Completing TIMSS and PIRLS 2011

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Progress Since Last General Assembly…

December 11, 2012

- **TIMSS and PIRLS 2011 International Results released via web video**
  - **90,000 visits to TIMSS & PIRLS International Study Center website on release day**
  - **300 news articles in major media outlets around the world**

TIMSS 2011
International Results

TIMSS 2011 International Results in Mathematics and Science

Fourth and Eighth Grades

- Assessed 600,000 students in 63 countries and 14 states or regions
- Mathematics fourth and eighth grades – top performers included Singapore, Korea, Chinese Taipei, Hong Kong SAR, and Japan
- Science fourth and eighth grades – top performers included Singapore, Korea, Chinese Taipei, Japan, Finland, the Russian Federation

PIRLS 2011 Achievement Results

PIRLS 2011 International Results in Reading

Fourth Grade

- Assessed 300,000 students in 49 countries and 9 states or regions
- Top performing countries were Hong Kong SAR, Russian Federation, Finland, and Singapore

TIMSS 2011 Encyclopedia: Grades 4 and 8

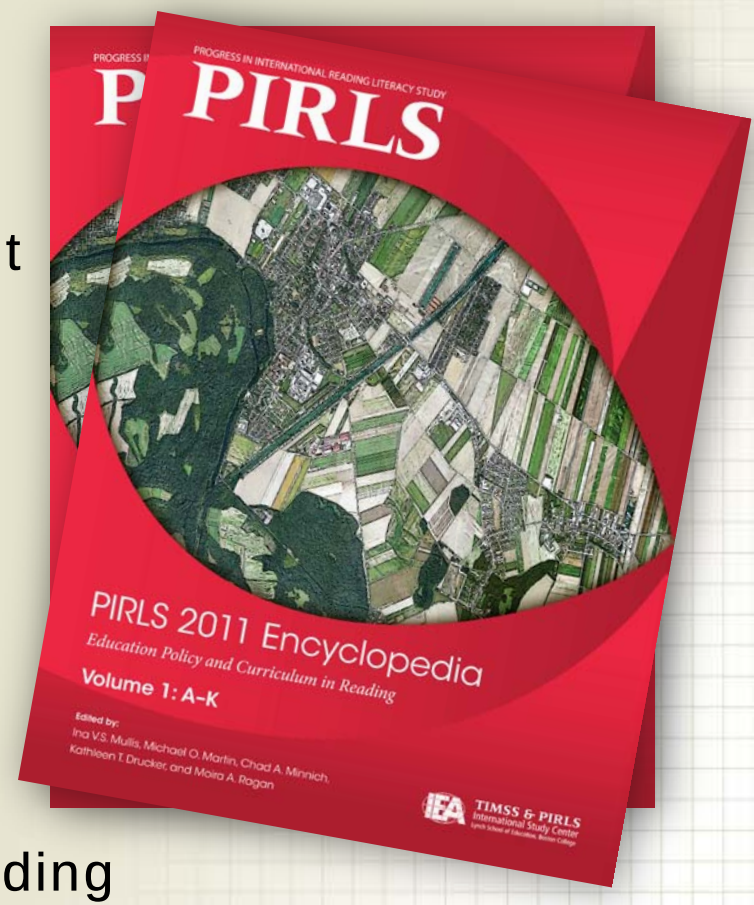
69 individual country chapters

- Overview of education systems
- Mathematics curriculum
- Science curriculum
- Instruction in mathematics and science
- Teachers and teacher education
- Monitoring student progress in mathematics and science
- Impact of TIMSS

PIRLS 2011 Encyclopedia: Grade 4

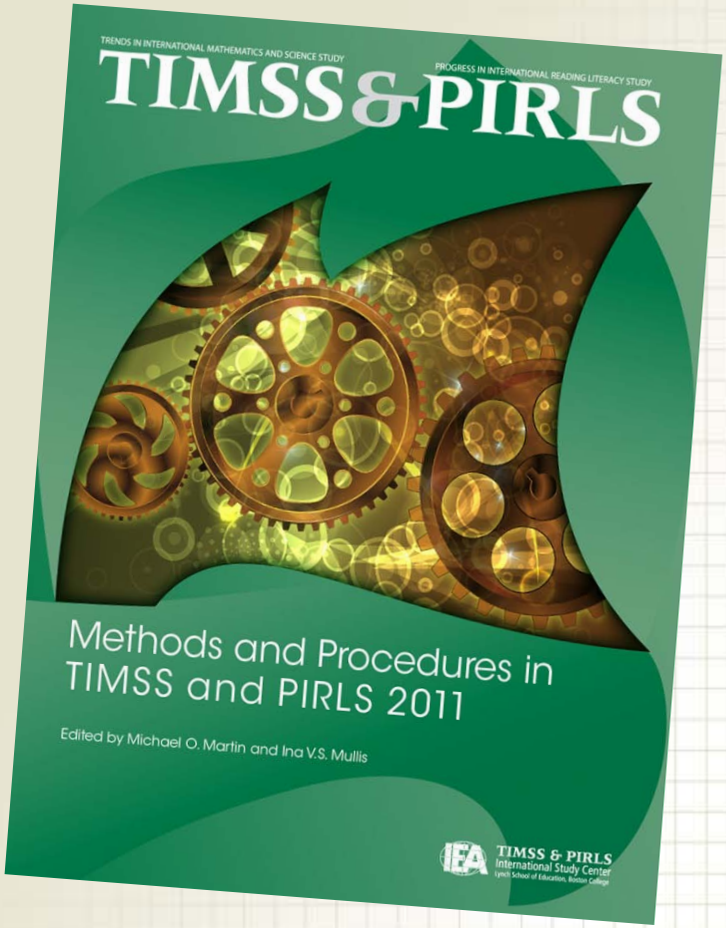
56 individual country chapters

- Language and literacy environment
- Overview of education systems
- Language/reading curriculum
- Reading instruction
- Students with reading difficulties
- Teachers and teacher education
- Monitoring student progress in reading
- Impact of PIRLS



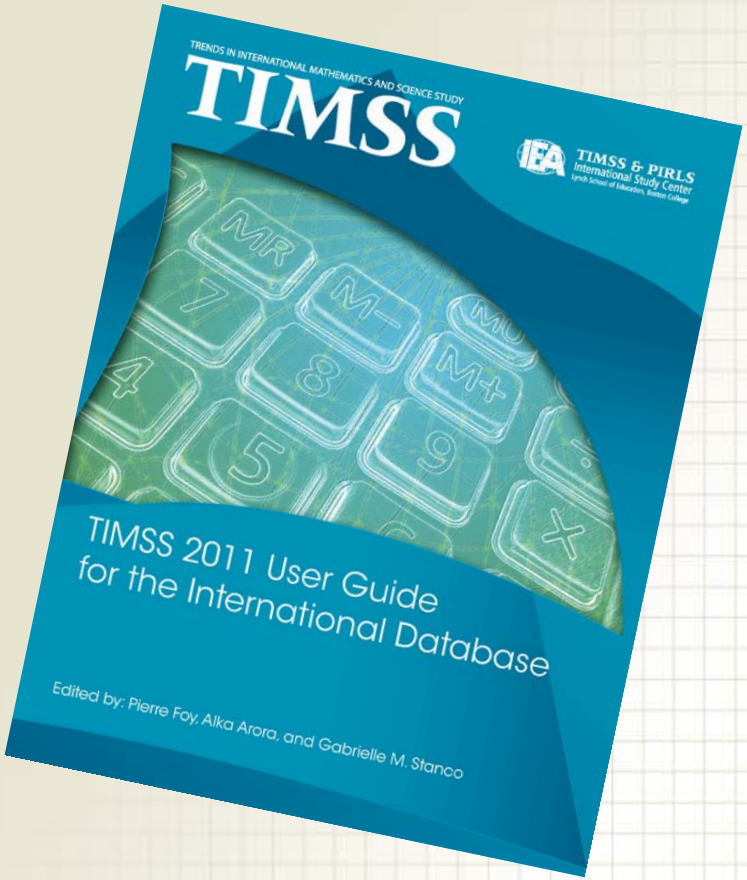
Methods and Procedures in TIMSS and PIRLS 2011 - Online

- Assessment framework and instrument development
- Sample design and implementation
- Translation and translation verification
- Operations and quality assurance
- Creating the international databases
- Creating and interpreting the achievement scales
- Creating and interpreting the context questionnaire scales



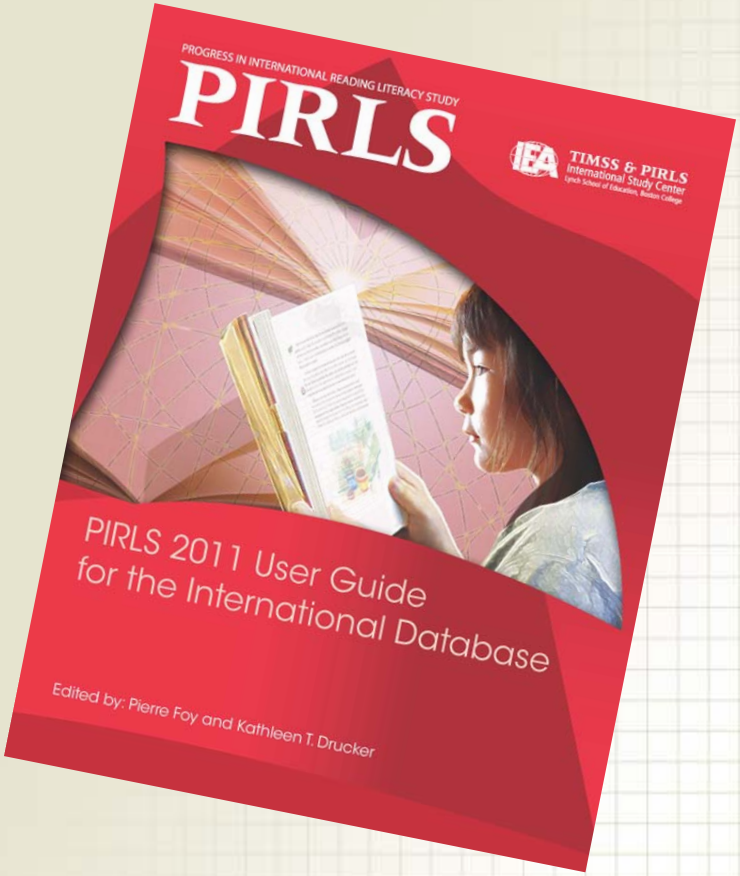
TIMSS 2011 International Database – January 17, 2013

- International Data
  - SAS and SPSS formats
- User Guide
- Released items with percent correct statistics
  - Mathematics
  - Science



PIRLS 2011 International Database – February 7, 2013

- International Data
  - SAS and SPSS formats
- User Guide
- Released items with percent correct statistics



TIMSS and PIRLS Together in 2011 – Capitalizing on the Opportunity

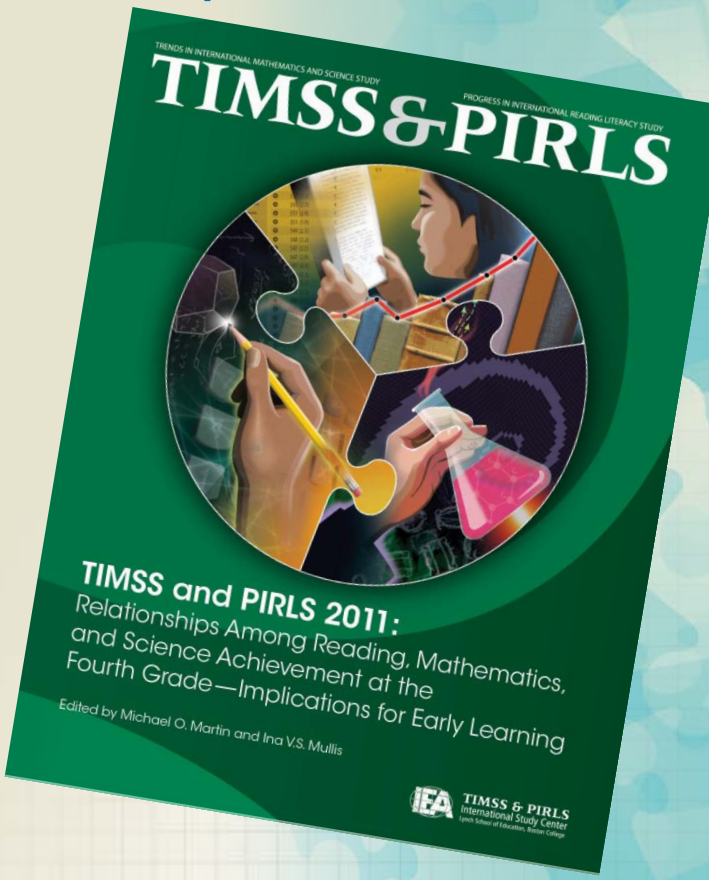
- Countries administered both TIMSS and PIRLS to the **same** students at fourth grade
- 34 countries and 3 benchmarking entities
- Comprehensive achievement data in three fundamental curricular areas
  - Reading, mathematics, science
- Array of background questionnaire data
  - Home, school, classroom contexts for learning

TIMSS and PIRLS Together in 2011 – Capitalizing on the Opportunity

Data on same fourth grade students in three core subject areas

- Possible to investigate important home and school characteristics that influence early learning
  - While controlling for extraneous factors
- Possible to apply a variety of modeling techniques to examine interrelationships

TIMSS and PIRLS 2011: Relationships among Reading, Mathematics, and Science Achievement at the Fourth Grade—Implications for Early Learning

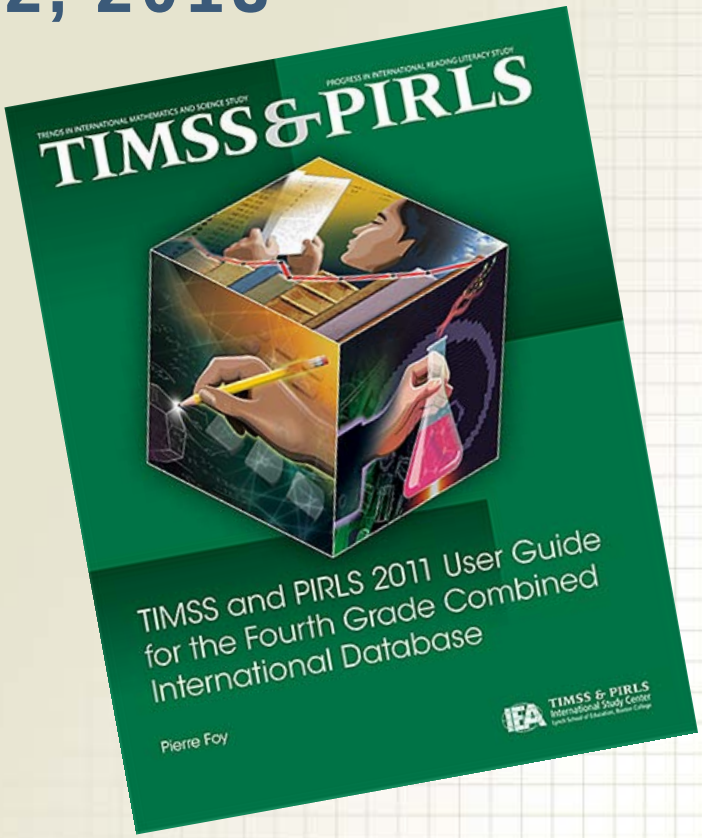


Edited volume of four chapters

- Profiles of achievement across reading, mathematics, and science
- Impact of reading ability on TIMSS mathematics and science achievement
- Effective schools in reading, mathematics, and science
- Effects of home background on student achievement

TIMSS and PIRLS 2011 Fourth Grade Combined International Database – September 12, 2013

- Special international database including only fourth grade students assessed in all three subjects
- Primary value - countries conduct own in-depth research for school improvement



Profiles of Achievement Across Reading, Mathematics, and Science Achievement at the Fourth Grade

Ina V.S. Mullis

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

Profiles of Achievement

Are primary schools around the world providing students a solid foundation in core subjects – reading, mathematics, and science?

- Percentages of students reaching the TIMSS and PIRLS International Benchmarks
- **High** International Benchmark – proficient or competent level of achievement in each subject
- **Low** International Benchmark – basic level of understandings and skills in each subject

High International Benchmarks Fourth Grade

Reading: Make and support inferences based on dense text and visual information; make generalizations across text

Mathematics: Solve a variety of problems involving place value, patterns, geometry, and tables and graphs

Science: Explain phenomena involving ecosystems and organisms, properties of matter, forces and motion, the solar system, and scientific inquiry

Low International Benchmarks Fourth Grade

Reading: Locate and retrieve explicitly stated information

Mathematics: Basic mathematical knowledge of addition and subtraction, geometric shapes, simple bar graphs and tables

Science: Elementary knowledge of life, physical, and earth sciences, e.g., human health, characteristics of animals, physical properties of matter, simple diagrams

Strength

High Benchmark

Mathematics – 78%

Science – 68%

Reading – 62%

High Benchmark All Three - 54%

- Only country >50%

Low Benchmark All Three - 95%

Exhibit 1.3: Singapore

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	54 (1.9)
Reading	62 (1.8)
Mathematics	78 (1.4)
Science	68 (1.7)

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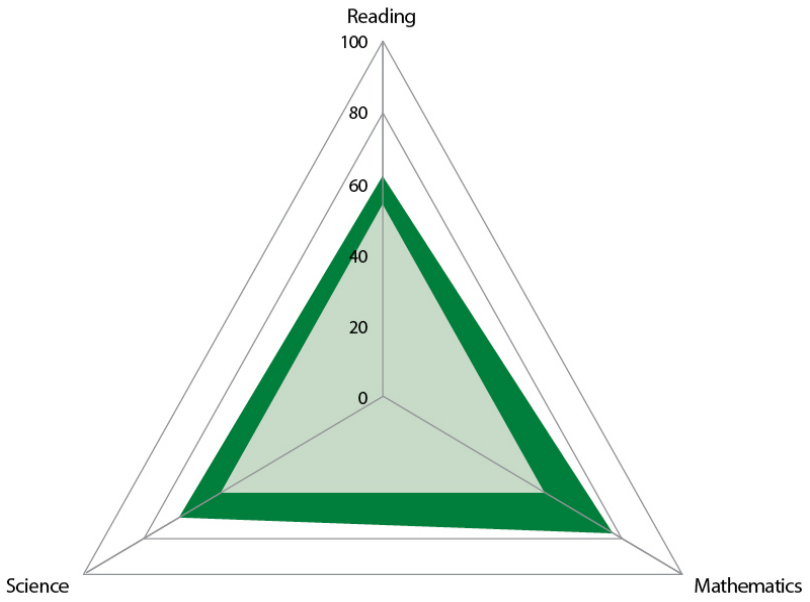

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	95 (0.6)
Reading	97 (0.4)
Mathematics	99 (0.2)
Science	97 (0.4)

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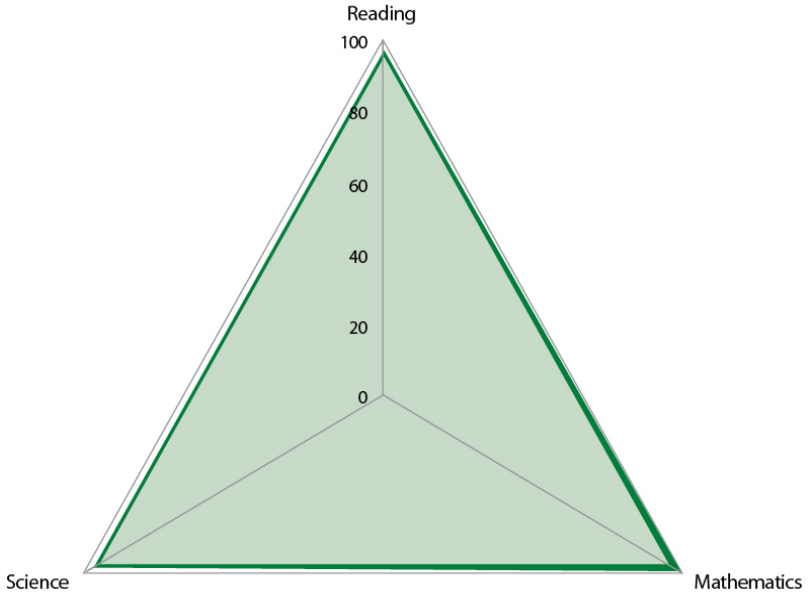

Strength

High Benchmark

Mathematics – 82%

Reading – 67%

Science – 46%

High Benchmark All Three - 39%

Low Benchmark All Three - 97%

Exhibit 1.5: Hong Kong SAR

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	39 (1.8)
Reading	67 (1.6)
Mathematics	82 (1.3)
Science	46 (2.1)

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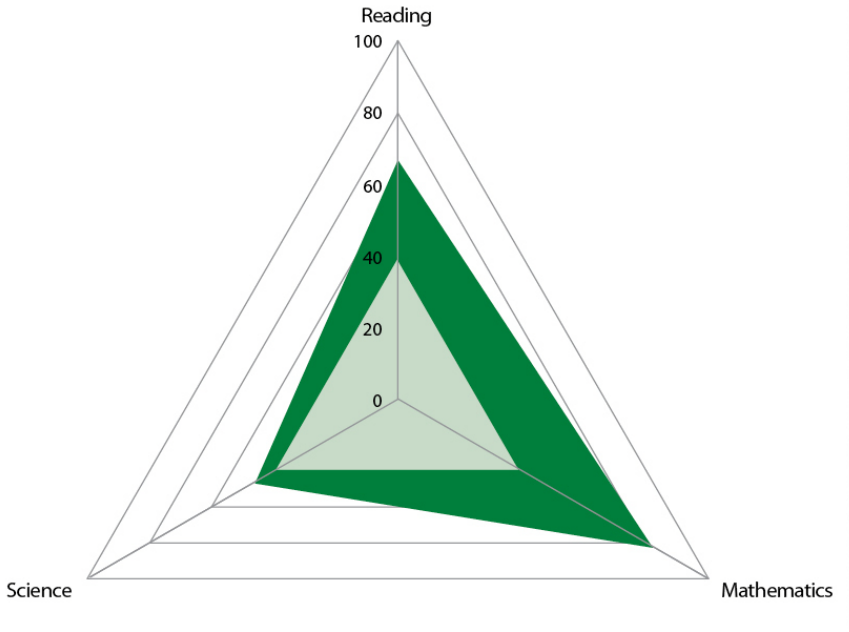

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	97 (0.5)
Reading	99 (0.2)
Mathematics	100 (0.1)
Science	97 (0.4)

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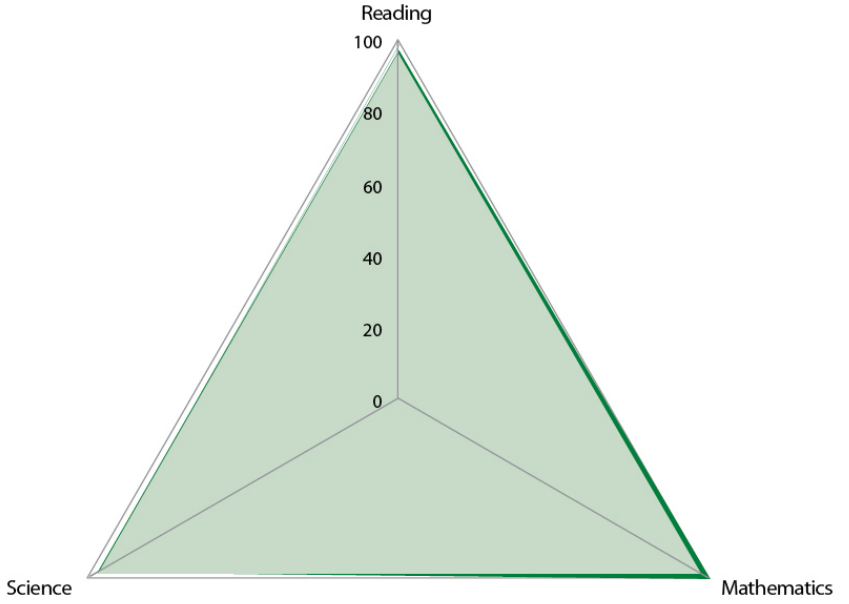

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Strengths

High Benchmark

Science – 65%

Reading – 63%

Mathematics – 50%

High Benchmark All Three - 39%

Low Benchmark All Three - 97%

Exhibit 1.6: Finland

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	39 (1.3)
Reading	63 (1.2)
Mathematics	50 (1.4)
Science	65 (1.7)

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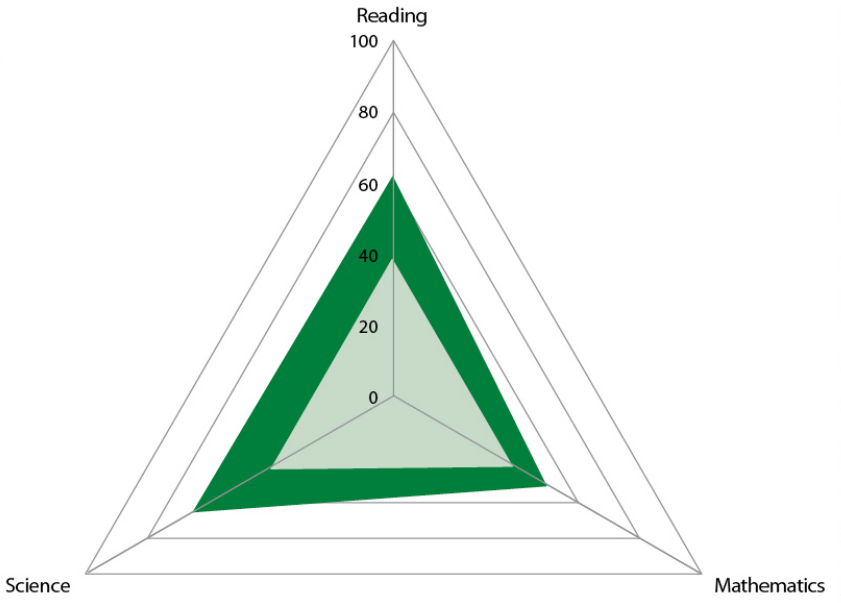

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	97 (0.5)
Reading	99 (0.2)
Mathematics	98 (0.4)
Science	99 (0.3)

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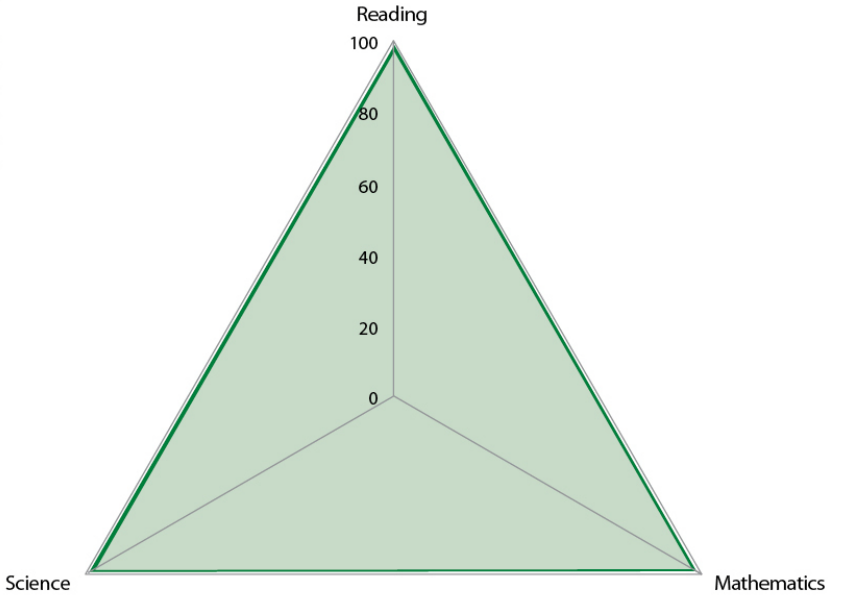

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 201

Strengths

High Benchmark

Reading – 48%

Science – 46%

Mathematics – 37%

High Benchmark All Three - 28%

Low Benchmark All Three - 88%

Exhibit 1.9: Hungary

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	28 (13)
Reading	48 (1.5)
Mathematics	37 (1.4)
Science	46 (2.0)

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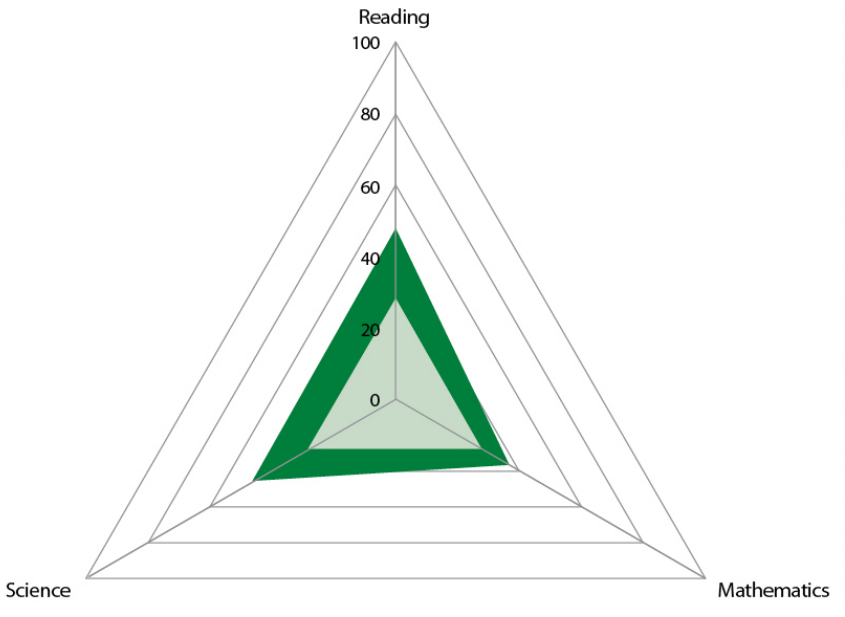

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	88 (1.1)
Reading	95 (0.8)
Mathematics	90 (0.9)
Science	93 (0.9)

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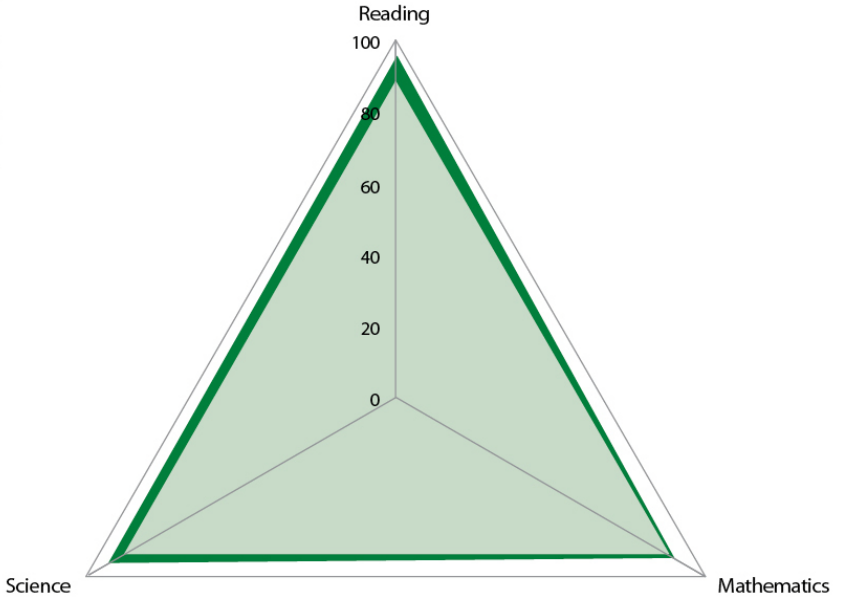

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Strength

High Benchmark

Reading – 54%

Mathematics – 41%

Science – 35%

High Benchmark All Three - 25%

Low Benchmark All Three - 90%

Exhibit 1.10: Ireland

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	25 (1.5)
Reading	54 (1.4)
Mathematics	41 (1.6)
Science	35 (1.7)

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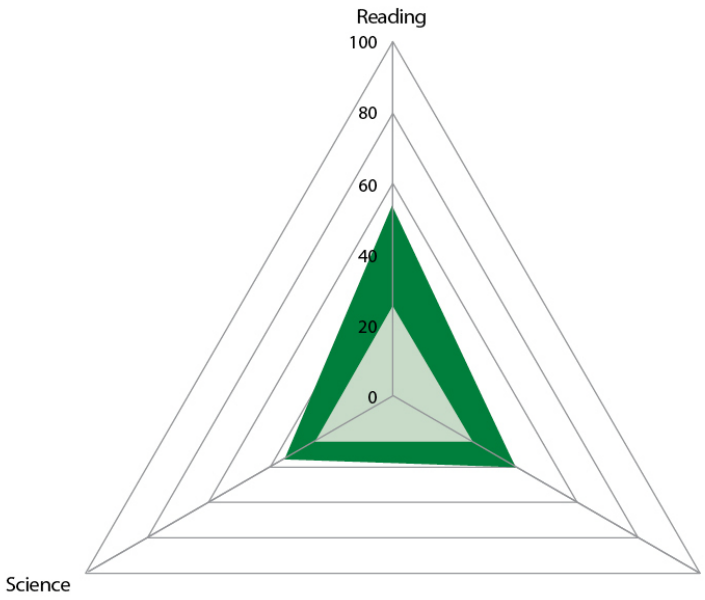

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	90 (0.9)
Reading	97 (0.5)
Mathematics	94 (0.6)
Science	92 (0.8)

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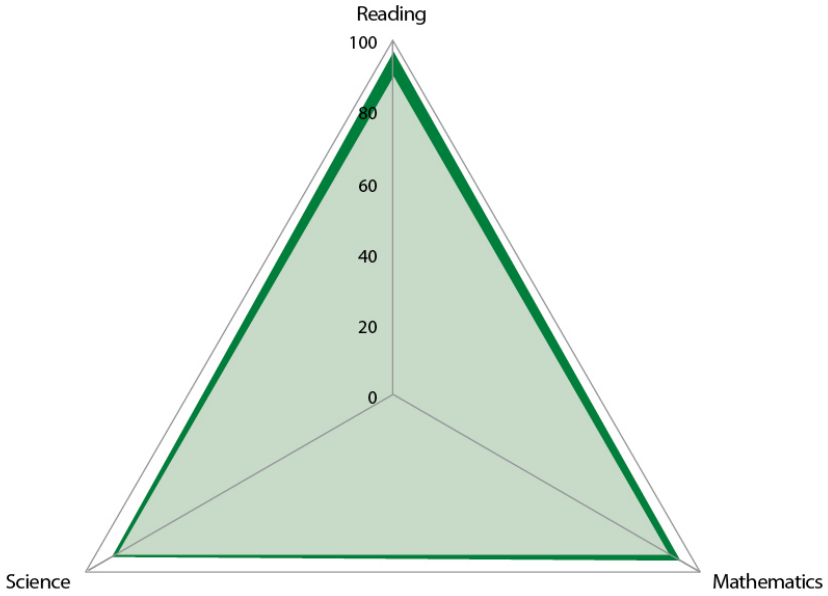

Well Balanced

High Benchmark
Reading – 46%
Science – 39%
Mathematics – 37%

High Benchmark All Three - 23%

Low Benchmark All Three - 94%

Exhibit 1.11: Germany

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	23 (1.3)
Reading	46 (1.3)
Mathematics	37 (1.4)
Science	39 (1.5)

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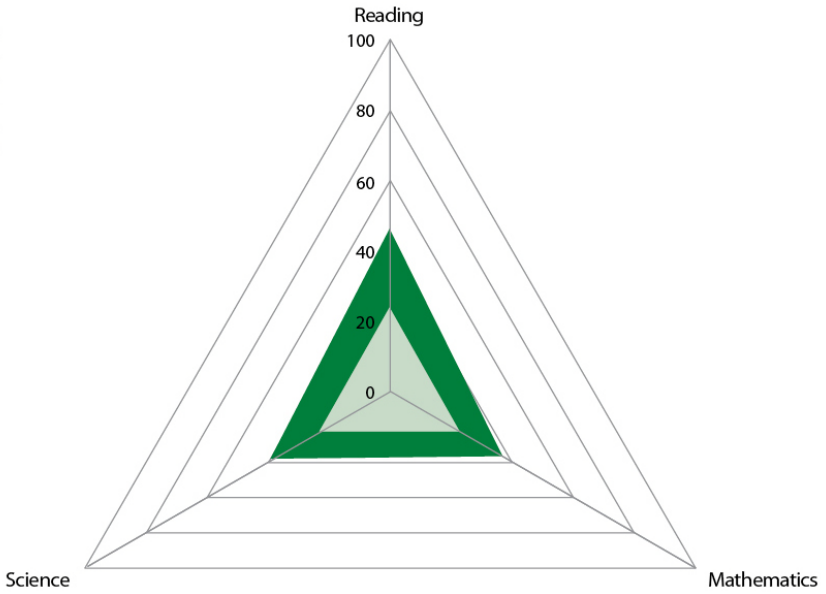

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	94 (0.8)
Reading	98 (0.4)
Mathematics	97 (0.5)
Science	96 (0.8)

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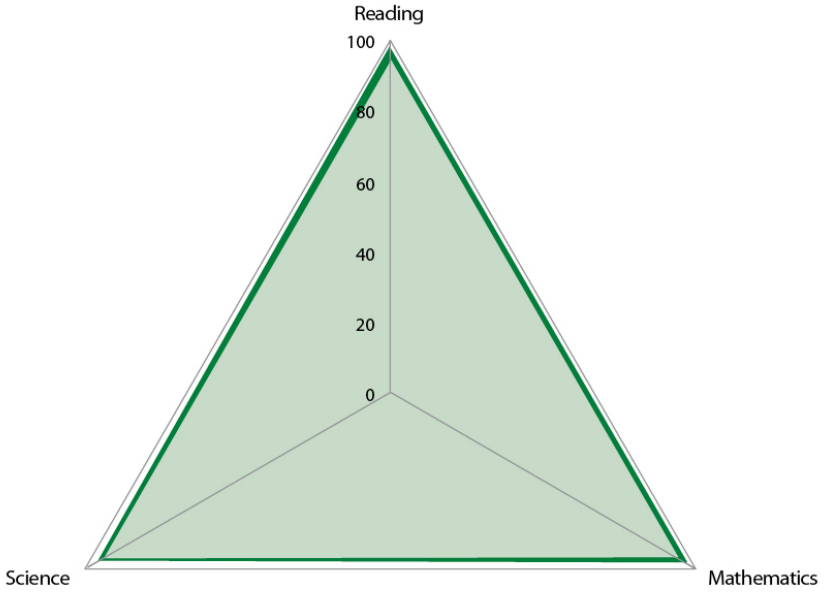

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Strength

High Benchmark

Reading – 47%

Mathematics – 40%

Science – 36%

High Benchmark All Three - 23%

Low Benchmark All Three - 93%

Exhibit 1.12: Portugal

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	23 (1.7)
Reading	47 (1.8)
Mathematics	40 (2.0)
Science	36 (2.0)

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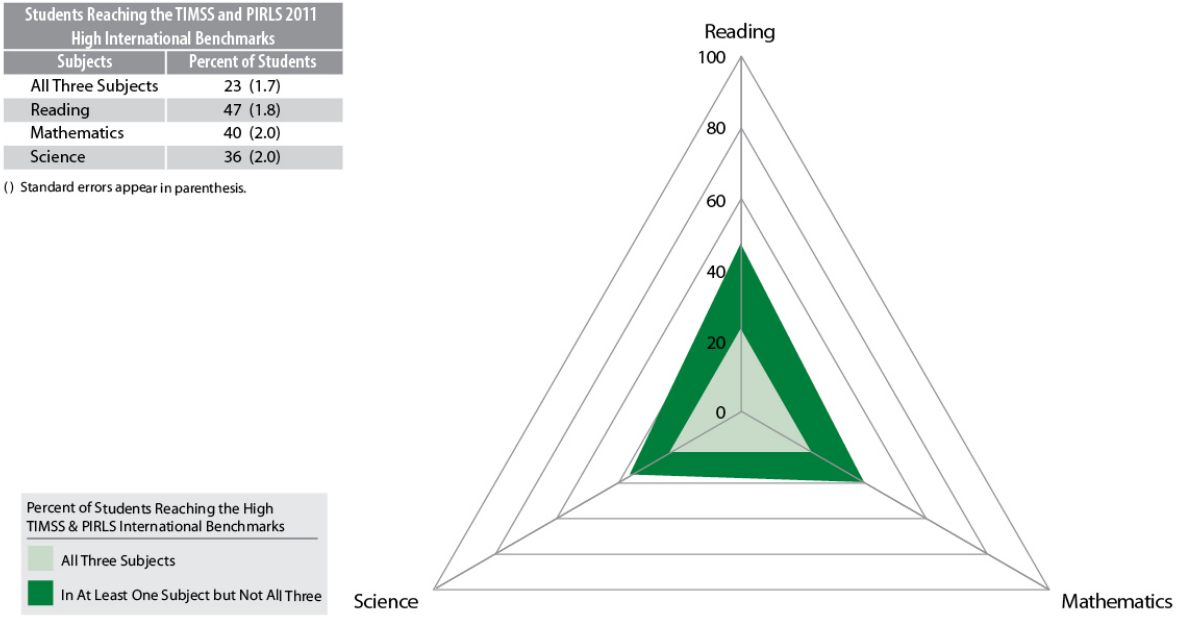

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	93 (1.1)
Reading	98 (0.5)
Mathematics	97 (0.7)
Science	95 (0.9)

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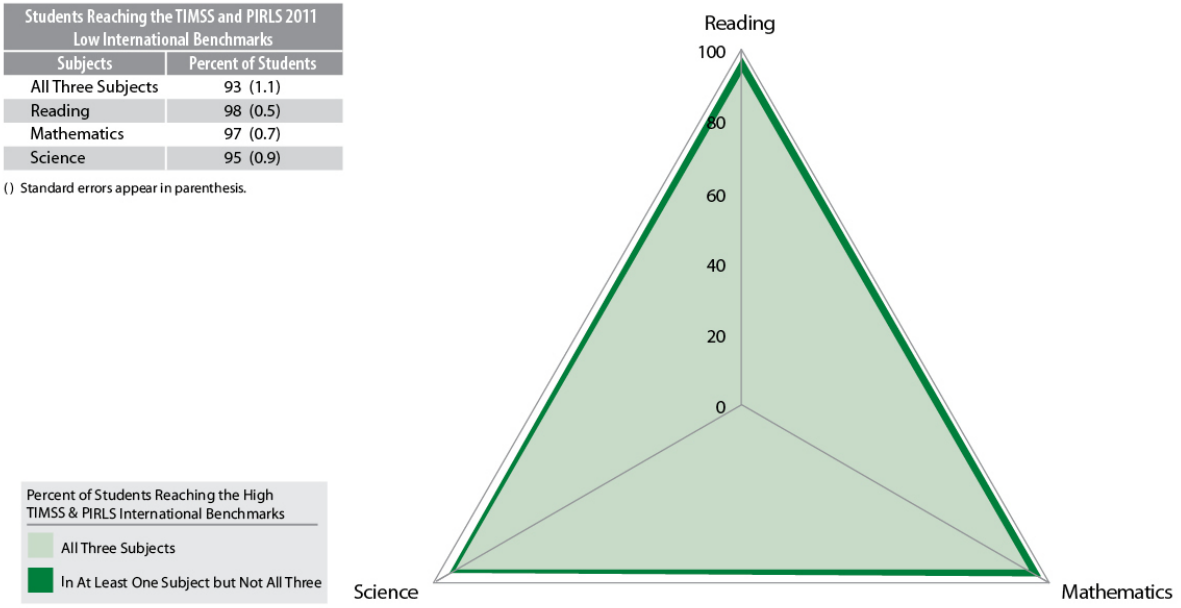

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Strengths

High Benchmark

Reading – 50%

Science – 45%

Mathematics – 30%

High Benchmark All Three - 21%

Low Benchmark All Three - 92%

Exhibit 1.14: Czech Republic

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	21 (1.1)
Reading	50 (1.4)
Mathematics	30 (1.6)
Science	45 (1.5)

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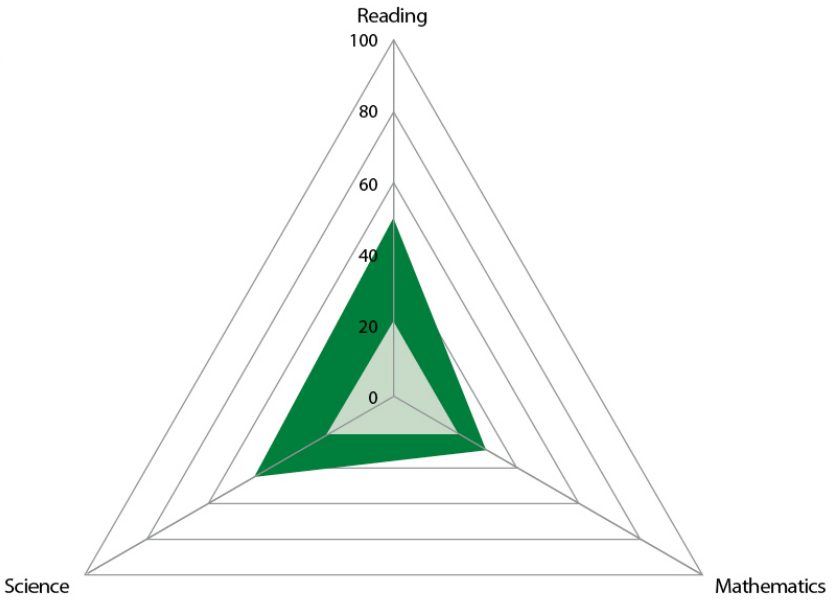

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	92 (0.8)
Reading	98 (0.5)
Mathematics	93 (0.8)
Science	96 (0.7)

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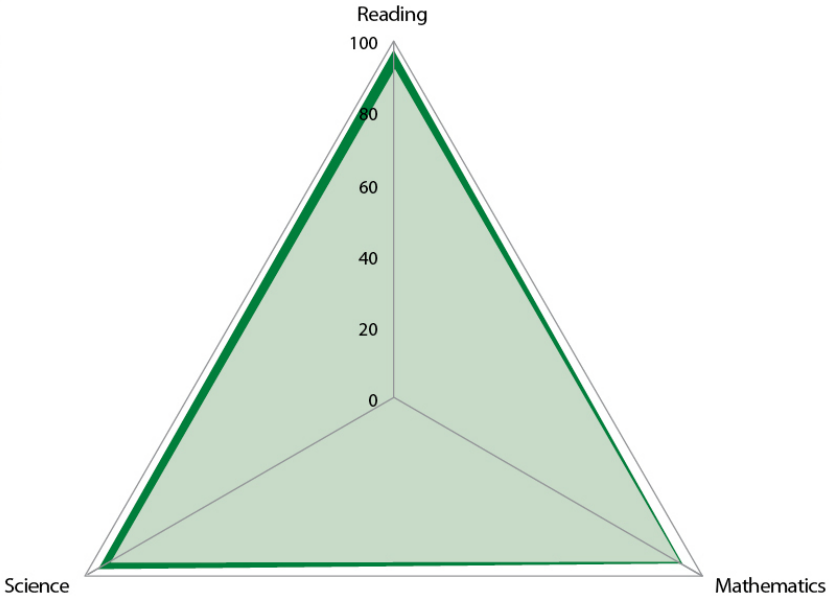

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Strengths

High Benchmark

Reading – 47%

Science – 44%

Mathematics – 25%

High Benchmark All Three - 18%

Low Benchmark All Three - 91%

Exhibit 1.19: Sweden

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	18 (1.1)
Reading	47 (1.6)
Mathematics	25 (1.2)
Science	44 (1.5)

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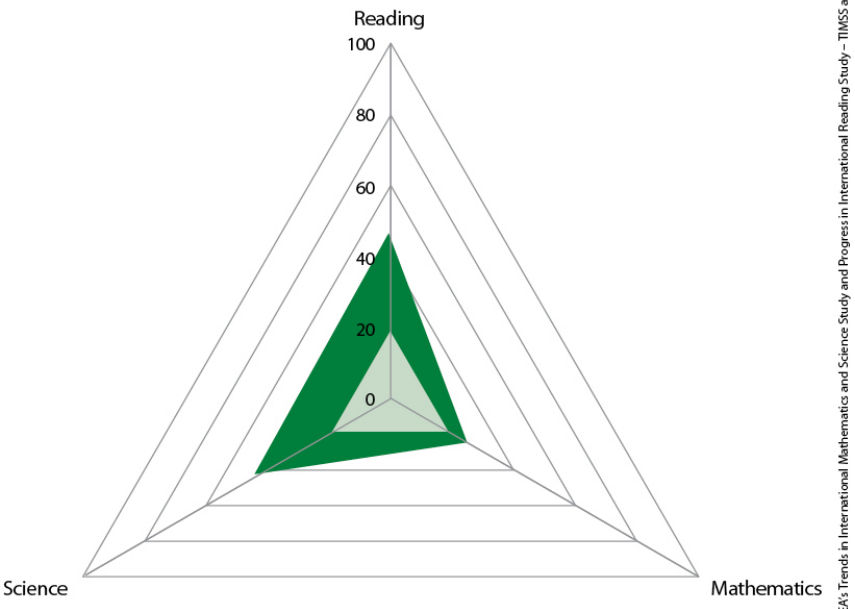

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	91 (0.7)
Reading	98 (0.3)
Mathematics	93 (0.6)
Science	95 (0.5)

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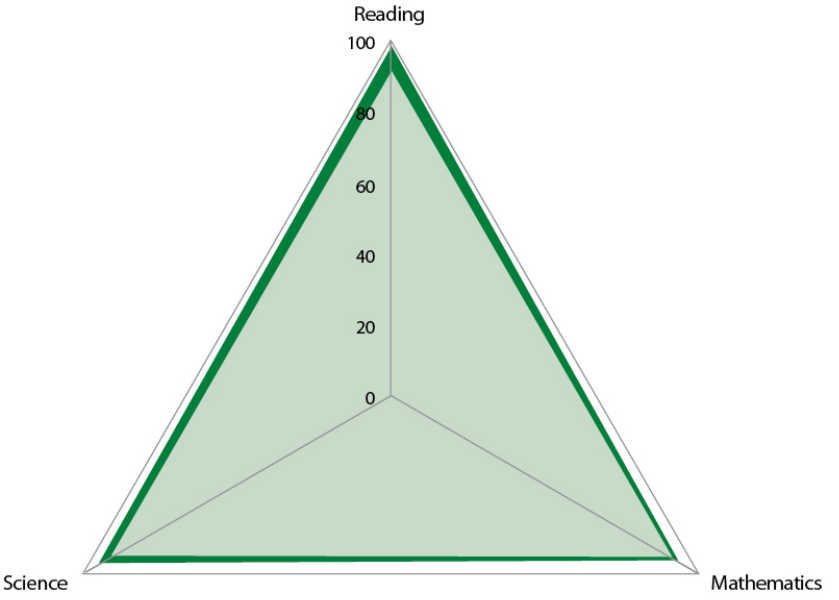

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Well Balanced

High Benchmark
Reading – 25%
Mathematics – 21%
Science – 19%

High Benchmark All Three - 8%

Low Benchmark All Three - 86%

Exhibit 1.25: Norway

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	8 (0.9)
Reading	25 (1.6)
Mathematics	21 (1.6)
Science	19 (1.3)

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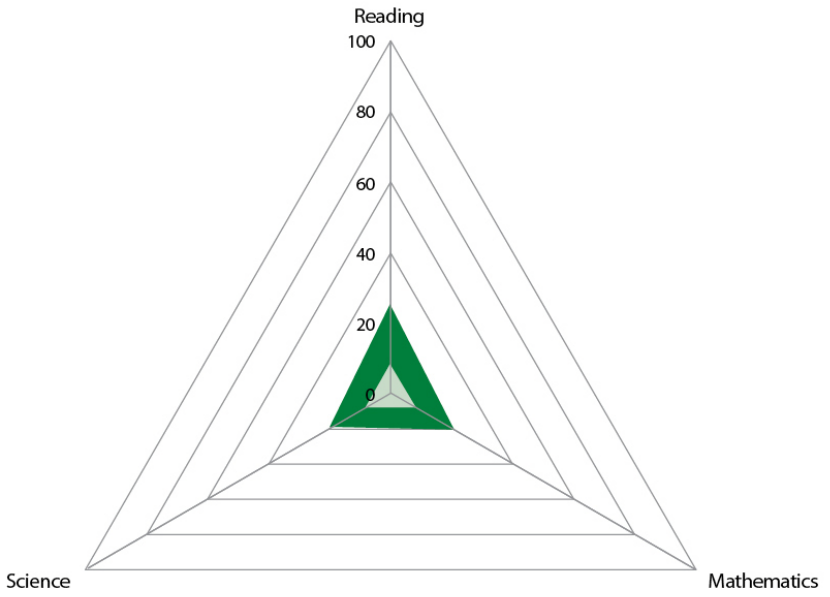

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	86 (1.2)
Reading	95 (0.8)
Mathematics	91 (0.9)
Science	92 (0.9)

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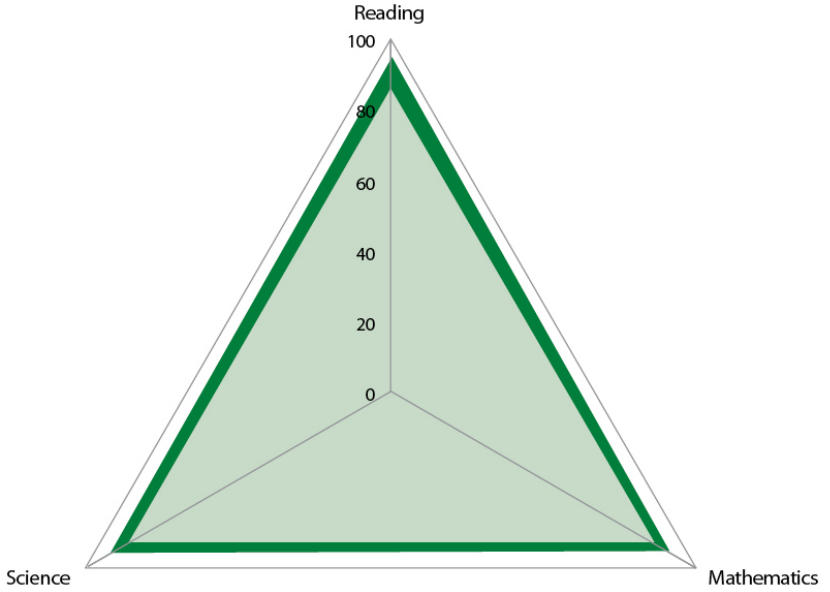

SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

Well Balanced

High Benchmark
Reading – 14%
Science – 12%
Mathematics – 14%

High Benchmark All Three - 6%

Low Benchmark All Three - 48%

Exhibit 1.27: United Arab Emirates

Profiles of High and Low Performance in Reading, Mathematics, and Science

High International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 High International Benchmarks	
Subjects	Percent of Students
All Three Subjects	6 (0.4)
Reading	14 (0.6)
Mathematics	12 (0.5)
Science	14 (0.5)

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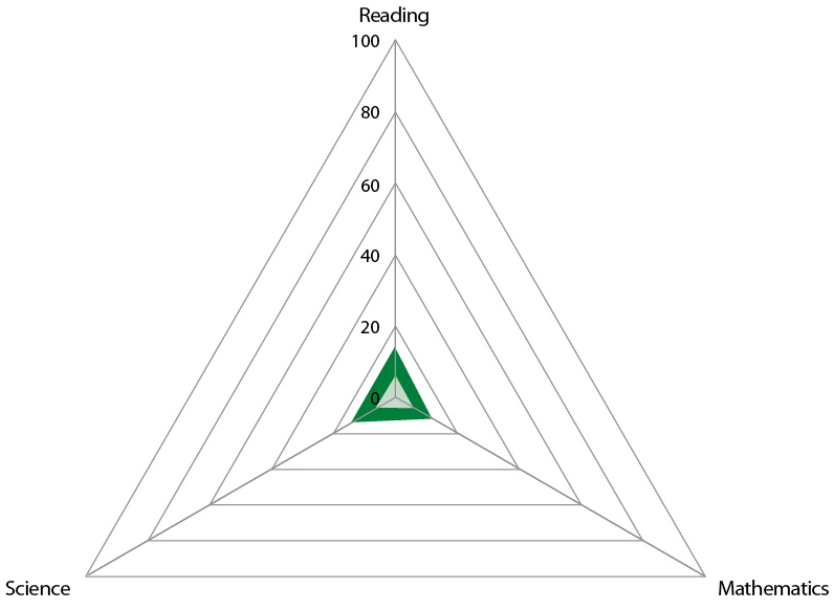

Low International Benchmarks

Students Reaching the TIMSS and PIRLS 2011 Low International Benchmarks	
Subjects	Percent of Students
All Three Subjects	48 (1.1)
Reading	64 (0.9)
Mathematics	64 (1.0)
Science	61 (1.1)

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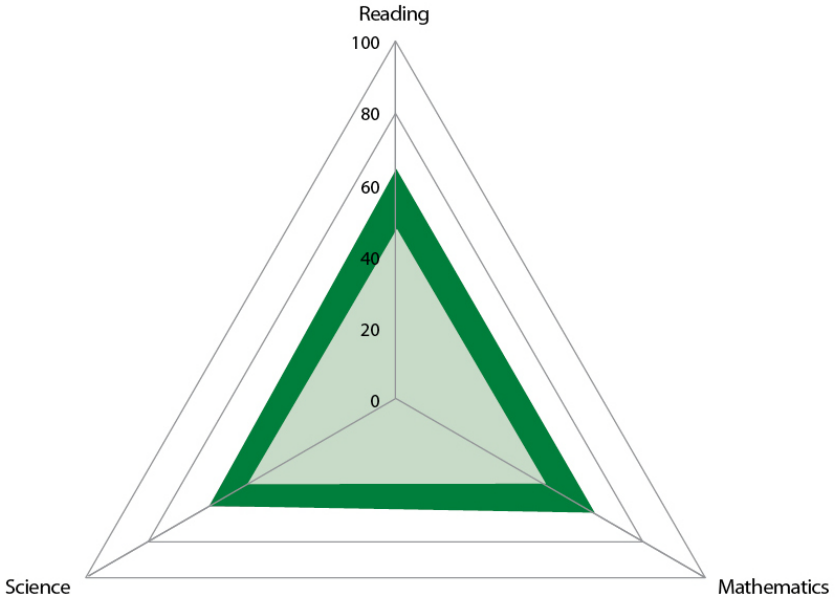


SOURCE: IEA's Trends in International Mathematics and Science Study and Progress in International Reading Study – TIMSS and PIRLS 2011

The Impact of Reading Ability on TIMSS Mathematics and Science Achievement at the Fourth Grade: An Analysis by Item Reading Demands

Ina V.S. Mullis, Michael O. Martin, and Pierre Foy

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

TIMSS/PIRLS 2011 Relationships Report
Impact of Reading Ability on TIMSS

How does reading ability impact mathematics and science achievement?

- Doing mathematics and science involve considerable reading and communication – reflected in the TIMSS Framework and assessment items
- TIMSS fourth grade items span a range of mathematics reading or science reading demands, from minimal to more demanding
  - None involve reading of any length or complexity
  - Greater range at eighth grade

Hypotheses

- Students with high reading ability would not be impacted by item reading demands
  - Would score similarly on TIMSS items with varying levels of reading demands
- Students with lower reading ability would perform relatively better on items with less reading
  - Would score better on low reading demand items, and less well on high reading demand items

Study Approach

Phase 1

Sort the TIMSS fourth grade mathematics items (175) and science items (172) according to **three** levels of reading demands

Phase 2

Look at the relationship between students' reading ability (measured by PIRLS) and their performance on TIMSS items at the three levels of reading demands

Phase 1: Categorizing the Items by Reading Demands

- Considered literature about dimensions of reading difficulty – in TIMSS context
- Holistic scoring to separate items into three reading demands categories – high, medium, low
- Developed and applied detailed coding guide to each item
- Validated holistic categories through quantitative analysis (discriminant function analysis)

Major Indicators of Reading Demands

- Number of words (anywhere in the item)
- Number of different symbols (e.g., numerals, operators)
- Number of different specialized vocabulary words
- Total number of elements (density) in the visual displays

Example TIMSS 4th Grade Mathematics Item - Low Reading Demands

M051203

$23 \times 19 =$

Answer: _____

Example TIMSS 4th Grade Science Item - Medium Reading Demands

S031421

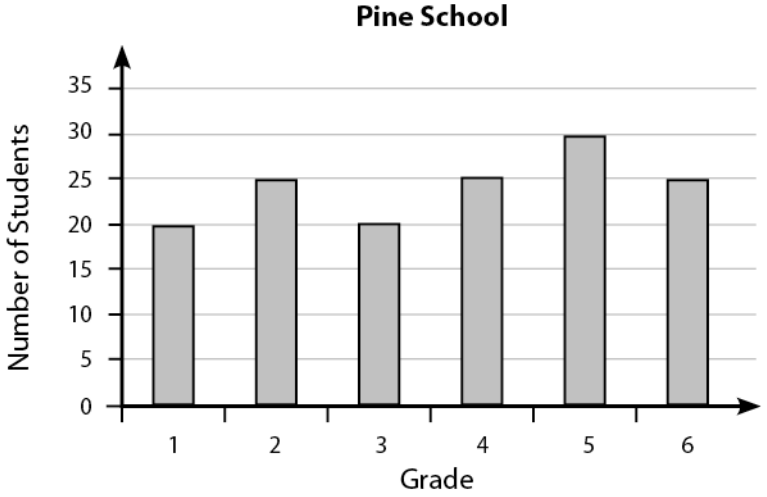
Some of the materials below will burn and some will not.
Put an X in the box next to the materials that will burn.

(You may put an X in more than one box.)

- ☐ water
- ☐ wood
- ☐ sand
- ☐ gasoline
- ☐ air

Example TIMSS 4th Grade Mathematics Item - High Reading Demands

The graph shows the number of students at each grade in the Pine School.



In the Pine School there is room in each grade for 30 students.
How many more students could be in the school?

Ⓐ 20

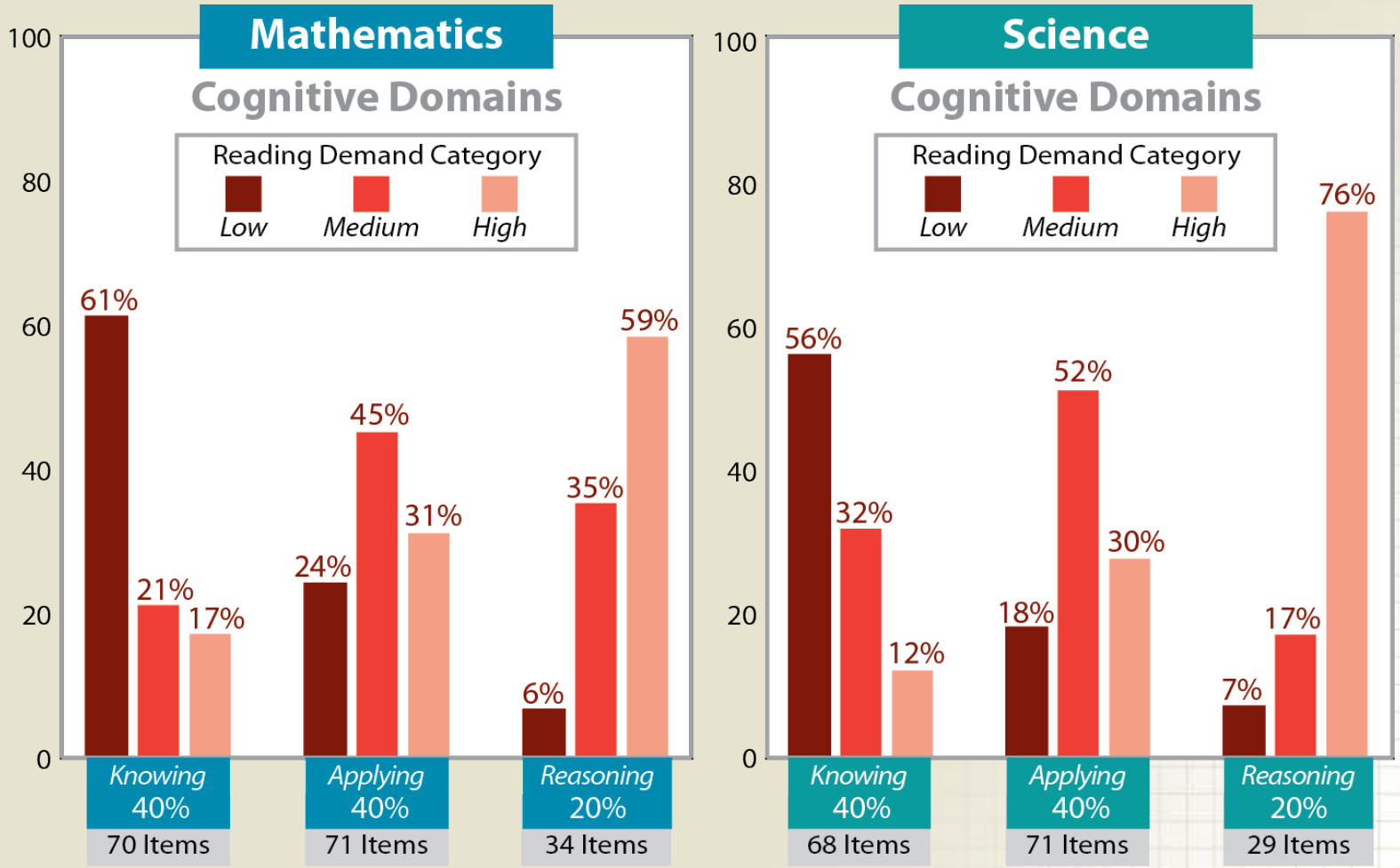
Ⓑ 25

Ⓒ 30

Ⓓ 35

M051117

Mathematics and Science
Cognitive Domain by Reading Demands



Generalizability of Item Categorizations Across Languages

NRCs from 17 countries used holistic process and submitted categorizations

- High level of agreement, on average, between countries and the TIMSS & PIRLS International Study Center for both mathematics and science items
  - 71% exact agreement
  - 98% adjacent agreement
- Some items (15%) with exact agreement below 50%
  - Often had complicated graphics

Reading Demands Study

Analysis

- Average percent correct on items with high, medium, and low reading demands
- For each of three levels of reading ability on PIRLS

Expected

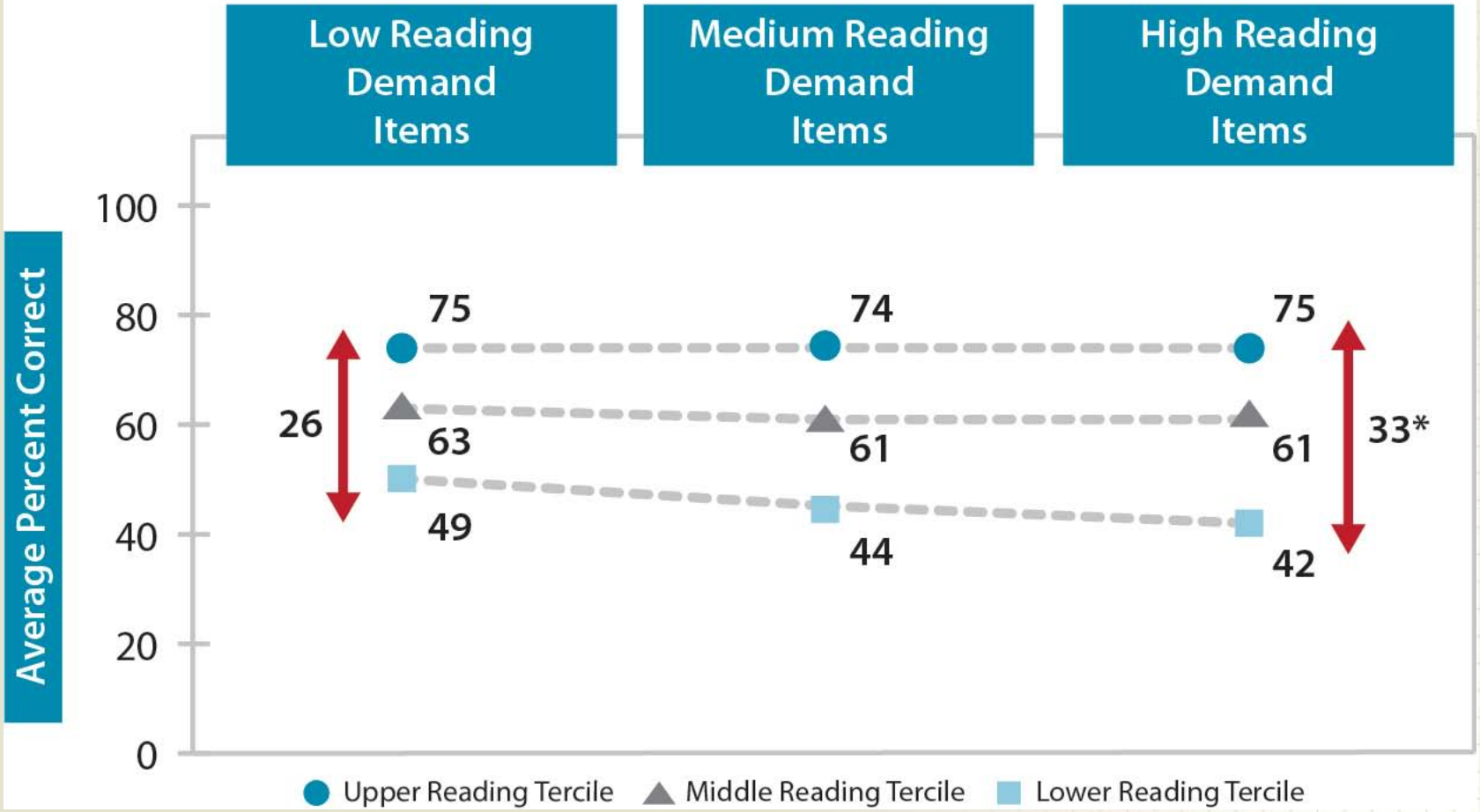
- Best readers would perform similarly on high, medium, and low demand items
- Poor readers would perform relatively better on low demand items, and less well on high demand items

Mathematics Achievement – Fourth Grade

Average Percent Correct for Students at Three Levels of PIRLS Reading Ability on Mathematics Items Grouped by Three Levels of Reading Demand

TIMSS & PIRLS 2011

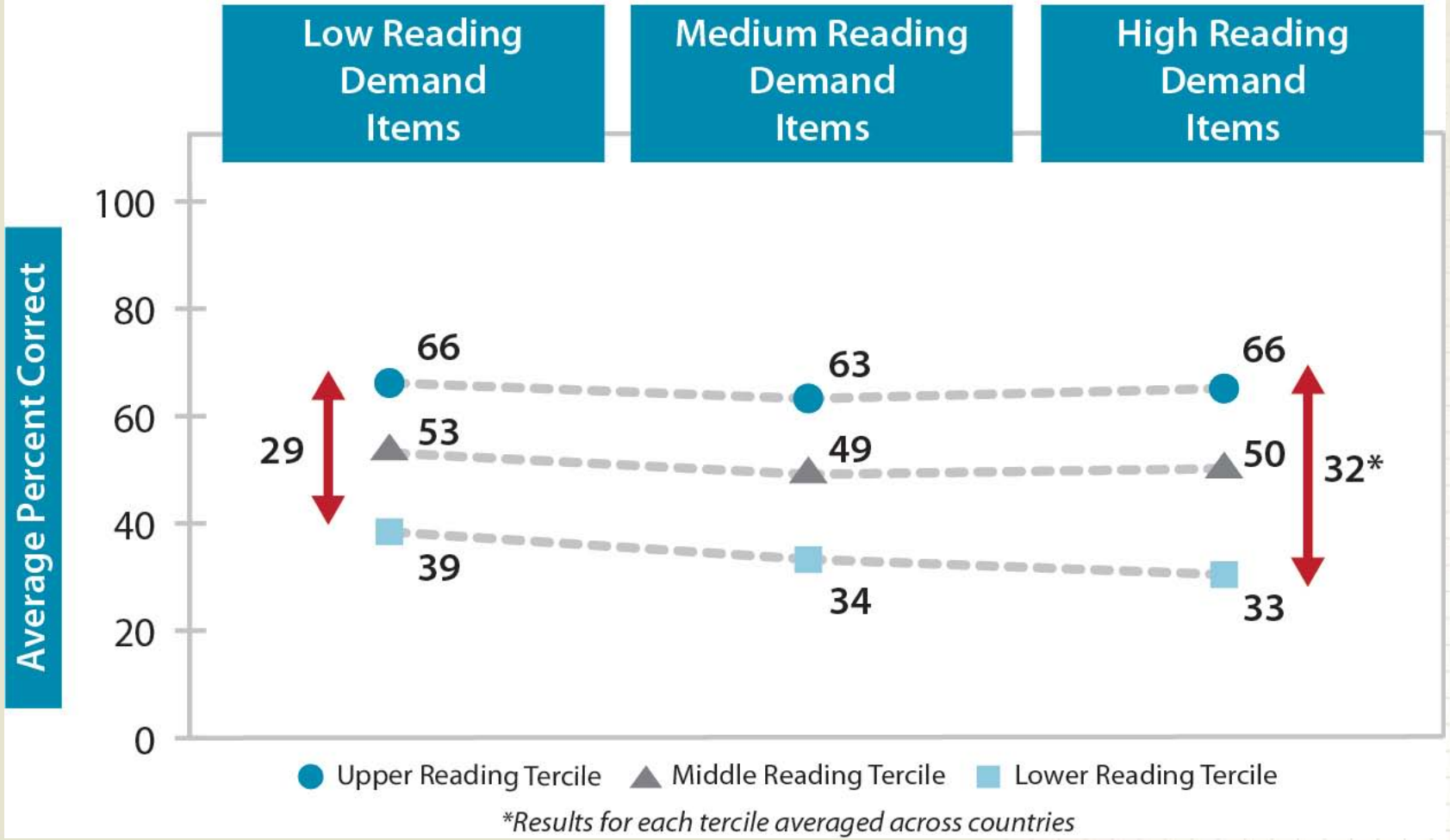
Russian Federation



Mathematics Achievement Across Countries – Fourth Grade

Average Percent Correct for Students at Three Levels of PIRLS Reading Ability on Mathematics Items Grouped by Three Levels of Reading Demand

TIMSS & PIRLS 2011



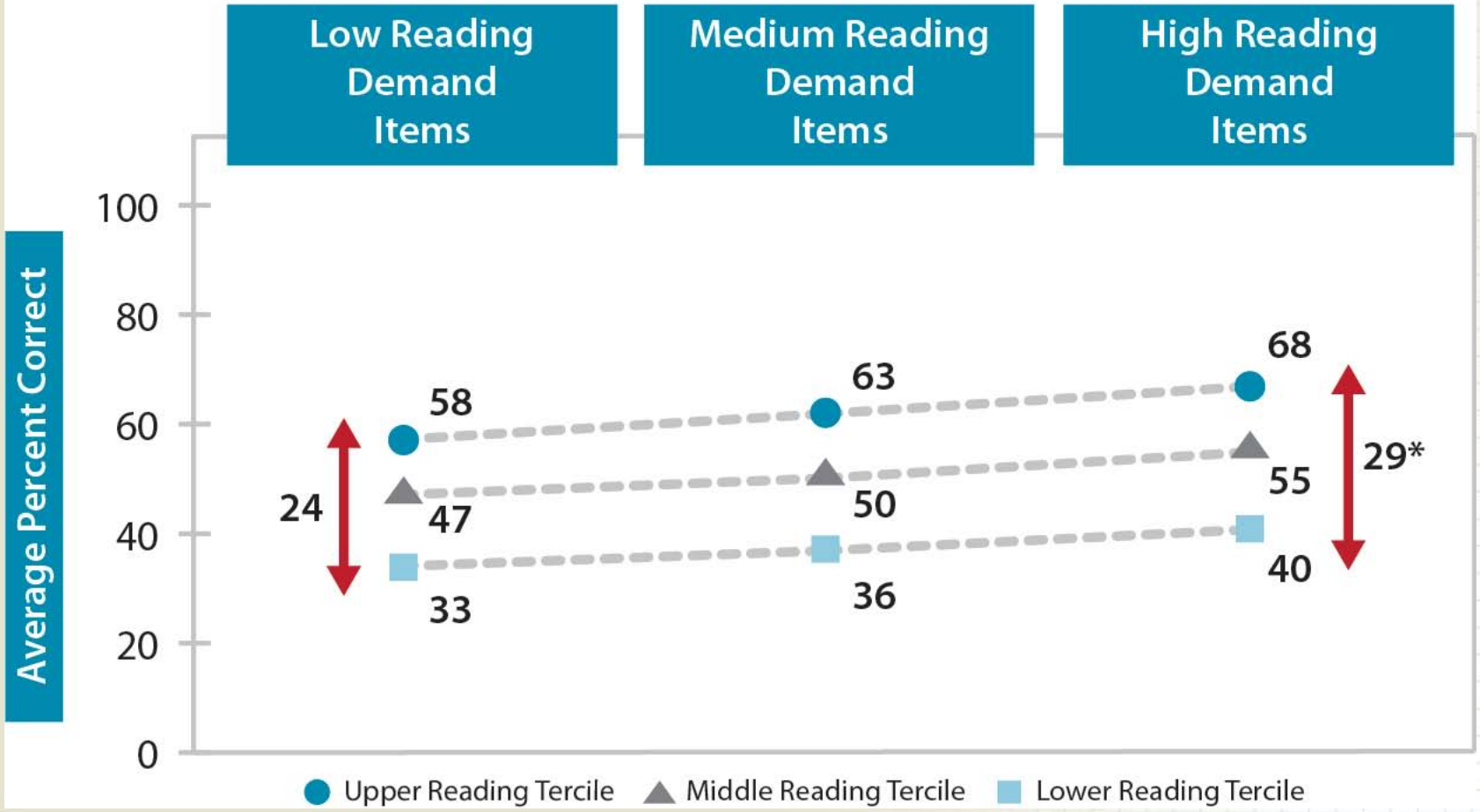
*Results for each tercile averaged across countries

Mathematics Achievement – Fourth Grade

Average Percent Correct for Students at Three Levels of PIRLS Reading Ability on Mathematics Items Grouped by Three Levels of Reading Demand

TIMSS & PIRLS 2011

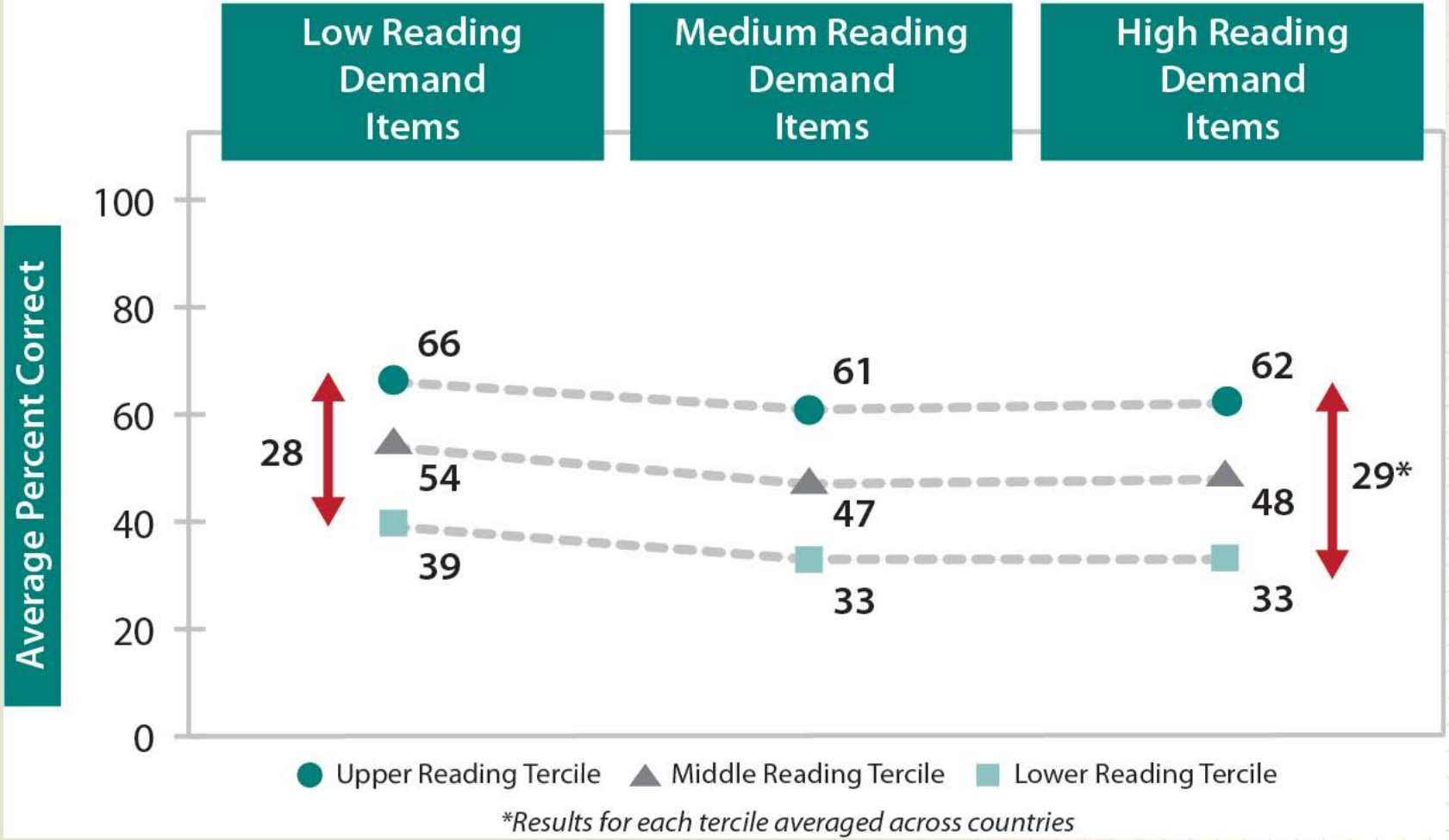
Sweden



Science Achievement Across Countries – Fourth Grade

Average Percent Correct for Students at Three Levels of PIRLS Reading Ability on Science Items Grouped by Three Levels of Reading Demand

TIMSS & PIRLS 2011



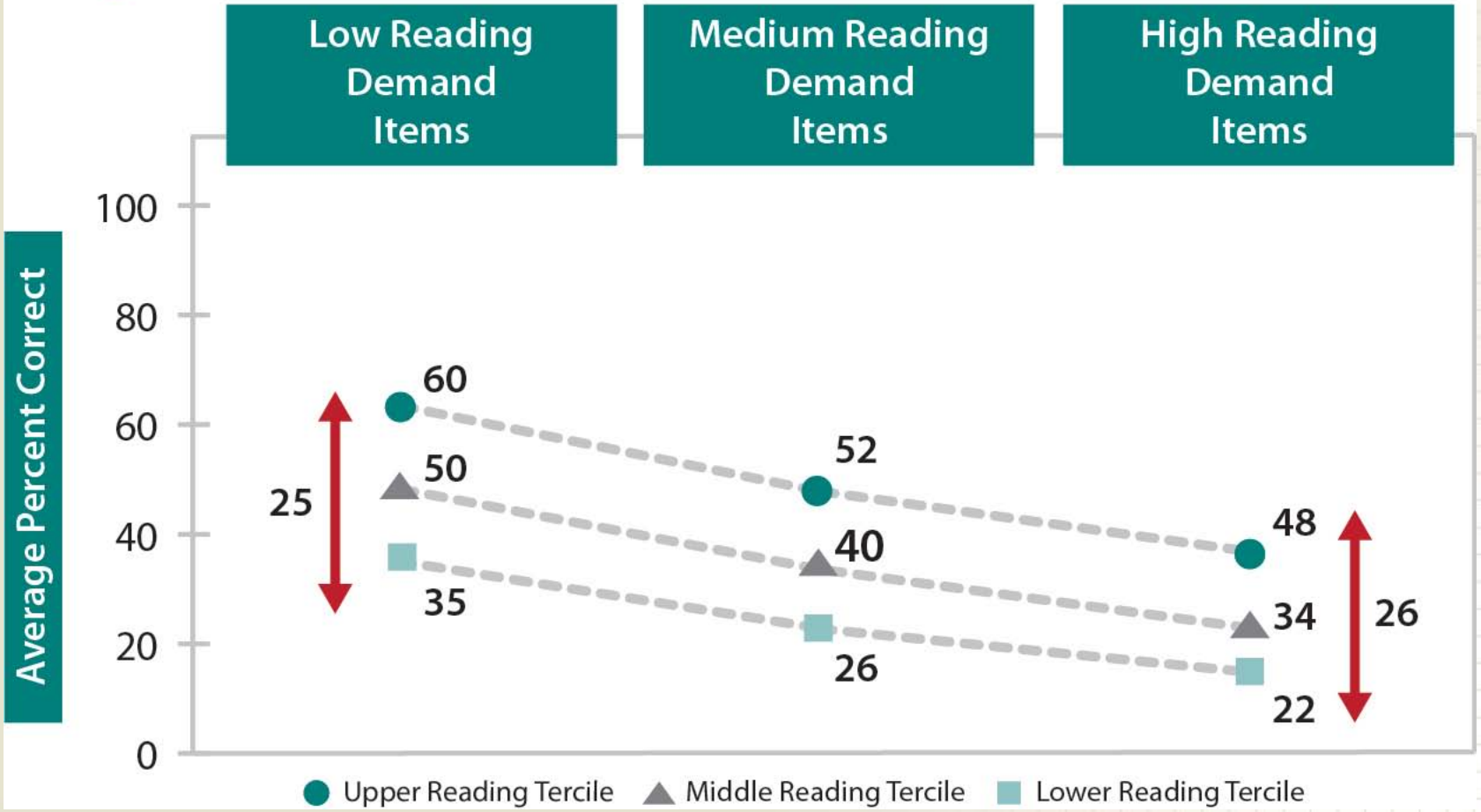
*Results for each tercile averaged across countries

Science Achievement – Fourth Grade

Average Percent Correct for Students at Three Levels of PIRLS Reading Ability on Science Items Grouped by Three Levels of Reading Demand

TIMSS & PIRLS 2011

Georgia



Reading Demands Study Results

- In mathematics, hypotheses supported in most countries (31/37)
- In science, hypotheses supported in just over half the countries (21/37)

Students are likely to be at a disadvantage in mathematics and science if they lack reading skills

  - For example, the traditional gender gap in reading may impact performance in other content areas

Effective Schools in Reading, Mathematics, and Science at the Fourth Grade

Michael O. Martin, Pierre Foy, Ina V.S. Mullis, and Laura O'Dwyer

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

Investigating Effective Schools in TIMSS/PIRLS 2011- Fourth Grade

This study uses a “school effectiveness” approach to examine how indicators of effective schools operate across countries and school subjects

- In this approach, an effective school is one that has an effect on student achievement over and above home influence
- Thus, effective schools research attempts to examine school factors, while controlling for home background influence

Universally Relevant Characteristics of Effective Schools

Strong Conceptual Model

Strongly supported by research, we have a firm conviction that effective schools

- Are safe and orderly
- Have adequate facilities and equipment
- Support academic success
- Rigorous Curriculum
- Are staffed with well-prepared teachers
- Have well-resourced classrooms
- Provide effective instruction

Investigating Effective Schools in TIMSS/PIRLS 2011- Fourth Grade

Summary of Analysis:

Across 34 countries and 3 benchmarking participants:

1. Given the factors that are known to contribute to school effectiveness
2. Given that the students in schools have been adjusted (statistically) to all have the same backgrounds
   - Which school factors will have the most influence across countries?
   - Will there be a difference across school subjects?
     - Reading
     - Mathematics
     - Science

Hierarchical Linear Modeling (HLM) takes into account nesting of students within schools—Analyses conducted separately for each country

Variables Included in the School Effectiveness Analysis

School Environment

- Schools Are Safe Orderly
- Schools Support Academic Success
- Adequate Environment Resources

School Instruction

- Emphasis in Early Grades on Reading Proficiency
- Students Engaged in Their Classroom Lessons

Home Background Variables

- Home Resources for Learning
- Students Could Do Literacy/Numeracy Tasks When Started School

TIMSS/PIRLS 2011 Analytic Approach

Country by country:

1. Examine relationship between school variables and achievement – explanatory model, without controls
2. Introduce controls for students' home background
3. Reexamine school variable relationships with achievement, after controlling (statistically) for home background

Controlling for Home Background

Home background influences operate…

- At the individual student level
  - Each individual student comes to school with certain advantages and disadvantages
  - These can help or hinder the student
- At the school level (compositional effect)
  - Composition of the student body can have an additional effect – attending a school with lots of advantaged students vs. lots of disadvantaged students

Some Challenges

Analytic approach depends on analyzing between-school variation in cross-sectional data – “naturally occurring variation”

However, school systems carefully managed

- Some countries have little variation between schools
- Some countries have little variation in particular factors
  - Instructional time for a subject may be a national policy
  - In affluent countries, schools may be equally well resourced

Method of Analysis

- Hierarchical linear modeling (multilevel modeling)
  - School effects on student achievement
  - Explicitly models the nesting of students within schools
- Two-level analysis – schools and students
- Separate analysis for each country
- Series of models
  - Each stage of the analysis

Models for Analysis

1. Baseline model
   - Achievement differences between schools
2. Explanatory model
   - School Environment and Instruction effects, **ignoring** student home background
3. Home background control Model
   - Home Background, between and within schools
4. Explanatory with control model
   - School Environment and Instruction effects, **controlling for** student home background

Results - %Variance Between Schools

Upper limit on impact of school variables

- 5-50% range
- Lowest in Slovenia, Finland, Norway
- Highest in Honduras, UAE, Qatar, Azerbaijan
- Reading, mathematics, and science similar, but a little less for reading

Results
Example Country - Australia

Subject	Variance between Schools (%)
Reading	23%
Mathematics	28%
Science	28%

Variables		School Environment	
School Explanatory Variables			
School Environment			
Schools Are Safe and Orderly	REA	.55	21 (3.5) ▲
	MAT	.54	21 (4.1) ▲
	SCI	.54	20 (3.5) ▲
Schools Support Academic Success	REA	.44	6 (2.1) ▲
	MAT	.43	6 (2.4) ▲
	SCI	.44	6 (2.0) ▲
Adequate Environment and Resources	REA	.28	2 (2.5)
	MAT	.28	3 (2.5)
	SCI	.28	2 (2.5)

Australia

Variables		School Instruction	
School Instruction			
Early Emphasis on Reading Skills	REA	.03	0 (1.8)
	MAT	.04	1 (1.9)
	SCI	.02	0 (1.7)
Students Engaged in Reading, Mathematics, and Science Lessons	REA	.21	15 (5.2) ▲
	MAT	.21	16 (5.6) ▲
	SCI	.21	14 (5.2) ▲

Australia

Variables		Home Background Control Model
Home Background Control Variables		
Students within Schools		
Home Resources for Learning	REA	.31 12 (1.3)
	MAT	.32 12 (1.4)
	SCI	.36 13 (1.1)
Early Literacy/Numeracy Tasks	REA	.17 11 (1.3)
	MAT	.23 15 (1.4)
	SCI	.20 12 (1.2)
Between Schools		
School Average of Home Resources for Learning	REA	.70 49 (3.7)
	MAT	.70 56 (4.0)
	SCI	.72 49 (3.4)
School Average of Early Literacy/Numeracy Tasks	REA	.22 19 (6.8)
	MAT	.27 23 (8.4)
	SCI	.25 21 (6.0)

Australia

Variables		School Environment and Instruction	School Environment and Instruction (With Home Background Controls)
School Explanatory Variables			
School Environment			
Schools Are Safe and Orderly	REA	20 (3.5) ▲	10 (3.5) ▲
	MAT	21 (4.1) ▲	11 (4.0) ▲
	SCI	19 (3.5) ▲	8 (3.3) ▲
Schools Support Academic Success	REA	6 (2.1) ▲	3 (1.8)
	MAT	7 (2.4) ▲	3 (2.1)
	SCI	6 (2.0) ▲	3 (1.6)
Adequate Environment and Resources	REA	2 (2.5)	1 (1.9)
	MAT	3 (2.5)	1 (2.0)
	SCI	2 (2.5)	1 (1.8)
School Instruction			
Early Emphasis on Reading Skills	REA	2 (1.5)	1 (1.3)
	MAT	2 (1.7)	2 (1.4)
	SCI	2 (1.5)	1 (1.2)
Students Engaged in Reading, Mathematics, and Science Lessons	REA	6 (4.2)	4 (3.6)
	MAT	6 (4.3)	3 (3.6)
	SCI	5 (4.2)	3 (3.2)

Australia

Source of Variance	Percentage of Variance Explained		
	School Explanatory Model	Home Backrgound Control Model	School Explanatory Model with the Control Model
	School Environment and Instruction		School Environment and Instruction
Reading			
Between Schools (23%)	44	58	67
Mathematics			
Between Schools (28%)	43	58	67
Science			
Between Schools (28%)	43	61	69

Australia

Summary

Number of Countries with Significant Predictors AFTER Controlling for Home Background

Predictor	At Least One Subject	All three Subjects
Schools safe and orderly	16	7
Support academic success	10	2
Adequate environment /resources	3	1
Emphasis on reading	1	1
Students engaged in lessons	13	5

Safe and Orderly School

- Maintains discipline and safety
- Is safe and orderly
- Reduces the frequency of bullying among students

Schools Support Academic Success

Working together to ensure success

- Teachers understand curricular goals
- Teachers are successful in implementing curriculum
- Teachers expect student high achievement
- Parents support student achievement
- Students desire to do well

Students Engaged in Lessons

- Students know what they are expected to do
- Students like what they read
- Teachers are easy to understand
- Teachers present content in interesting ways
- Teachers give students interesting things to do

What Have We Learned?

- TIMSS and PIRLS 4th grade data a valuable resource for school effectiveness research
  - Comprehensive achievement data on reading, mathematics, and science
  - Wide range of home, school, and predictor variables
- Cross country perspective crucial
  - No one country give complete picture
    - Challenges of statistical modeling cross-sectional data
  - Takes all of the countries together to show the conceptual model in action in the data

Effects of Home Background on Student Achievement in Reading, Mathematics, and Science at the Fourth Grade

Jan-Eric Gustafsson, Kajsa Yang Hansen, and Monica Rosén

University of Gothenburg

How Does Home Background Influence Student Achievement?

- Takes as starting point the well-established relationship between home background and achievement
- Examines the extent to which literacy and numeracy resources and activities are the **mechanism** through which parental education and gender influence fourth grade students' achievement in reading, mathematics, and science

The Model

Effect of parental education and gender on achievement mediated via

- Availability of home resources
- Early literacy and numeracy activities
- Literacy and numeracy skills when beginning school
- Achievement in reading, mathematics, and science at the fourth grade

Structural equation modeling approach

Early Literacy Activities

Items in the Early Litreracy Activities Before Beginning Primary School Scale

Before your child began primary/elementary school, how often did you or someone else in your home do the following activities with him or her?

	Often	Sometimes	Never or almost never
1) Read books	○	○	○
2) Tell stories	○	○	○
3) Sing songs	○	○	○
4) Play with alphabet toys (e.g., blocks with letters of the alphabet)	○	○	○
5) Talk about things you had done	○	○	○
6) Talk about what you had read	○	○	○
7) Play word games	○	○	○
8) Write letters or words	○	○	○
9) Read aloud signs and labels	○	○	○

Early Numeracy Activities

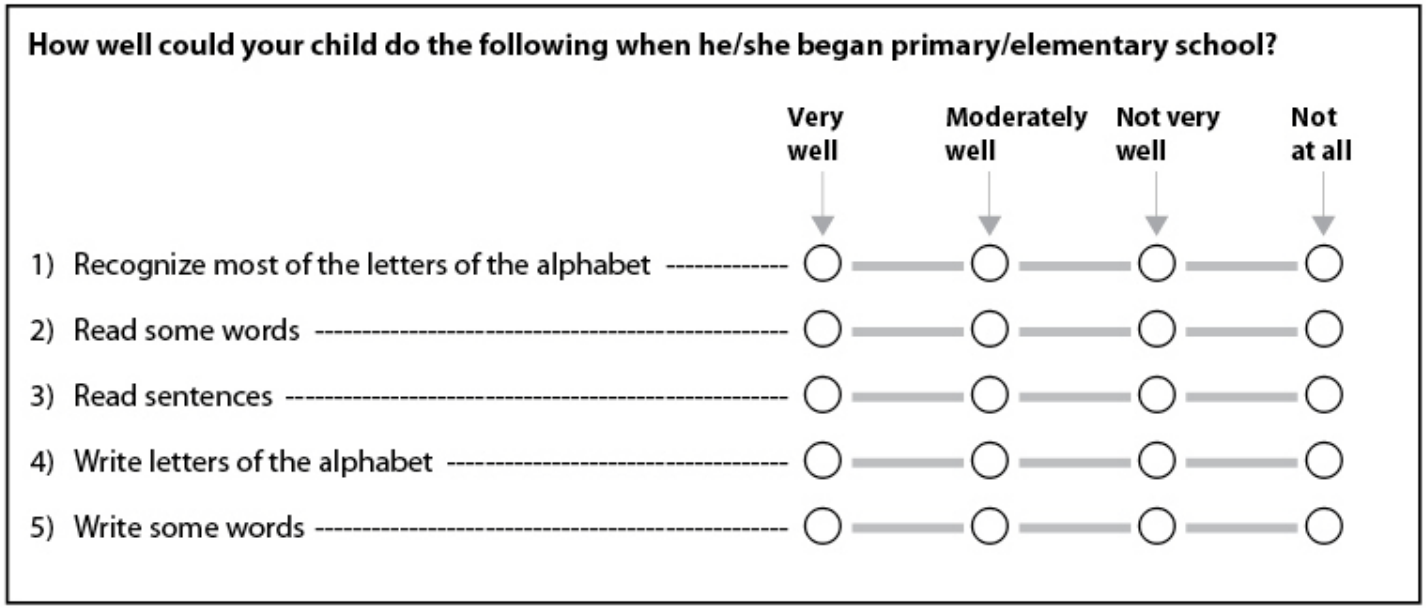
Items in the Early Numeracy Activities Before Beginning Primary School Scale

Before your child began primary/elementary school, how often did you or someone else in your home do the following activities with him or her?

	Often	Sometimes	Never or almost never
1) Say counting rhymes or sing counting songs	○	○	○
2) Play with number toys (e.g., blocks with numbers)	○	○	○
3) Count different things	○	○	○
4) Play games involving shapes (e.g., shape sorting toys, puzzles)	○	○	○
5) Play with building blocks or construction toys	○	○	○
6) Play board games or card games	○	○	○

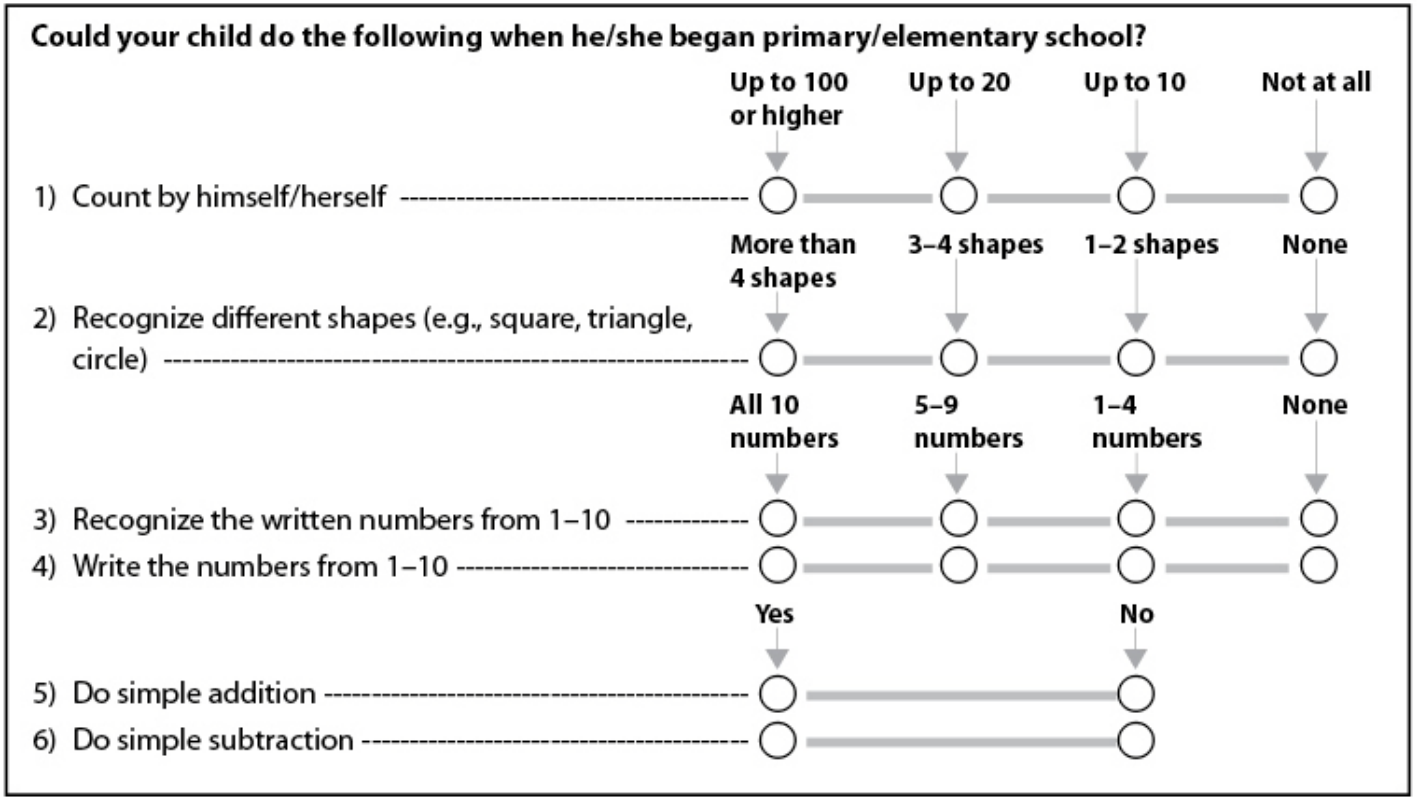
Literacy Skills When Beginning School

Items in the Could Do Early Literacy Tasks When Began Primary School Scale



Numeracy Skills When Beginning School

Items in the Could Do Early Numeracy Tasks When Began Primary School Scale



Educationally Oriented Activities in the Home

Parents' responses reflected general level of activity, rather than early literacy and numeracy activities separately

Bi-factor approach

- One general activity variable including both literacy and numeracy - **Activity**
- One variable representing the balance between literacy and numeracy activities - **NumLitAct**

Skills when Beginning School

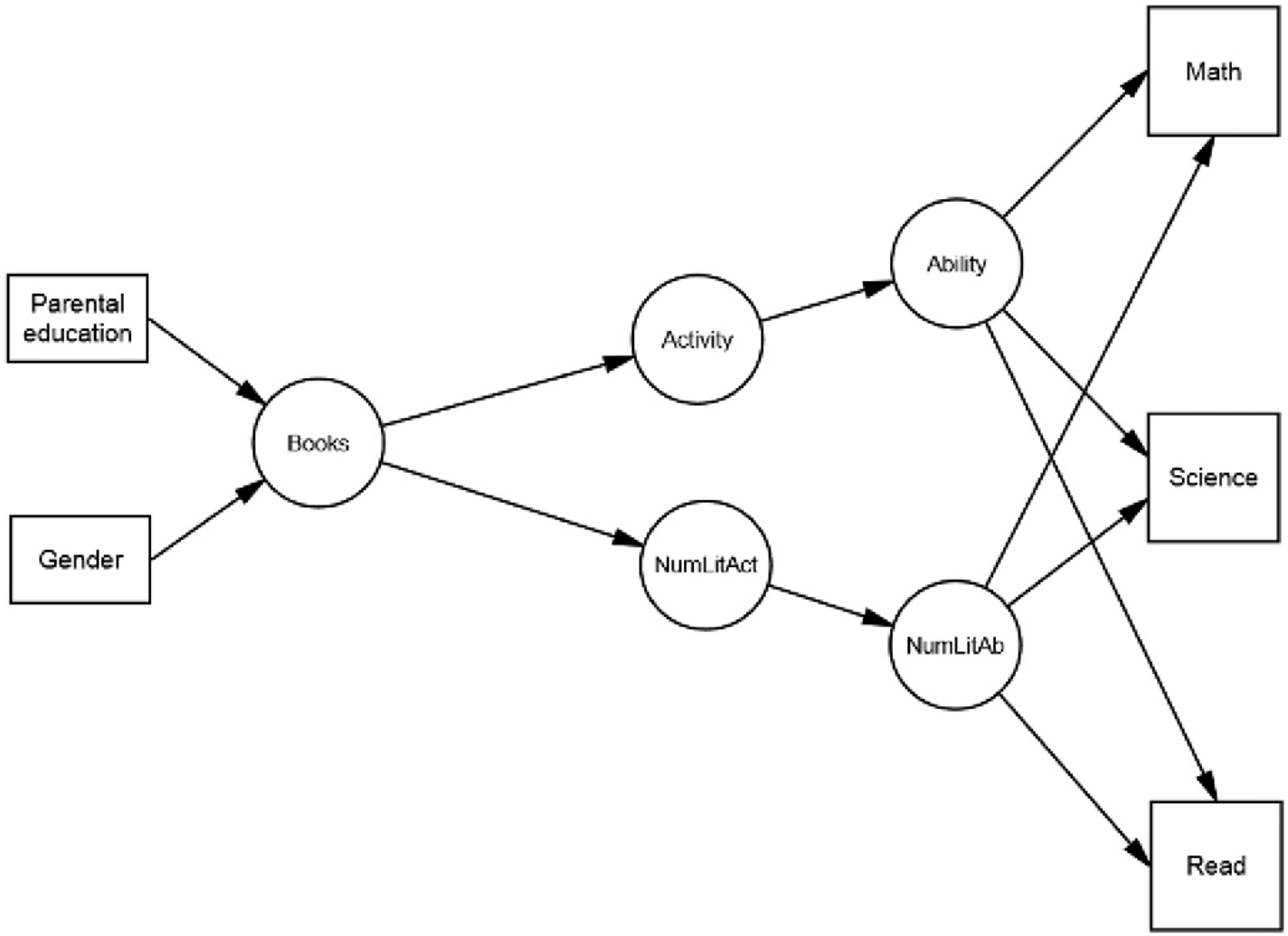
Similar bi-factor approach

- One general ability variable including parents' reports of how well the child could do both literacy and numeracy tasks - **Ability**
- One variable representing the contrast between how well the child could do literacy compared to numeracy tasks - **NumLitAb**

Standardized Factor Loadings in the Measurement Model for the Common Model

	Activity		NumLitAct		Ability		NumLitAb		Books	
Indicator	Beta	t-value	Beta	t-value	Beta	t-value	Beta	t-value	Beta	t-value
LITACT1	0.78	95.69	0.23	56.97						
LITACT2	0.78	99.35	0.22	52.95						
NUMACT1	0.78	82.01	-0.20	-57.63						
NUMACT2	0.77	100.88	-0.19	-47.87						
LITAB1					0.90	234.47	0.29	79.81		
LITAB2					0.88	169.87	0.28	85.77		
NUMAB1					0.75	79.62	-0.47	-45.05		
NUMAB2					0.74	73.67	-0.43	-51.70		
NBOOK									0.80	58.12
NCBOOK									0.80	66.03

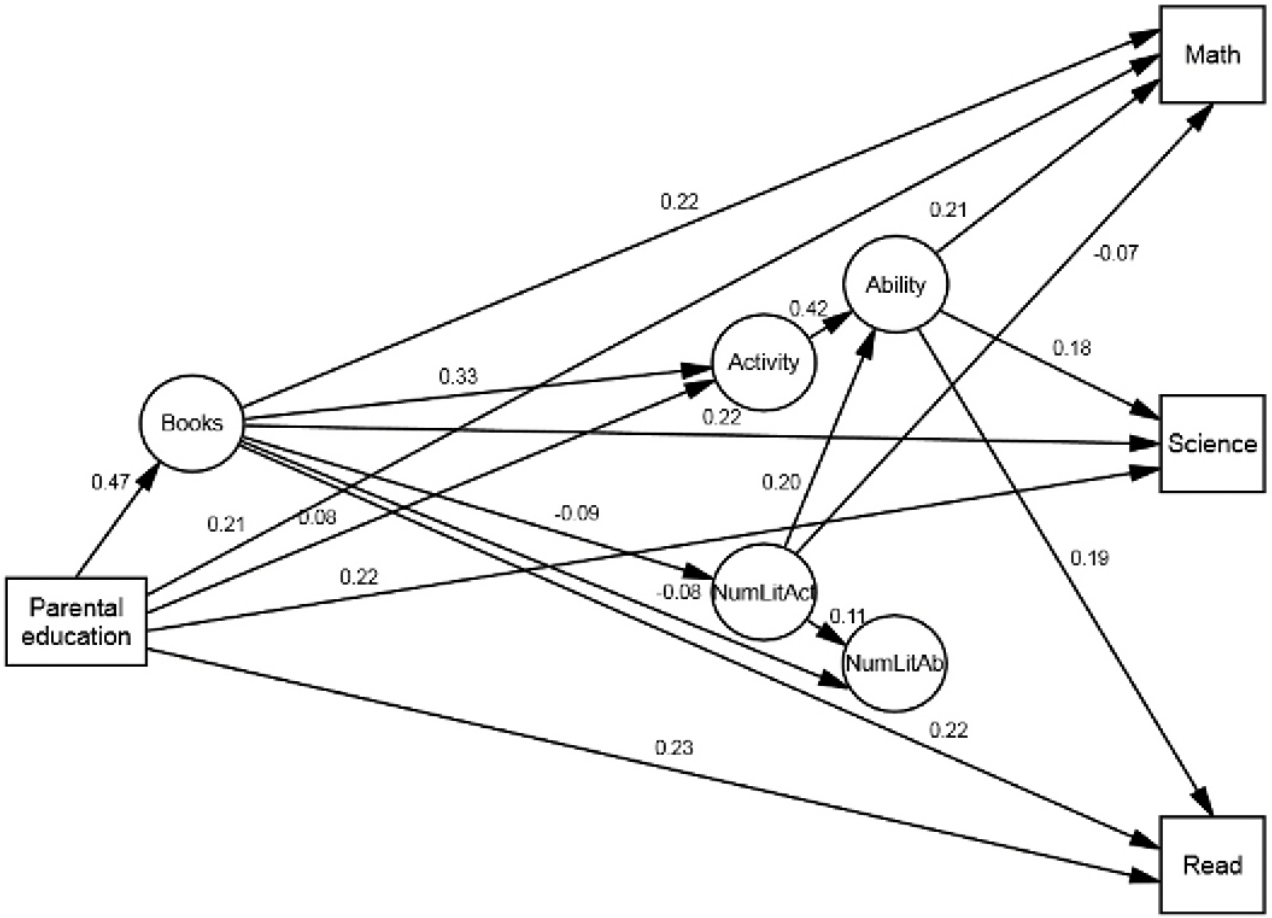
A Schematic Description of the Hypothesized Path Model



Structural Model

- Overall model – pooled data from all countries
- Parental education and gender unrelated
  - Can be presented separately
- Separate models for each country

Path Diagram for Relations between Parental Education and Achievement (All Participants, Pooled Data)



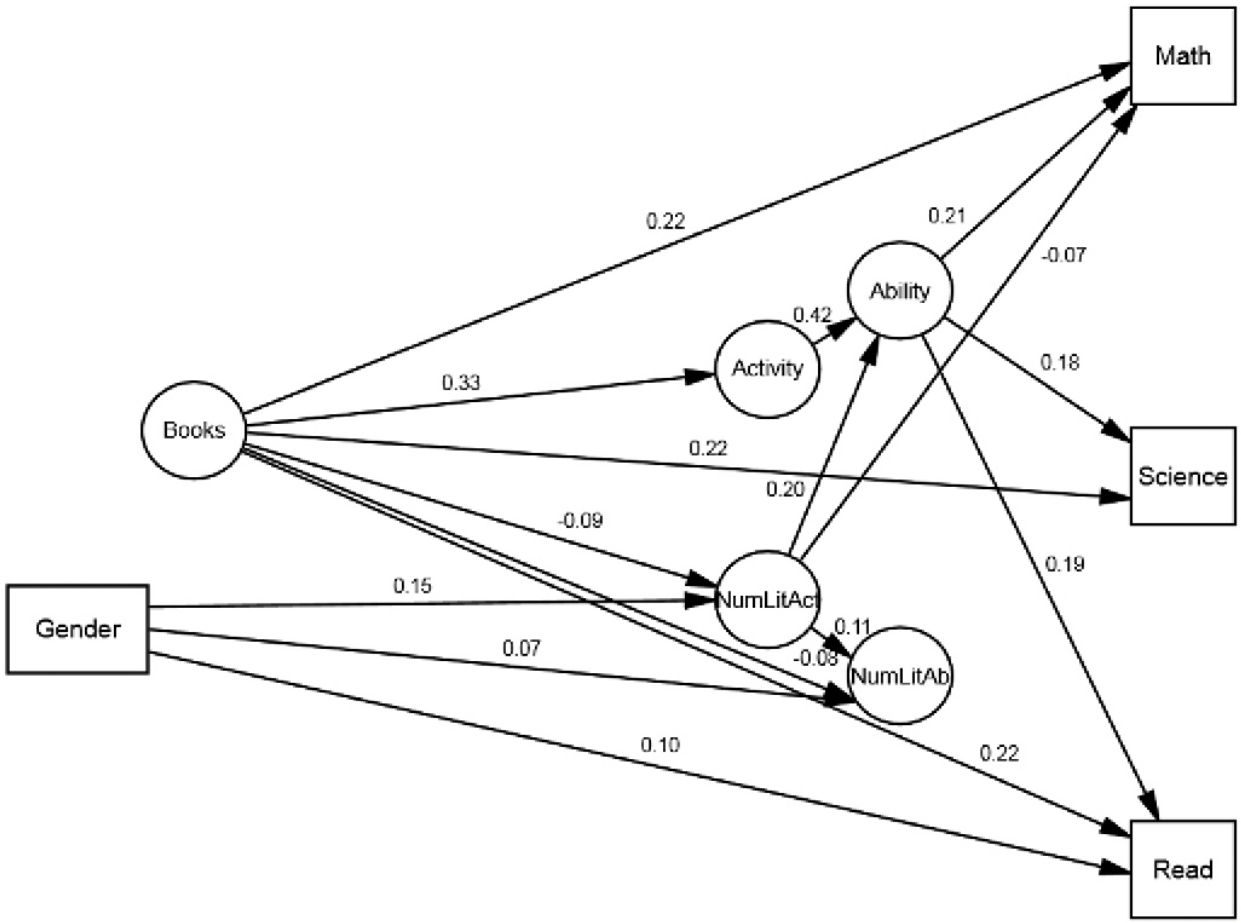
The Main Path for Parental Education

- **Main path** theoretically and empirically important – all links in chain fairly strong
- Books (total and children's books) an important mediating variable – represents valuing and investing in education
- Engaging in early literacy and numeracy activities strongly influences the child's skills when beginning school
- Second important path directly from parental education to activity, circumventing books

Literacy / Numeracy Emphasis

- Homes reporting stronger emphasis on literacy than numeracy activities also reported higher level of ability in general, leading to positive effect on achievement in all three subjects
  - An emphasis on literacy activities may have a positive effect on development of both literacy and numeracy skills
  - Numeracy skills at beginning of primary school tend to involve both reading and writing

Path Diagram for Relations between Gender and Achievement (All Participants, Pooled Data)



Gender

- Substantial gender effect in favor of girls with regard to reading
- Essentially no gender effects for mathematics or science
- Only a small part of the gender effect was mediated by the variables in the model
- For girls, activities in the home more oriented toward literacy than numeracy
  - Accentuates the Ability-Achievement path for girls

Conclusions

For nearly all countries,

- Effects of parental education on achievement at fourth grade were mediated via books, activities, and abilities (Main Path)

- There were substantial effects of number of books in the home on achievement

Conclusions (cont.)

- Another mechanism is that a stronger emphasis on literacy than numeracy activities influences the level of **both** literacy and numeracy skills when beginning primary school, which influences achievement
- It is more common for girls than for boys to have such an emphasis
- In many countries, homes with a larger number of books put more emphasis on literacy than on numeracy activities

Thank You!

Ina V.S. Mullis and Michael O. Martin

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