

Capturing Teacher's Mathematical Knowledge for Teaching

CIES 2023

Wendi Ralaingita, RTI International
Aizada Mamytova, RTI International
Yasmin Sitabkhan, RTI International



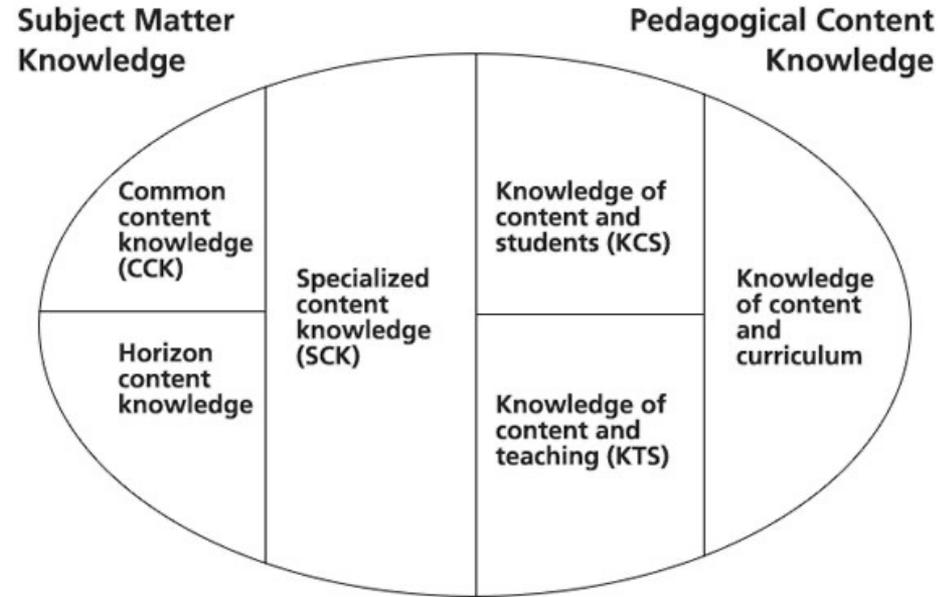
Outline

- Introduction to MKT
- Instrument development and Field test
- Pilot-Kyrgyz Republic
- Discussion and next steps



Mathematical Knowledge for Teaching – an Introduction

- Essential question: What do math teachers need to know and be able to do in order to teach effectively?
- From foundation of Shulman's Content Knowledge/Pedagogical Content Knowledge
- MKT Unpacks CK and PCK



From Ball, D.L., Thames, M.H., Phelps, G.C. (2008). Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education* 59(5) 389-407.

Developing the MKT Survey

- Can we develop a tool with core items that can be easily adapted for valid use in different contexts?
- Based on existing tools, developed matrix of domains and problem types
- Adapted and generated problems according to matrix (refined over time)
- Cognitive interviews
- Problem refinement/finalization

	Developmental progressions	Scaffold	Content
Number			
Operations			
Geometry and Spatial Sense			
Measurement			

Students in your class are asked to measure the length of the classroom in steps. Ruslan says the classroom is 10 steps long. Ayana says the classroom is 12 steps long. Both think they are right.

How can you help them explain this difference?

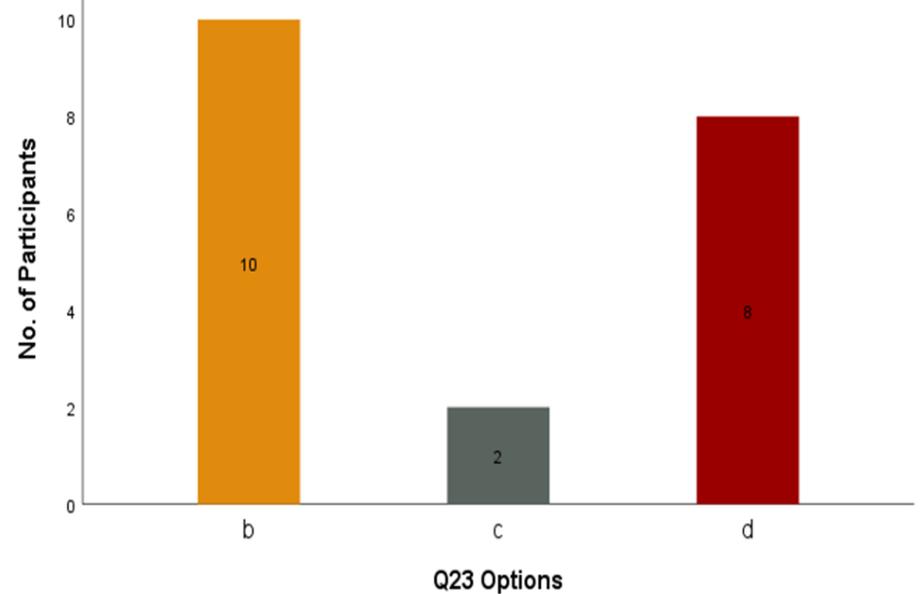
- Ask them to measure the length of the classroom with a ruler.
- Ask them to measure the classroom again in steps.
- Ask them to compare the length of their step.
- I have difficulties answering.

Tools Adaptation Process



23 Which of the following is the approximate diameter of a mature tree found in Kathmandu valley and its surrounding?

- a. 0.5 millimeters
- b. 0.5 meters
- c. 10 meters
- d. I have difficulties answering



- Option C - I think trees are bigger. So, I chose the highest diameter.
- Option D- it can be not said since there is no numeric value. It can be anything.

Overall Observations:

- 1) Teachers appear to understand questions
- 2) Teachers are less aware with the progression of mathematical knowledge.
- 3) Teachers are more focused on algorithmic problem solving rather than conceptual learning.

Pilot- Kyrgyz Republic



USAID Okuu Keremet! (Learning is awesome!) project

- 5-year project to improve reading and math instruction in primary schools benefiting more than 450,000 children in 1,682 public schools
- 10 training modules on improved math instruction developed covering key math domains
- Mathematics program piloted in 30 schools in 2021 before large-scale intervention
- Over 13,000 teachers joined the training in 2022



Methods

KoboToolbox

**Математиканы
башталгыч класстарда
окутууну баалоо**

*13. Кайсы теманы өздөштүрүү үчүн берилген сүрөт эң пайдалуу болушу мүмкүн?

а. Көбөйтүү

б. Формаларды аныктоо

в. Үлүштөр

д. Мен жооп берүүдөн кыйналып турам

→ Следующий

Powered by ENKETO

Назад

← Вернуться в нач... Перейти к концу →

- MKT survey administered during a teacher training in 30 math pilot schools
- 323 teachers took part in pre-test in February 2021 (Module 2). 280 teachers took part in post-test in November 2021 (Module 10)
- Teachers were sent a link with the survey; answered questions during the training using their phones
- Survey was adapted in country to align with curriculum
- 23 items across number, operations, geometry, and measurement included in survey

Illustrative Findings

- At the baseline, teachers answered, on average, 56% of items correctly.
- At endline, the average score was 63% correct. This represented about two more problems solved correctly at endline out of 23.
- Areas in which teachers showed growth were directly related to content provided in the modules
 - Ex: developing mathematical models for word problems
- Individual problems within each domain best illustrated how teachers shifted in knowledge during the pilot intervention.



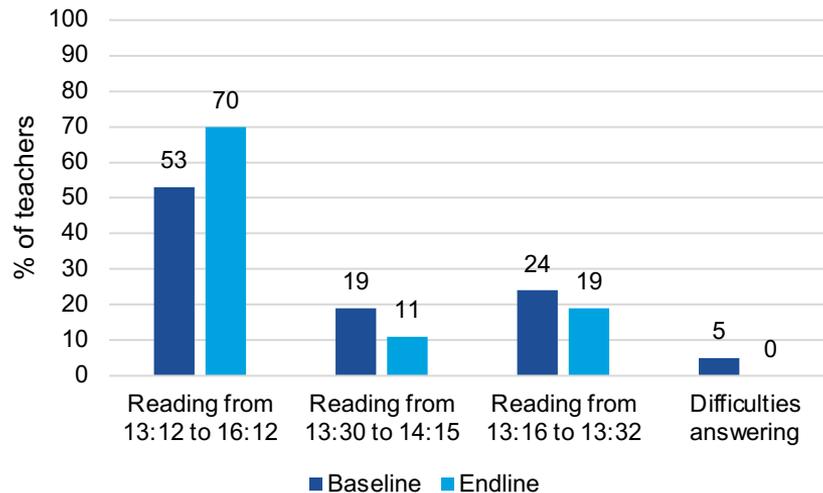
Illustrative Findings

Teacher performance on **Measurement** items was strong given the centrality of measurement in both current textbooks as well as the modules.

Which word problem would be the easiest for a child to solve during the initial stage of learning?

- a. Rima was reading a book. She started reading at 13:12 and finished at 16:12. For how many hours did she read?
- b. Aknur was reading a book. He started reading at 13:30 and finished at 14:15. For how many minutes did he read?
- c. Zina was reading a book. She started reading at 13:16 and finished at 13:32. For how many minutes did she read?
- d. I have difficulties answering

Which problem is the easiest for a child to solve?



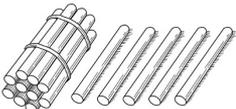
Illustrative Findings

Teacher performance on **Early Mathematics** items went down from baseline to endline.

What is easier for most learners to do during the initial stage of learning?

The teacher asks Sezim to show her 15.

a. Sezim will show the teacher the following sticks:



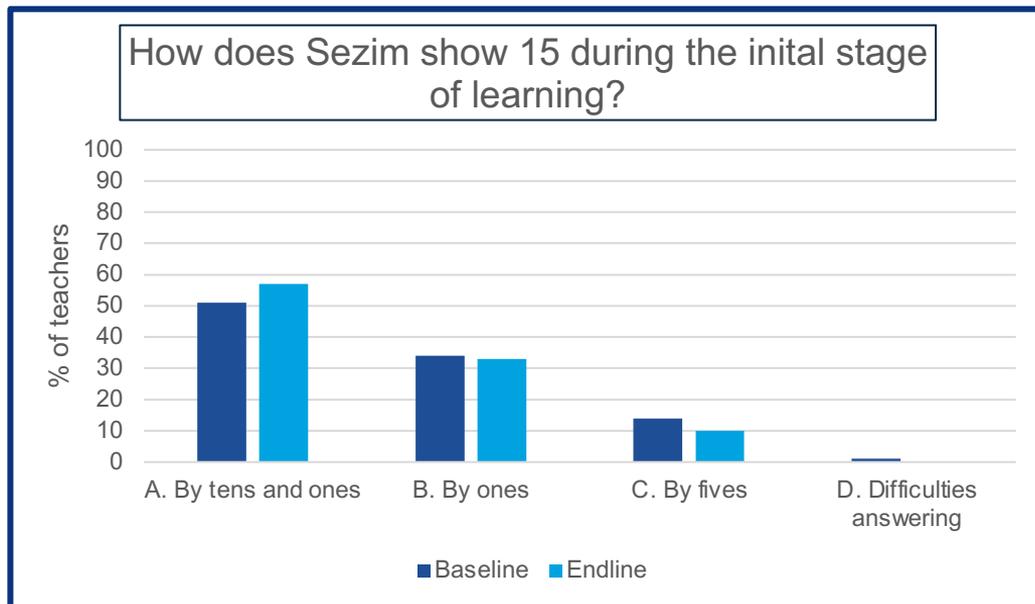
b. Sezim will show the teacher the following sticks:



c. Sezim will show the teacher the following sticks:



d. I have difficulties answering



Revised modules on numbers and operations to include more early mathematics concepts

Conclusion and Next Steps



Conclusion and Next Steps

- The survey has many uses:
 - **Before:** Inform development of teacher trainings to better target teacher needs
 - **During:** Be a tool to for professional development during teacher trainings
 - **Before and After:** A subset of the items can be used as a pre-post survey to understand how teacher knowledge changes over time (confirmed via IRT analysis)

Conclusion and Next Steps

- Share the tool with the larger education community (will be shared on <https://shared.rti.org/> soon!), with guidelines for adaptation and use.
- Utilize MKT survey in multiple contexts (e.g., Numeracy at Scale)
- Collaborate with larger community to create tools and resources to improve teachers' MKT in early grades.

Key References and Resources

- Ball, D.L., Thames, M.H., Phelps, G.C. (2008). Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education* 59(5) 389-407.
- Cole, Y. Assessing elemental validity: the transfer and use of mathematical knowledge for teaching measures in Ghana. *ZDM Mathematics Education* 44, 415–426 (2012). <https://doi.org/10.1007/s11858-012-0380-7>
- Hill, H., Schilling, S., & Ball, D. (2004). Developing Measures of Teachers' Mathematics Knowledge for Teaching. *The Elementary School Journal*, 105(1), 11-30.
- Platas, L. M. (2015). The Mathematical Development Beliefs Survey: Validity and reliability of a measure of preschool teachers' beliefs about the learning and teaching of early mathematics. *Journal of Early Childhood Research*, 13(3), 295-310.

Thank You!

Dr. Wendi Ralaingita | wralaingita@rti.org

Aizada Mamytova | amamytova@rti.org

Dr. Yasmin Sitabkhan | ysitabkhan@rti.org

Learn more about RTI's work in
International Education:



www.rti.org/idg_education