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Working Paper July 2018

Early Mathematics Counts

Promising Instructional Strategies from Low- and Middle-Income Countries

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There is a large body of evidence substantiating the importance of mathematical literacy and the key role of foundational mathematics in early years of education on later academic outcomes (Duncan et al., 2007; Duncan & Magnuson, 2011; Hanushek & Woessmann, 2008; Siegler et al., 2012). Despite this, we have little evidence from low- and middle-income countries on how to better ensure that students are learning the foundational skills in pre-primary through lower primary grades. Given that quality of instruction is key, we examined the evidence for the types of instructional strategies used in low- and middle-income contexts. We cannot link the effective instructional strategies to learning outcomes, given the limited information provided in reports we reviewed. However, understanding which strategies are used, and how they manifest in different contexts, is an important first step to understanding which strategies are effective for learning. This brief summarizes our forthcoming review paper (Sitabkhan & Platas, 2018).

Four strategies for teaching mathematics

1 Using multiple representations, including manipulatives:

instruction that

- addresses knowledge at both concrete and abstract levels
- uses concrete objects, including locally made objects
- provides exposure to a variety of representations when examining ideas and concepts and when solving problems

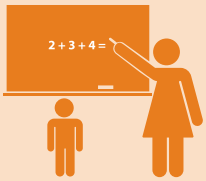
2 Knowing and using developmental progressions:

instruction that

- is sequenced
- builds on prior knowledge
- is differentiated
- provides appropriately challenging tasks
- uses both conceptual and procedural knowledge to build fluency

3 Supporting student explanation and justification:

instruction that



- draws on student thinking as a resource for explanation and justification
- encourages students to justify their solutions
- asks questions such as "why" and "how"

4 Integrating formal and informal mathematics:

instruction that

- recognizes and validates students' informal thinking
- integrates knowledge students bring from home and other out-of-school contexts

From Sitabkhan & Platas, 2018

We first conducted a global literature review of evidence showing use of instructional strategies in mathematics classrooms from pre-kindergarten to grade 3. Our review yielded four major practices for which there is substantial evidence, though most of this evidence comes from high-income countries. The four strategies are shown at left.

Our next step was to conduct a comprehensive review of instructional strategies in documented interventions in low- and middle-income countries. Our search included a broad base of scholarship from 1993 to 2018, including non-journal-based research. The search resulted in 1,484 documents, yielding 24 articles with articulated instructional strategies for pre-school through grade 3 in quasi-experimental or random control studies. We coded each article for evidence of the four instructional strategies, as shown in the table.

Instructional Strategies in Low- and Middle-Income Countries

The most commonly seen instructional strategy was the use of multiple representations of mathematics concepts, including manipulatives. This strategy was seen in 16 of the 24 studies. The prevalence of this strategy was likely augmented by mentions of "hands-on" learning and "use of locally sourced materials." However, frequently not mentioned in the articles were descriptions of what the manipulatives were, how teachers were taught to use them, and how they were used by students, if at all. While the use of manipulatives is a key instructional strategy, it is imperative to understand how those manipulatives were used in the classroom. We did not find much evidence for the use of other representations such as ten frames or number lines, though this could have been because of the lack of detailed descriptions of instructional strategies in many reports.

In 10 of the 24 studies, we found indications that teachers had been provided with support in understanding and offering instruction according to developmental progressions. Most of this evidence showing use of developmental progressions came from sample materials provided and from references to sequenced content and differentiated instruction.

Selected studies on early grade mathematics instruction

Authors and year	Country focus	Multiple representations	Developmental progressions	Explanation and justification	Integration of formal and informal mathematics
Amente et al., 2013	Ethiopia	✔			
Banerjee et al., 2007*	India		✔		
Bekman, 2011	Turkey	✔			
Brombacher, 2015 Brombacher et al., 2015	Jordan	✔	✔		
Education Development Center, 2017	Rwanda			✔	
de Baessa & Chesterfield, 1996	Guatemala				✔
Dillon et al., 2017*	India				✔
Fleisch et al., 2016*	South Africa		✔		
Gallego, Näslund-Hadley, & Alfonso, 2017	Peru	✔	✔		
Guajardo et al., 2013	Malawi	✔			
Hembold, 2014	South Africa	✔			
Jonason et al., 2014	Bangladesh	✔			
King et al., 2015	Liberia		✔		
Martinez et al., 2013	Mozambique	✔			
McEwan, 1998*	Colombia	✔	✔		✔
Näslund-Hadley et al., 2012 Näslund-Hadley et al., 2014*	Paraguay	✔	✔		✔
Opel, Camellia, & Aboud, 2006	Bangladesh	✔			
Opel et al., 2012*	Bangladesh	✔		✔	
Piper & Mugenda, 2014 Piper et al., 2016*	Kenya	✔	✔	✔	
Piper, Sitabkhan, & Nderu, in press*	Kenya	✔	✔	✔	
Save the Children, 2015	Rwanda	✔			
Tabakamulamu, 2010	Zambia			✔	
Vaijayanti et al., 2016	India	✔	✔		✔
Vula et al., 2017*	Kosovo			✔	

* Peer-reviewed journal source

Mathematics instruction is not culture and context neutral. One instructional strategy may look very different across contexts.

Six of the 24 studies demonstrated in some way that teachers supported explanation and justification, and 5 showed that teachers integrated formal and informal mathematics. The small evidence base for these two strategies may be a result of a lack of information in the studies we reviewed. It could be the strategies were more prevalent, but our ability to determine their use was limited. In addition, these two strategies are among the most difficult to implement, as they require significant changes to teacher behavior.

Next Steps

Our review revealed that although there is some developing evidence illustrating the types of mathematics instruction strategies found in low- and middle-income contexts, more systematic research is needed to build our evidence base. We recommend the following.

- **Provide detailed information on instructional strategies**
  - To build our common knowledge, future interventions should make efforts to detail the types of instructional strategies used.
  - More studies that isolate instructional strategies are needed to produce better understanding of how strategies are implemented in different contexts.
- **Broaden methodology**
  - Future studies should measure teacher practices as an outcome in addition to student learning outcomes. This will help us understand what effective instruction looks like in different contexts.
- **Improve transparency and dissemination**
  - Studies should provide detailed information about the interventions investigated, including the materials developed, teacher training, and sample sizes. This information can help to better design effective interventions in early mathematics.

Works Cited

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Sitabkhan, Y., & Platas, L.M. (2018). *Early mathematics counts: Promising instructional strategies in low- and middle-income countries*. Research Triangle Park: NC: RTI Press.