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Middle East & North Africa 2013

Early Primary Mathematics Education in Arab Countries of the Middle East and North Africa

Desk study commissioned by: German Federal Ministry for Economic Cooperation and Development and the Islamic Development Bank

Authors: Mohammed Matar, Yasmin Sitabkhan, Aarnout Brombacher

BMZ Federal Ministry for Economic Cooperation and Development

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Outline

1. Rich mathematical history of the region
2. What does the data say?
   2.1 Achievements in Access
   2.2 Pressing Challenges
3. What is mathematics & how is it used?
4. What does it mean to know/do mathematics?
5. What/how to teach mathematics in the early grades?
6. Implications for countries
7. A map for a “road not-traveled” towards quality
8. Example of Palestine
9. Questions for further discussion

1. Rich Mathematical History of the Region

Muhammad al-Khawarazmi (9th century)

- **The decimal system:** introduced the Hindu numerals, including the concept of zero, into the Arab world, this system was later transmitted to the West.
- **Algebra:** The search for comprehensive method of division led Khawarazmi to the invention of algebra.

Omar Khayyam (1040-1123)

- Contributed to the advancement of Algebra
- In his use of analytical geometry, he anticipated the geometry of Descartes.
- Prepared a calendar said to be more accurate than the Gregorian one in use to the present day

2. What does the data say? International comparisons

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2.1 Achievements in the MENA Region - Access

- Over the last decade, the MENA region has seen significant progress in the education sector.
  - Large investments at the primary level have resulted in a dramatic increase in access to and completion of primary school
  - The region made tremendous strides in closing the education gender gap, providing equitable access to primary education for boys and girls

2.2 Pressing Challenges – Learning Outcomes

Data on learning outcomes from:

- TIMSS 2011 (4th grade; Participation of 11 Arab countries)
- Early Grade Mathematics Assessment (EGMA) (2nd and 3rd grade; 2 Arab countries participated)

Exhibit 1.1: Distribution of Mathematics Achievement

TIMSS 2011 Mathematics 4th Grade

Country	Average Scale Score
2 Singapore	606 (3.2)
Korea, Rep. of	605 (1.9)
2 Hong Kong SAR	602 (3.4)
Chinese Taipei	591 (2.0)
Japan	585 (1.7)
1 Northern Ireland	562 (2.9)
Belgium (Flemish)	549 (1.9)
Finland	545 (2.3)
England	542 (3.5)
Russian Federation	542 (3.7)
2 United States	541 (1.8)
1 Netherlands	540 (1.7)
2 Denmark	537 (2.6)
1 2 Lithuania	534 (2.4)
Portugal	532 (3.4)
Germany	528 (2.2)
Ireland	527 (2.6)
2 Serbia	516 (3.0)
Australia	516 (2.9)
Hungary	515 (3.4)
Slovenia	513 (2.2)
Czech Republic	511 (2.4)
Austria	508 (2.6)
Italy	508 (2.6)
Slovak Republic	507 (3.8)
Sweden	504 (2.0)
2 Kazakhstan	501 (4.5)
TIMSS Scale Centerpoint	500
Malta	496 (1.3)
1 Norway	495 (2.8)
2 Croatia	490 (1.9)
New Zealand	486 (2.6)
Spain	482 (2.9)
Romania	482 (5.8)
Poland	481 (2.2)
Turkey	469 (4.7)
2 Azerbaijan	463 (5.8)
Chile	462 (2.3)
Thailand	458 (4.8)
Armenia	452 (3.5)
1 Georgia	450 (3.7)
Bahrain	436 (3.3)
United Arab Emirates	434 (2.0)
Iran, Islamic Rep. of	431 (3.5)
2 Qatar	413 (3.5)
Saudi Arabia	410 (5.3)

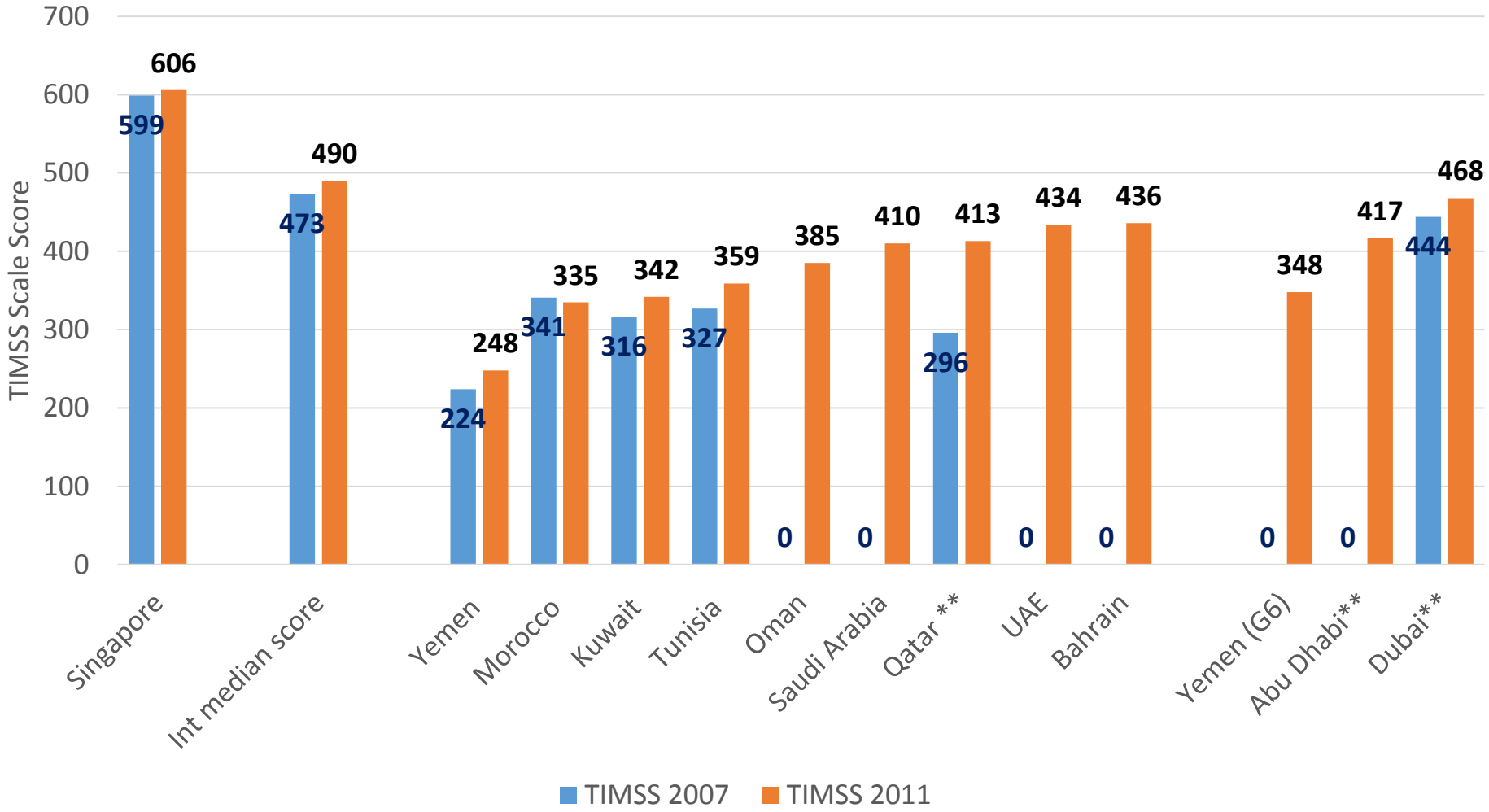
Mathematics Achievement Distribution

TIMSS 2011 Mathematics 4th Grade

Bahrain	436 (3.3)
United Arab Emirates	434 (2.0)
Iran, Islamic Rep. of	431 (3.5)
2 Qatar	413 (3.5)
Saudi Arabia	410 (5.3)
Ψ Oman	385 (2.9)
Ψ Tunisia	359 (3.9)
1 ж Kuwait	342 (3.4)
ж Morocco	335 (4.0)
ж Yemen	248 (6.0)

ж Yemen	348 (5.7)
Dubai, UAE	468 (1.6)
Abu Dhabi, UAE	417 (4.6)

What About "TREND" Indicators?



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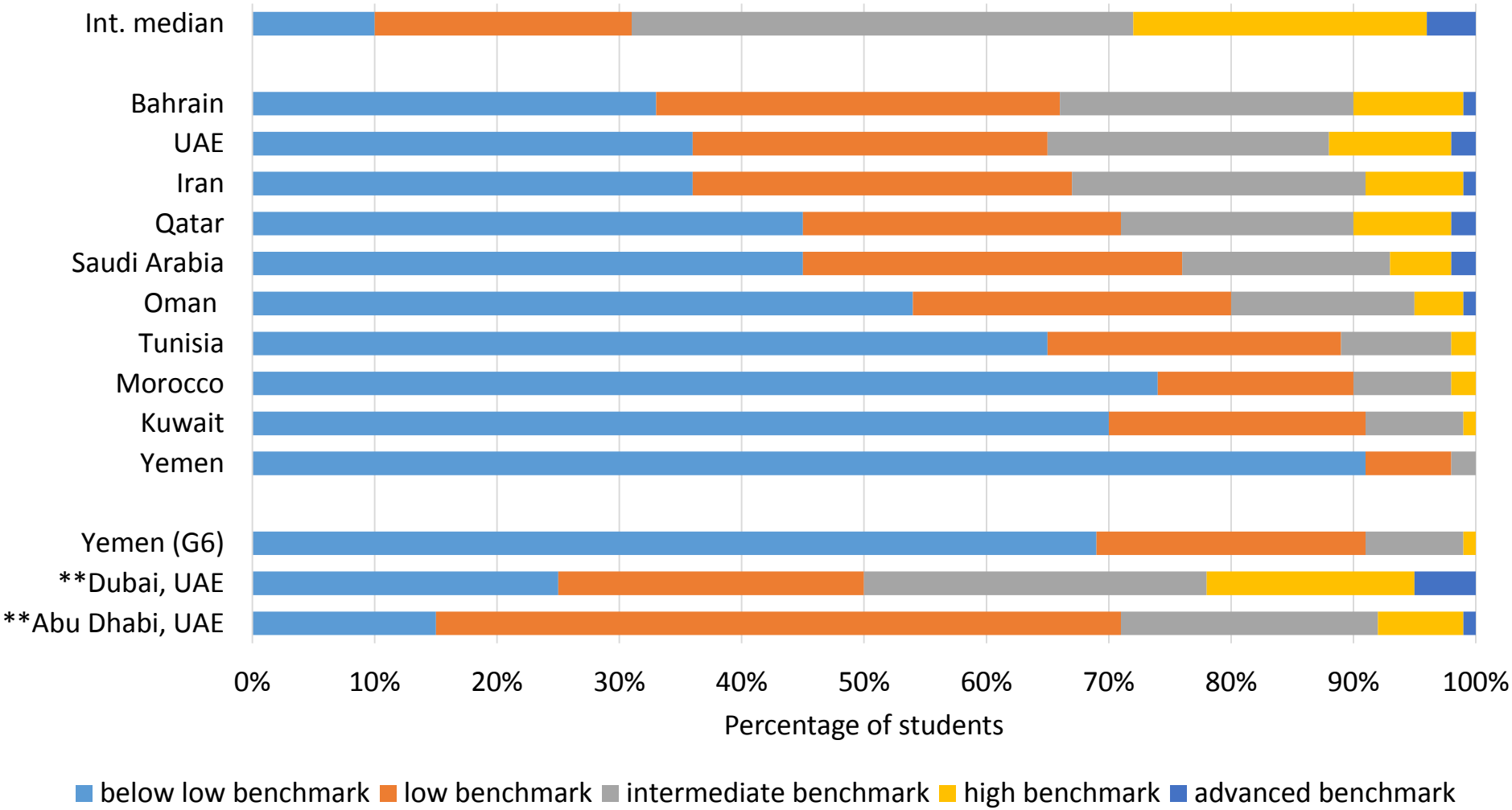
Grade 4 TIMSS performance at International Benchmarks of Mathematics Performance



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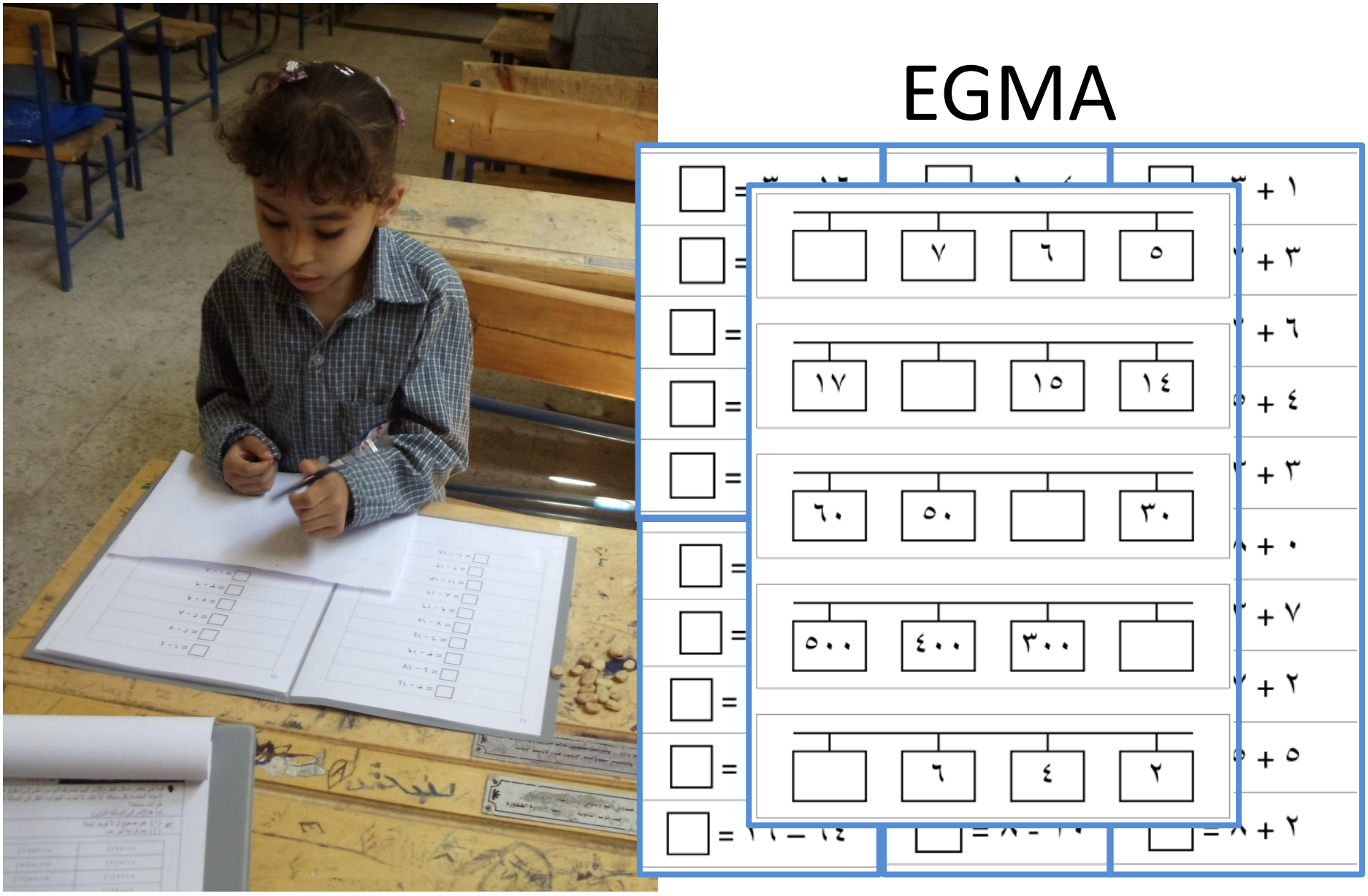
EGMA



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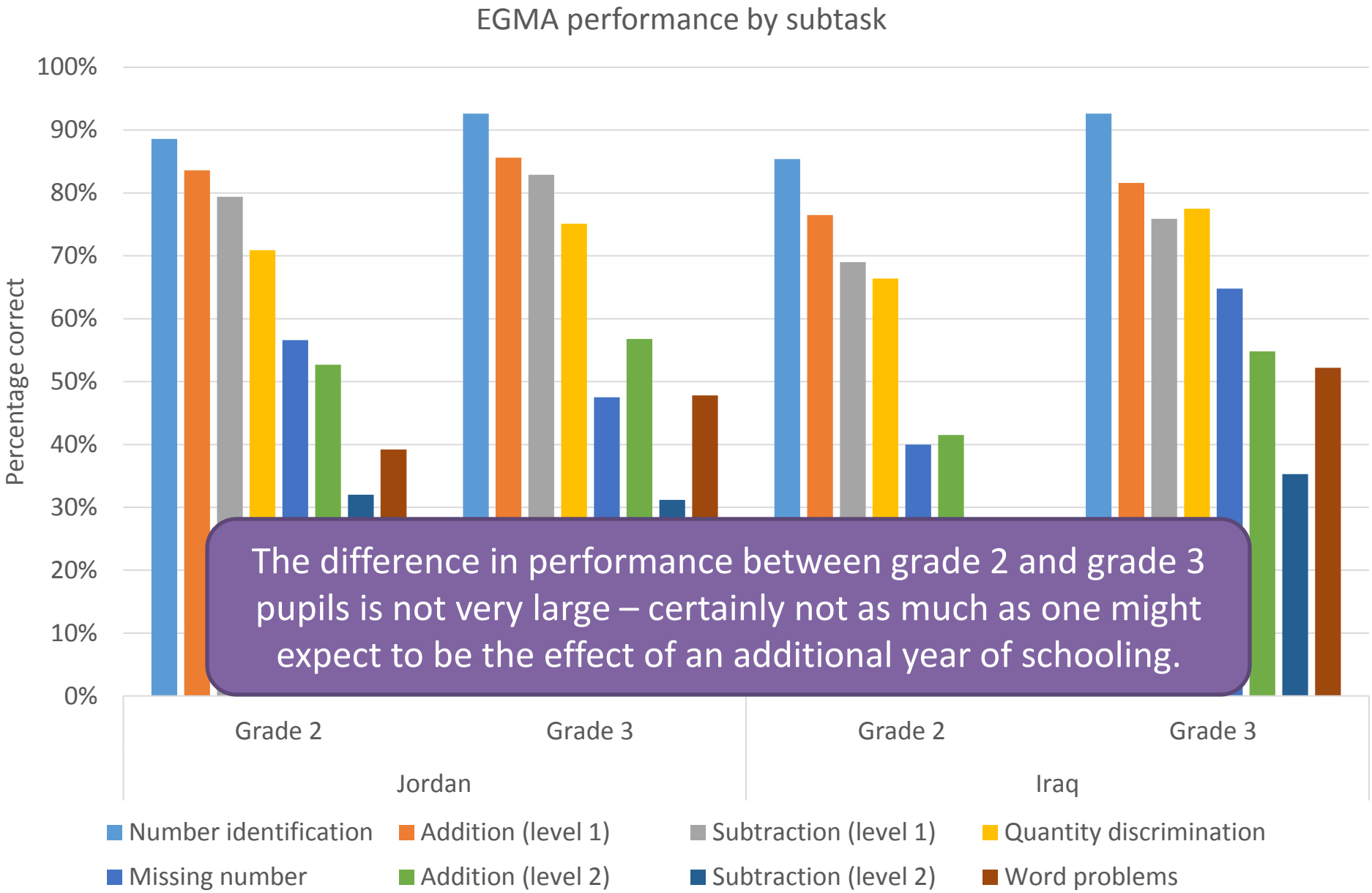

The difference in performance between grade 2 and grade 3 pupils is not very large – certainly not as much as one might expect to be the effect of an additional year of schooling.

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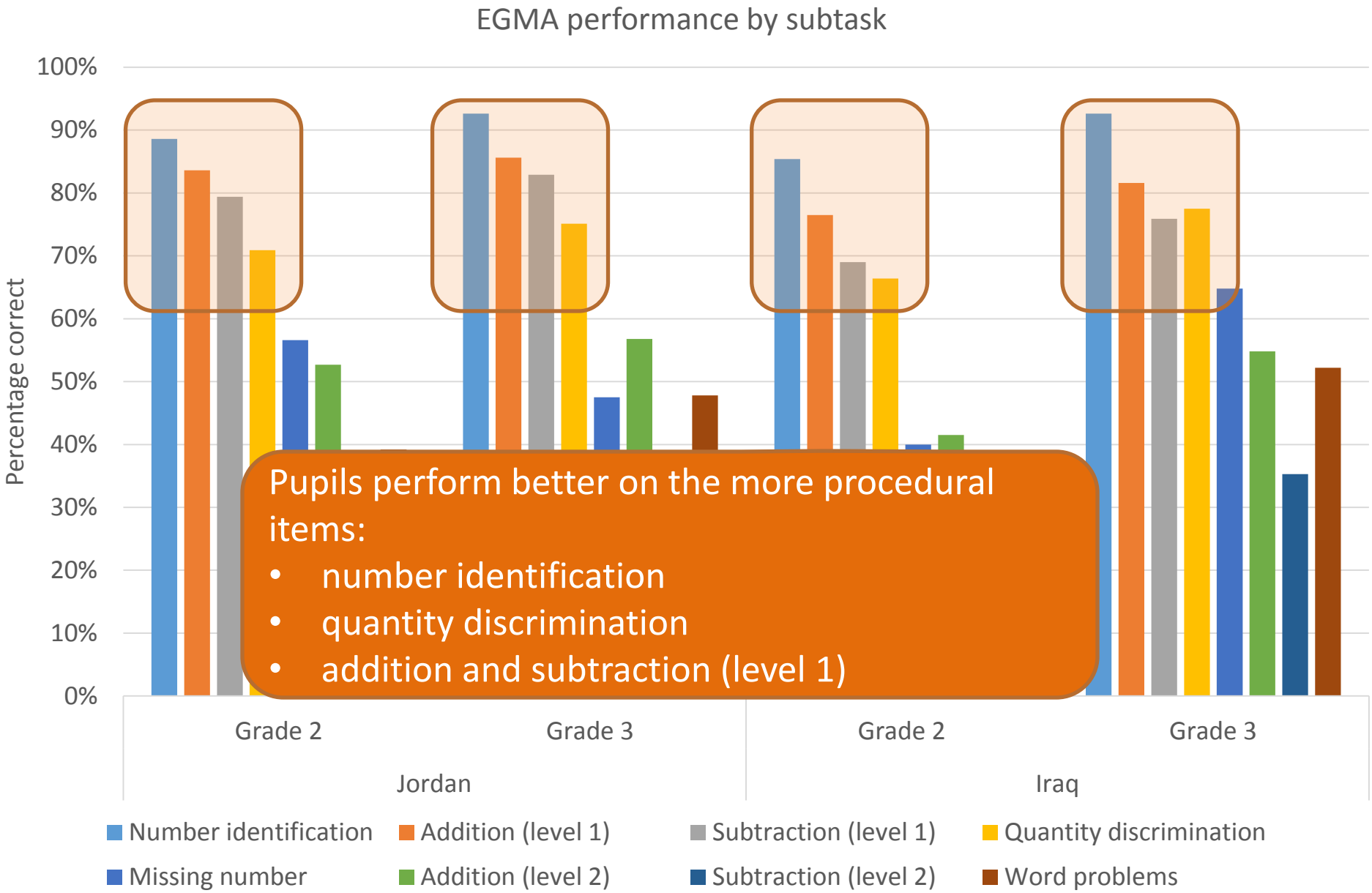

Pupils perform better on the more procedural items:

- number identification
- quantity discrimination
- addition and subtraction (level 1)

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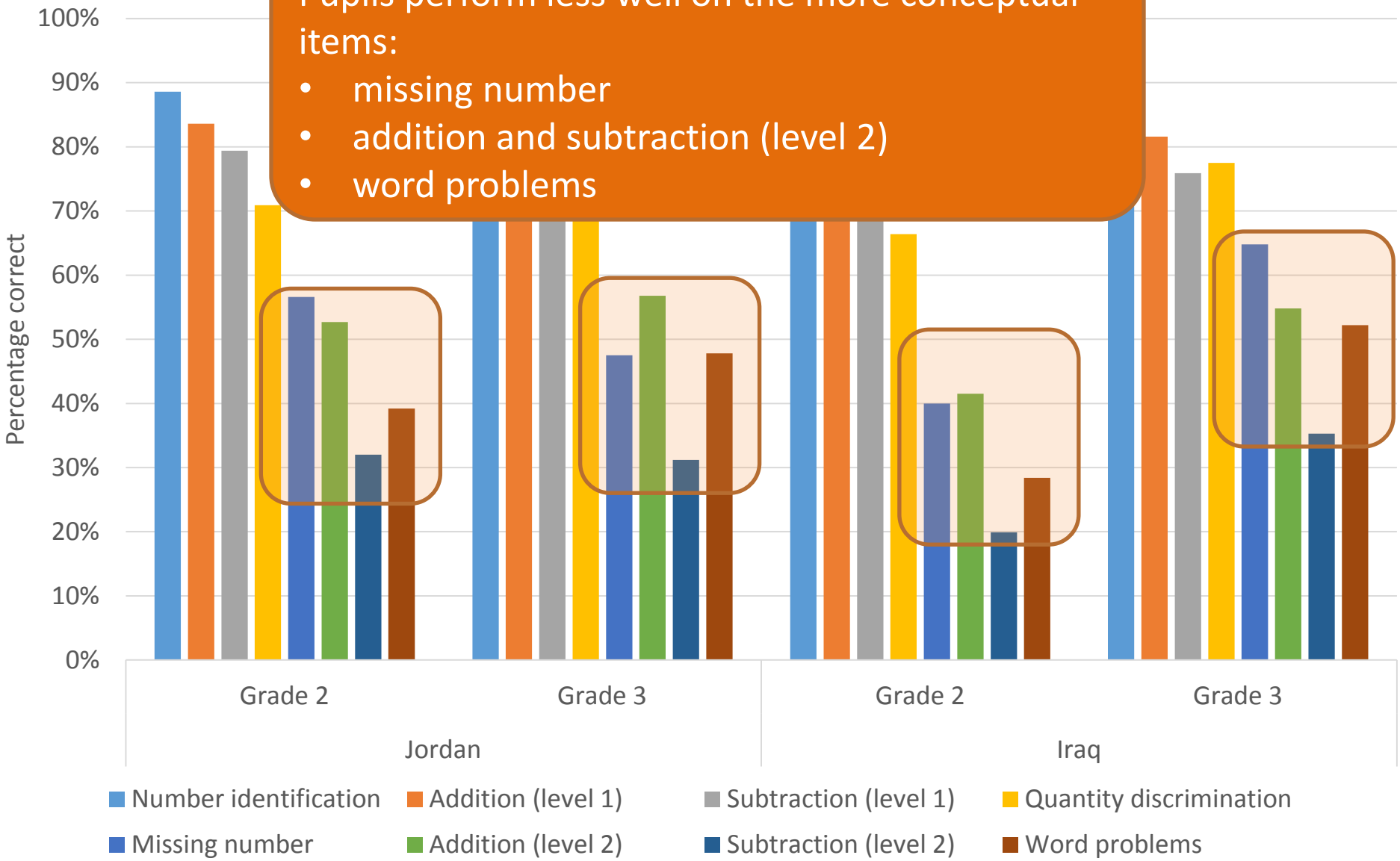
Pupils perform less well on the more conceptual items:

- missing number
- addition and subtraction (level 2)
- word problems



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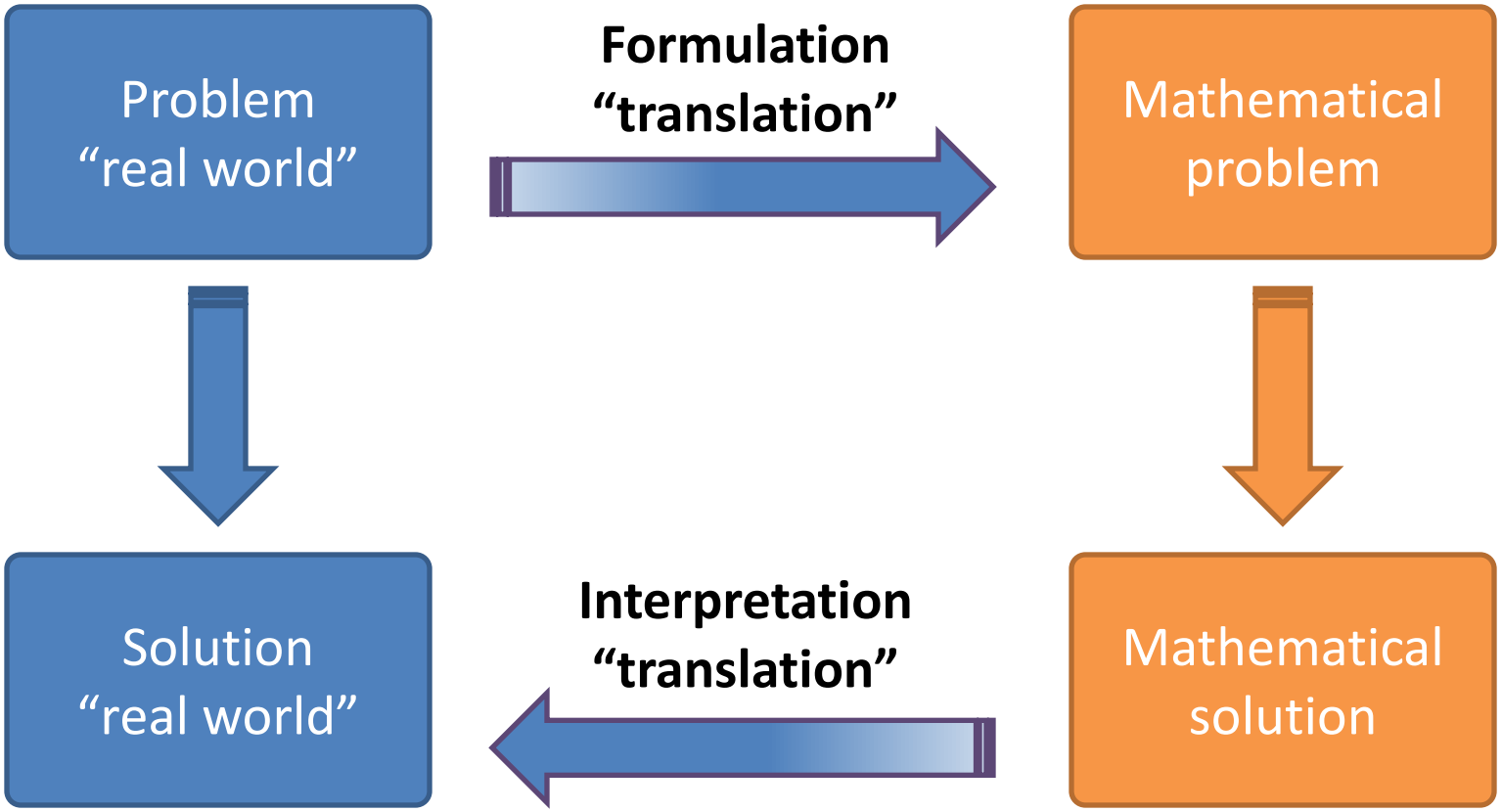
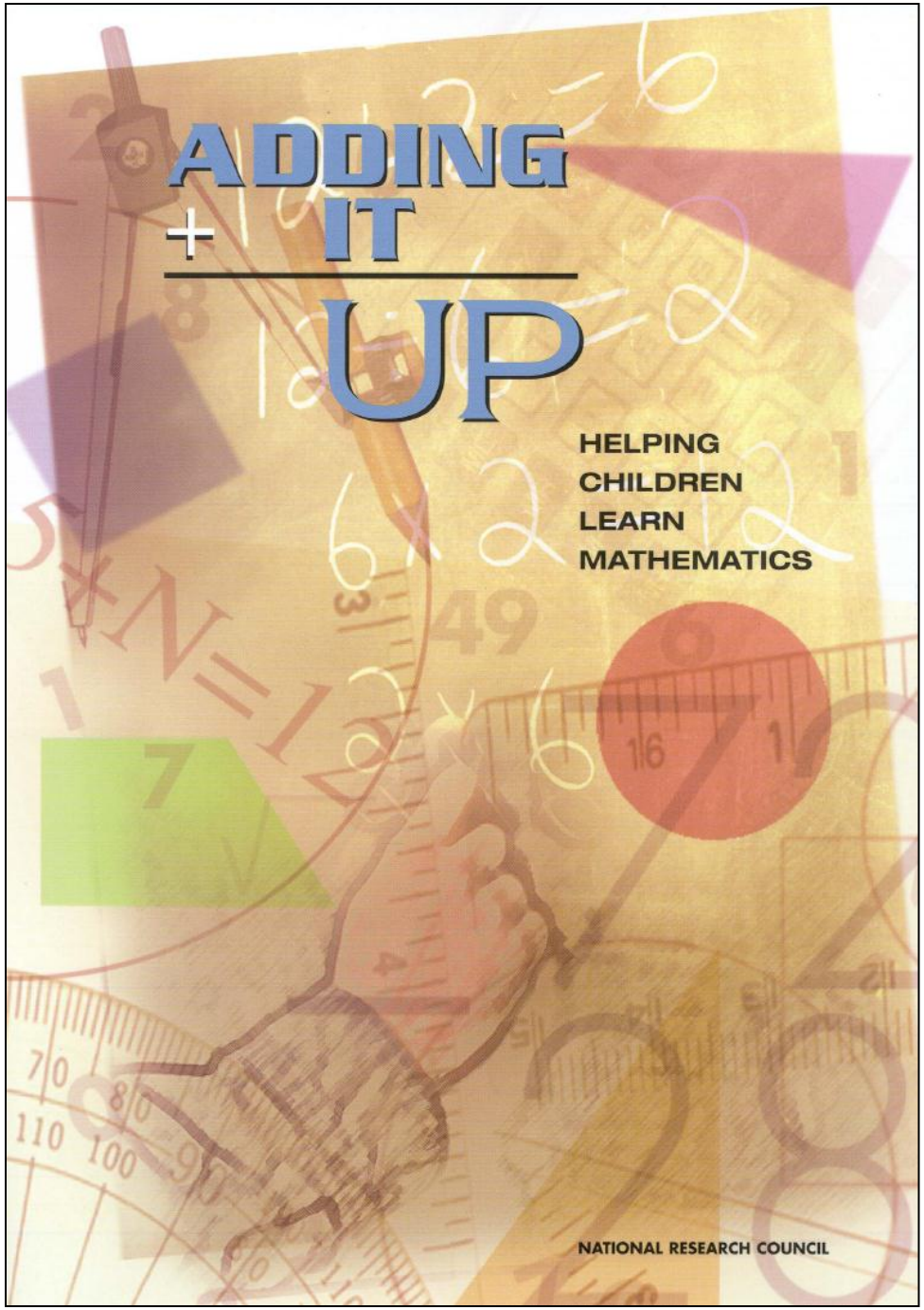
3. What is mathematics and how is it used?

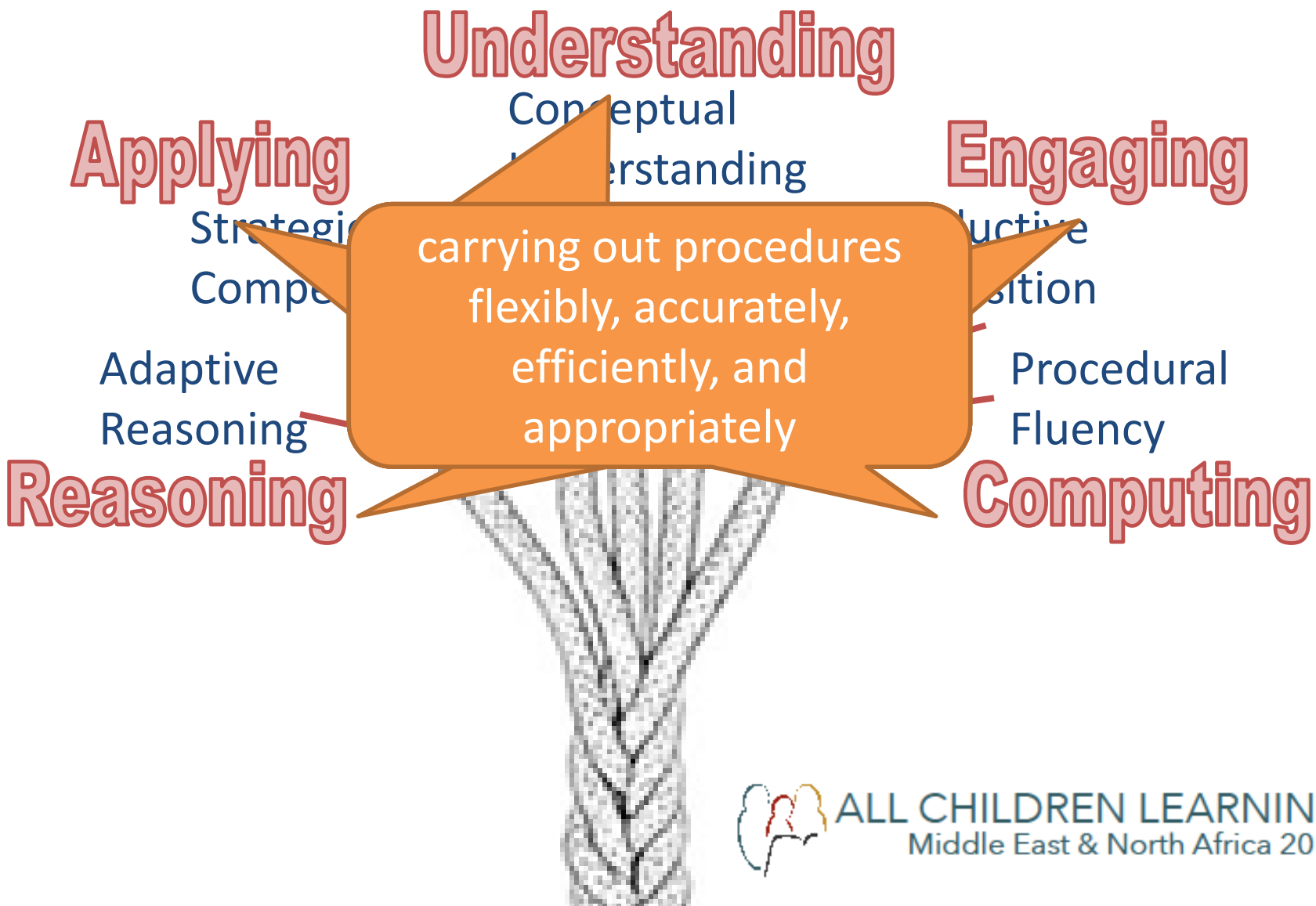




… to adopt a composite, comprehensive view of successful mathematics learning… we have chosen mathematical proficiency to capture what we think it means for anyone to learn mathematics successfully.

Mathematical proficiency, as we see it, has five strands

4. What does it mean to know/do mathematics?



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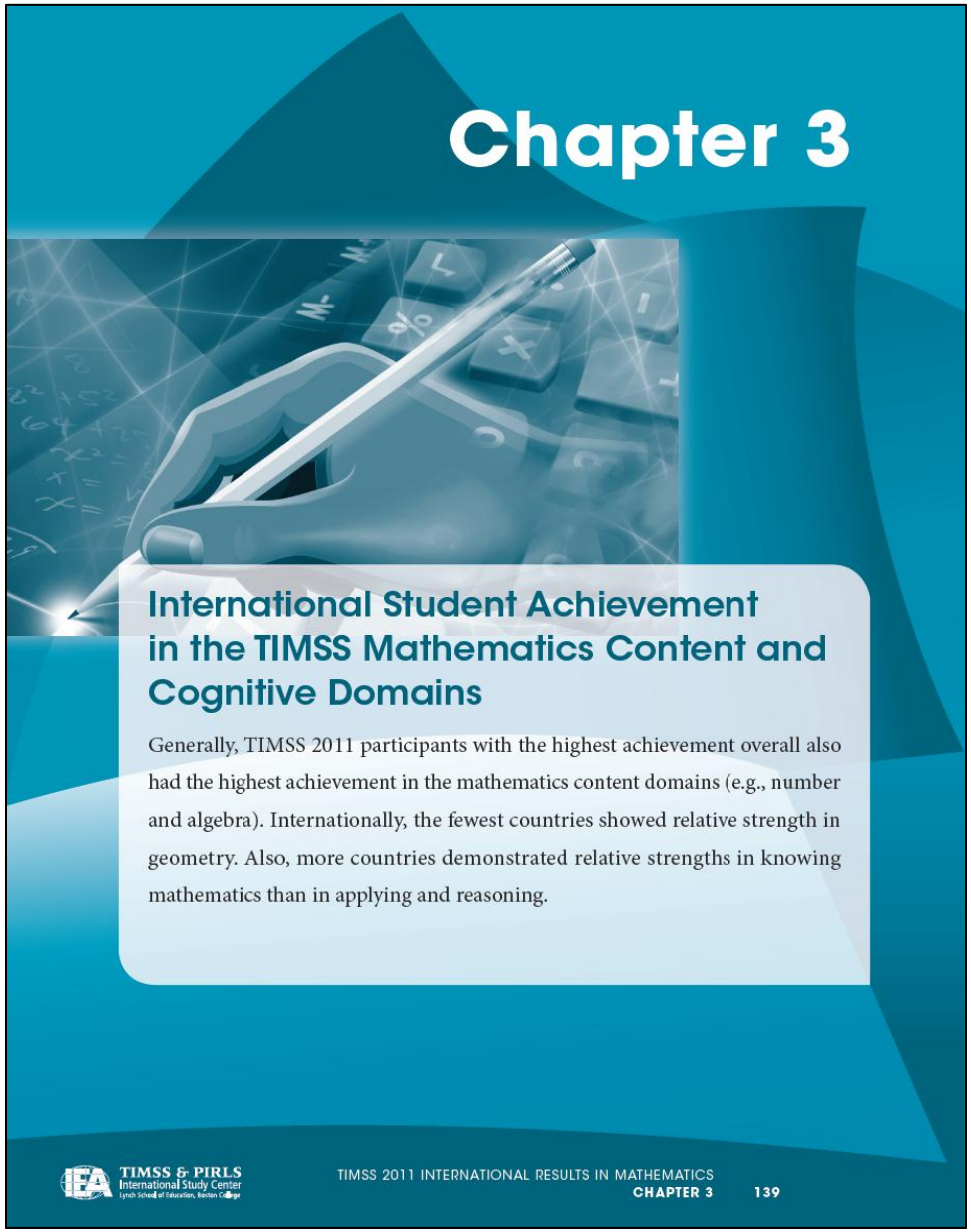
Example from TIMSS: three content and cognitive domains

- **Knowing** refers to the student's knowledge base of mathematics facts, concepts, tools, and procedures.
- **Applying** focuses on the student's ability to apply knowledge and conceptual understanding in a problem situation.
- **Reasoning** goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems.



Chapter 3

International Student Achievement in the TIMSS Mathematics Content and Cognitive Domains

Generally, TIMSS 2011 participants with the highest achievement overall also had the highest achievement in the mathematics content domains (e.g., number and algebra). Internationally, the fewest countries showed relative strength in geometry. Also, more countries demonstrated relative strengths in knowing mathematics than in applying and reasoning.

TIMSS & PIRLS International Study Center

TIMSS 2011 INTERNATIONAL RESULTS IN MATHEMATICS
CHAPTER 3 139

… the mathematics assessment is organized around two dimensions: a **content dimension** specifying the subject matter or content domains to be assessed in mathematics, and a **cognitive dimension** specifying the **thinking processes** that students are likely to use as they engage with the content.

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Communalities in learning outcomes in content and cognitive domains

International Student Achievement in the TIMSS Mathematics Content and Cognitive Domains

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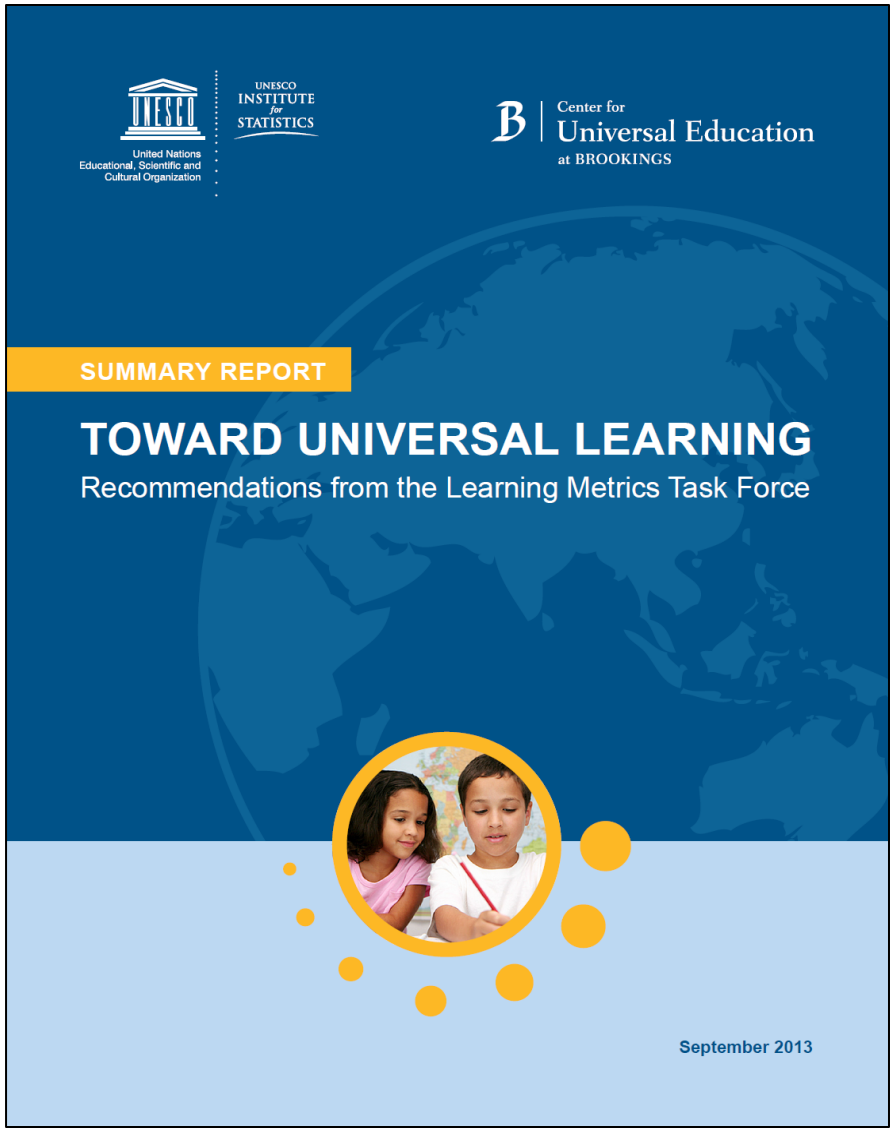
5. What and how to teach mathematics in the early years?



Focal outcomes for Early Childhood Level:

1. Number sense and operations
2. Spatial sense and geometry
3. Patterns and classification
4. Measurement and comparison

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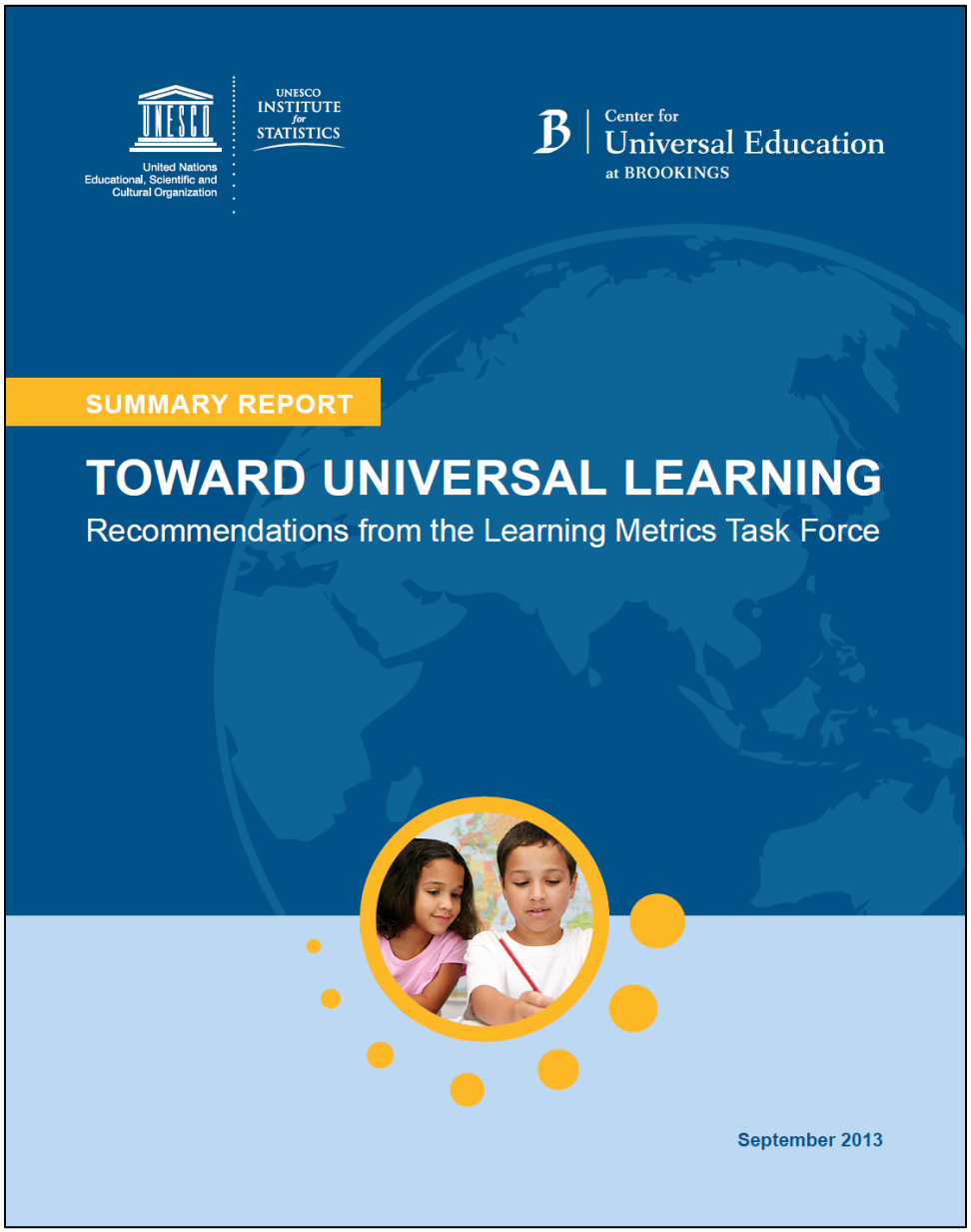

Focal outcomes for Primary Level:

1. Number concepts and operations
2. Geometry and patterns
3. Mathematics application

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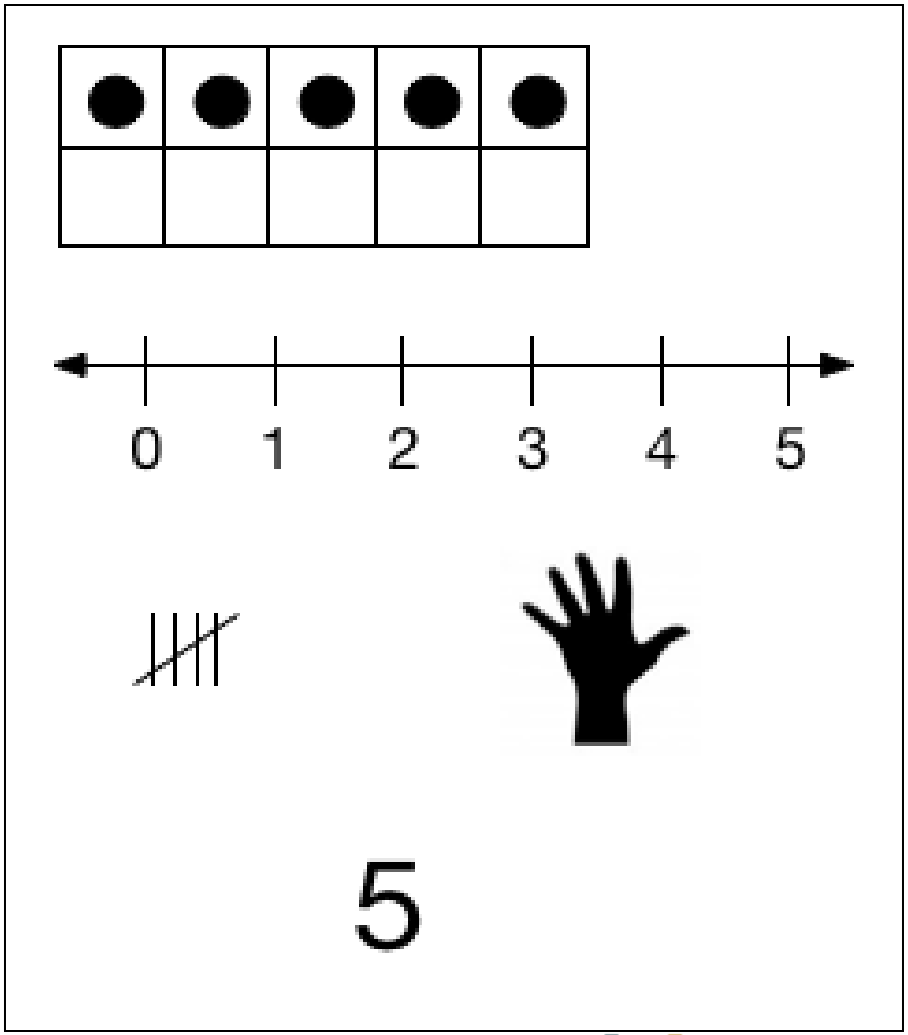
HOW? - Number concepts: The Importance of Mathematical Representations



6. Implications for Countries

- Changing teaching and learning from what children learn to how children learn
- The role of curriculum
- The role of assessment
- The role of policy
- Teacher training: In service and Pre-service
- National vision(s) and leadership
- At the institutional level (MoE)

7. A map for a “road not-traveled” towards quality

How to reform inputs and processes **towards improved learning outcomes** in early grade mathematics…?

1. How to reform **math instruction** to strengthen instructional methodologies which promote active learning and critical thinking. ?
2. How to reform **teacher education** programs?
3. How to reform **learning materials?**
4. How to reform **community and parental involvement**; and
5. How to reform early grade math **policy oriented research** ?

8. Palestine – An Example how the prior mentioned questions were addressed

1. Advancing pedagogy using IT, and non traditional teaching methods
2. Developing mew curriculum focusing on cross thematic approach and (math for life)
3. Reforming teacher education programs based on action researches using national and data from international large scale assessments

9. Questions for Discussion

- How can math standards be formulated and used to advance early mathematics teaching and learning?
- How can assessments results better be used to improve classroom practices?
- Your questions