade 7</i>	<i>Grade 8</i>
<i>Predictor</i>	Estimate ( StdError, p )	Estimate ( StdError, p )	Estimate ( StdError, p )	Estimate ( StdError, p )
<i>Number of Topics Aligned with Ideal Scenario</i>	<b>7.52</b> ( 6.57 , 0.268 )	<b>4.91</b> ( 3.19 , 0.141 )	<b>1.84</b> ( 1.06 , 0.094 )	<b>1.66</b> ( 0.87 , 0.068 )
<i>Number of Topics Not Aligned (Introduced Prior to Ideal Scenario)</i>	<b>-2.42</b> ( 1.13 , 0.047 )	<b>-2.58</b> ( 1.05 , 0.025 )	<b>-1.79</b> ( 0.71 , 0.017 )	<b>-1.97</b> ( 0.70 , 0.009 )
<i>Model Fit</i>				
<i>R-Square</i>	<b>0.2191</b>	<b>0.2574</b>	<b>0.1826</b>	<b>0.2122</b>
<i>Residual Mean Sq.</i>	<b>1652.9</b>	<b>1489.0</b>	<b>1547.9</b>	<b>1396.6</b>
<i>p&lt;</i>	0.1222	0.0687	0.0538	0.0279
<i>No. of Countries</i>	20	21	32	33
<i>Standardized Coefficient</i>				
<i>Number of Topics Aligned with Ideal Scenario</i>	<b>0.3309</b>	<b>0.4807</b>	<b>0.4382</b>	<b>0.4825</b>
<i>Number of Topics Not Aligned (Introduced Prior to Ideal Scenario)</i>	<b>-0.6209</b>	<b>-0.7646</b>	<b>-0.6405</b>	<b>-0.7151</b>