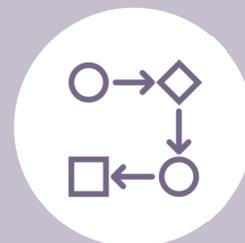


# Teachers' Understanding of Learning Progressions in Foundational Numeracy in Malawi



## Introduction

Malawi and many other countries in sub-Saharan Africa experience low learner achievement in mathematics in primary and secondary school, as evidenced by both national assessments and international assessments (Brombacher, 2019; Kazima et al., 2022; Milner et al., 2011). One of the main factors underlying this low achievement is the poor quality of mathematics teaching in primary schools. While there are many challenges that teachers face, we focus in this study on a well-documented area: teachers' mathematical knowledge for teaching (MKT), specifically as it relates to students' learning progressions. There is ample evidence of the link between MKT and high-quality instruction from high-income contexts (Ball et al., 2008; Hill et al., 2008). What is understudied is how teachers grapple with their own knowledge about how students learn when confronted with a new curriculum that may or may not align with their own knowledge, and the ways they make sense of the new curriculum. This study took advantage of a unique moment in time, as primary teachers in Malawi are using a new set of teachers' guides and student workbooks. These new materials, rolled out in September 2024 by the government of Malawi, are based on a large body of research on how students learn, and they integrate "best practices" for high-quality instruction. The new materials stand in contrast to the older set of materials, which teachers used for several years.

Through qualitative interviews with standard 1 (grade 1) teachers, we aimed to probe teacher knowledge around how students learn two core concepts in primary: number sense and basic addition and subtraction.

This study highlights the importance of understanding teacher knowledge. Although there is prior research from low- and middle-income countries that documents strengths and weaknesses in teachers' MKT through surveys, and work that documents how to improve MKT among teachers in low-income environments (Kazima et al., 2022; Sitabkhan et al., 2024), one area that has been left under-explored is how teachers are thinking about learning progressions during a moment of transition. If we want to improve the quality of instruction in early primary, it is not enough to provide a new curriculum and ask teachers to follow it; instead, we need to understand the interaction between teacher beliefs about learning progressions and the curriculum and use this knowledge to design programs that teachers are more likely to use.

Below, we first describe our methods, and then present findings and discussion according to our research questions:

1. In what ways does the Malawi National Mathematics Curriculum for standard 1 sequence content? What differences in sequence are there between the new curriculum and the old curriculum?
2. How do teachers understand learning progressions in standard 1 when teaching number sense and basic addition and subtraction? How do teachers view the differences between the old and new curriculums?

We then offer concluding thoughts and recommendations both for future research and for program design and implementation.

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## Methods

### Setting

The study was conducted in two schools in rural areas of Zomba, a district in Malawi. Zomba was purposefully chosen for its convenient location close to the University of Malawi, where the research team was based, so that day trips could be possible. The two schools were suggested by the district's primary education advisor following our request to have at least three teachers from each school with experience in teaching standard 1 mathematics.

### Participants

We interviewed a total of six teachers (three teachers from each school). The teachers were identified by the head teachers as those who were currently teaching mathematics in standard 1 using the new curriculum and had taught mathematics in standard 1 in previous years using the old curriculum. All six teachers were women. It is typical in Malawi for schools to rely largely on female teachers for the early primary grades. The teachers' teaching experience is shown in Table 1.

**Table 1. Participant years of experience**

Teacher	Overall teaching experience (# of years)	Experience teaching grade 1 math (# of years)
1	27	18
2	14	7
3	11	2
4	30	6
5	9	5
6	8	5

### Interviews

We developed a semi-structured interview guide based on the research questions and the information we were seeking from the teachers. The draft interview guide was piloted on one teacher whom we identified during a previous project as an experienced teacher of standard 1 mathematics. Our aim in using this teacher as a pilot was for her to help us see if our questions would get the type of responses

we were looking for, and how to revise the questions to make them clear to the teachers. The revised interview guide (see Annex 1) was then introduced to the research assistants during a one-day training on how to interview teachers.

Each of the two research assistants conducted interviews with three teachers at one school. Thus, we had one research assistant per school. The day and time of the interviews were agreed on by the research assistant and the teachers. All of the interviews were completed over the course of five days. Each interviews lasted between 50 and 90 minutes. The interviews were audio recorded and transcribed.

The interviews were structured in a way to prompt teachers to talk specifically about what they do in their classroom. Based on the results of the curriculum analysis, we focused on two content areas where there were discernible differences between the old and new curriculums for standard 1: number sense, and addition and subtraction. For each area, we asked teachers about three aspects: learning goals for that particular concept, progressions for that concept, and activities to teach the content. We began with open questions, asking the teachers what they thought students needed to learn, how they learned it, and what types of activities were best. Then we brought in specific examples with artifacts (e.g., curriculum documents, teachers' guides, and textbooks) to ask teachers about specific differences between the old and new curriculums and associated materials. This approach allowed us to analyze how teachers were thinking about these two content areas from two different angles—both at a conceptual level and with regard to the Malawian materials specifically.

## Analysis

We read all of the interview transcripts and identified each teacher's responses to the two parts of the interview: introducing numbers, and addition and subtraction. For each part, we identified what the teachers said about (1) what they think the number range for standard 1 should be and why; (2) how they think that particular concept should be introduced to children; (3) the activities they use to teach the concept; and (4) their preferences between the old and new curriculums in terms of how the concept is presented. We constructed a table to capture all of the responses, and then identified patterns that emerged.

## Results

### In what ways does the Malawi National Mathematics Curriculum for standard 1 sequence content? What differences in sequence are there between the new curriculum and the old curriculum?

Tables 2 and 3 present the differences between the old and new curriculums with regard to number sense and the basic operations of addition and subtraction.

**Table 2. Introducing numbers: Differences between old and new curriculums**

Topic	Old syllabus	New syllabus
Number range	0–9 Term 1: 0–5 Term 2: 0–9 Term 3: 0–9	0–30 Term 1: 0–5 Term 2: 0–10 Term 3: 0–30

<p>Approach to introducing numbers</p>	<p>Each number is introduced separately and has several lessons.</p> <p>The order of introducing the numbers 0–5 is 1, 2, 3, 0, 4, 5.</p> <p>There are ten lessons each for 1, 2, and 3; eight lessons each for 0 and 4; and nine lessons for 5.</p> <p>Each number is introduced through objects showing the quantity the number represents.</p> <p>Activities for each number follow the progressions of:</p> <ul style="list-style-type: none"> <li>• recognizing the number</li> <li>• tracing the number</li> <li>• writing the number</li> </ul> <p>Ordering numbers is done after all of the numbers 0–5 have been introduced.</p>	<p>The numbers 1, 2, and 3 are introduced at the same time.</p> <p>The order of introducing numbers 0–5 is (1, 2, 3), 4, 5, 0.</p> <p>There are five lessons introducing 1, 2, and 3 together; two lessons each for 4 and 5; and one lesson for 0.</p> <p>The numbers are introduced through perceptual subitizing using a set of dot plates. Learners are taught to link the words “one,” “two,” and “three” to the correct number of dots. The progression of activities is:</p> <ul style="list-style-type: none"> <li>• subitizing numbers</li> <li>• modeling numbers</li> <li>• matching numbers to objects</li> <li>• composing numbers</li> <li>• comparing numbers</li> </ul>
<p>Numbers beyond 5</p>	<p>Numbers 6–9 are introduced separately in term 2 in the order 6, 7, 8, 9 and through similar activities of recognizing, tracing, and writing the numbers. There are seven lessons for 6; six lessons for 7; six lessons for 8; and seven lessons for 9.</p> <p>This is followed by ordering numbers 0–9 and filling in missing numbers in the range 0–9.</p>	<p>Numbers 6–10 are introduced in term 2 through conceptual subitizing.</p> <p>Numbers 6, 7, and 8 are introduced together in three lessons; 9 and 10 are introduced together in three lessons.</p>
<p>Resources for introducing numbers</p>	<p>Resources include:</p> <ul style="list-style-type: none"> <li>• objects and counters (e.g., bottle tops)</li> <li>• images of objects such as cups, fruits, and animals</li> <li>• fingers</li> <li>• the ground (learners practice writing numbers on the ground before writing in notebooks)</li> </ul>	<p>Resources include:</p> <ul style="list-style-type: none"> <li>• dot plates</li> <li>• number tracks</li> <li>• number cards</li> <li>• five frames and ten frames</li> <li>• part-whole models</li> <li>• counters (e.g., bottle tops and sticks)</li> <li>• fingers</li> </ul>

The number range for the old curriculum was 0–9, while the range for the new curriculum is 0–30. In the introduction of numbers, the main difference is that the old curriculum introduced one number at a time in the order 1, 2, 3, 0, 4, 5, 6, 7, 8, 9. Meanwhile, the new curriculum introduces 1, 2, and 3 at the same time; 6, 7, and 8 at same time; and 9 and 10 at same time. The order is (1, 2, 3), 4, 5, 0, (6, 7, 8), (9, 10). The old curriculum allocated a total of 47 lessons to introduce the numbers 0–5, and 26 lessons for 6–9, while the new curriculum has only ten lessons for 0–5 and six lessons for 6–10.

**Table 3. Addition and subtraction: Differences between old and new curriculums**

Topic	Old syllabus	New syllabus
Number range	0–9	0–20
Introduction	Addition and subtraction are introduced as separate topics: addition in topic 2 and subtraction in topic 3. The symbols +, –, = are introduced in the first few lessons.	Addition and subtraction are introduced together in topic 2 using part-whole models. The symbols + and = are introduced in lesson 4, while the symbol – is introduced in lesson 12 of the topic.
Structures of addition and subtraction	Addition is defined as “combining,” while subtraction is defined as “taking away.” There is no mention of other structures of addition and subtraction.	Addition and subtraction are grouped into three structures: combine, change, and compare.
Approach	<ol style="list-style-type: none"> <li>i. Introduction to addition using objects: learners count how many objects there are in each group, combine the groups, and then count how many there are all together.</li> <li>ii. Practicing how to write and say addition sentences using the + and = signs.</li> <li>iii. Completing addition sentences horizontally (e.g., <math>2 + 3 = ?</math>).</li> <li>iv. Adding numbers vertically.</li> <li>v. Introduction to subtraction: learners are introduced to the concept of taking away a given amount from a certain number.</li> <li>vi. Writing subtraction sentences horizontally.</li> <li>vii. Completing subtraction sentences horizontally.</li> <li>viii. Subtracting numbers vertically.</li> </ol>	<ol style="list-style-type: none"> <li>i. Introduction to addition and subtraction using part-whole models.</li> <li>ii. Writing number sentences from a part-whole model.</li> <li>iii. Number bonds.</li> <li>iv. Addition as adding together (combining) and adding more (changing).</li> <li>v. Finding missing parts.</li> <li>vi. Subtraction as how many left and finding a part.</li> <li>vii. Subtraction using number tracks.</li> <li>viii. Addition and subtraction contexts.</li> </ol>
Resources for addition and subtraction	Resources include: <ul style="list-style-type: none"> <li>• counters (e.g., bottle tops, sticks, stones, and seeds)</li> </ul>	Resources include: <ul style="list-style-type: none"> <li>• part-whole models</li> <li>• counters (e.g., bottle tops and sticks)</li> <li>• five frames and ten frames</li> <li>• number tracks</li> </ul>

The number range for addition and subtraction in the old curriculum was 0–9, while in the new curriculum it is 0–20. The main difference is that the old curriculum introduced addition and subtraction separately, while the new curriculum introduces the two together in one topic. Furthermore, the old curriculum introduced addition as combining, and subtraction as taking away, using physical objects to illustrate the operations. In contrast, the new curriculum introduces addition and subtraction using part-whole models. Lastly, while the old curriculum introduced the addition and subtraction signs in the first few lessons, the new curriculum does this later.

## How do teachers understand learning progressions in standard 1 when teaching number sense and basic addition and subtraction? How do teachers view the differences between the old and new curriculums?

To answer this, we first focus on number sense, and then on the basic operations of addition and subtraction.

### Number Sense

**Number range.** We asked teachers what range of numbers they believed students should learn in grade 1. Interestingly, a majority of teachers said that students should go beyond 9, the range in the old curriculum. Only one teacher, Teacher 1, thought that students have difficulty going beyond 10. She said:

*I think it should be from 0 to 10 ... Because most of the learners find it difficult from 10 ... For example, the learners learn the number line in the new curriculum, where they have to fill in the missing numbers on number line. So, when filling in the missing numbers from 0 to 10, most learners do this without much problems. But surpassing this point—going up to 11, 12, 13—that's where there are a lot of problems.*

The rest of the teachers felt that students are capable of going beyond 9 for reasons such as their prior experience at home, the need for subsequent learning, and the fact that once students know some numbers it is not hard to keep going. Teacher 2 thought that students have experience with counting objects at home, so they should not be subjected to an age-determined limit:

*The children should not necessarily be given a limit that in standard 1 they should not reach this point because when they are playing at home with different objects, they count the objects they are playing with up until they reach a certain number according to the number of objects they are playing with. So they should not be given a limit just because of their age.*

Teacher 4 referred to the patterns in the number system as a justification for why students are able to go beyond 9:

*Number 1 up to 30 [for standard 1] ... So, it will not be difficult for them. They just ... for they say 1 up to 10. And up to 10 they add a number, another number ... they add zero. And when they add zero, because 11, 12, 13, up to 20, and when they come to 20, it's 20 just ... they just add ... 21, 22, 23, already they know 20. So they add 10 another ... when they had another 10, they come to 30: 31, 32, 33 and then they add 40: 41, 42 ...*

**Introduction of numbers.** All teachers felt that numbers should be introduced one at a time. They supported the old curriculum's approach of exploring one number for several lessons before moving on to another number. However, they saw the pace of the old curriculum as too slow. The teachers thought that introducing more than one number at a time—for example, introducing 1, 2, and 3 at the same time, as is done in the new curriculum—is challenging to teach and difficult for learners. For example, Teacher 3 and Teacher 5 said:

*We start by helping the learners know everything about 1. When they know 1 properly, they can now move on to another number ... When ... for example 1 and 2 are introduced on the same day, the learners end up getting confused. (Teacher 3)*

*I think they should learn one [number] at a time. Like only to introduce to them that there is this number ... So, firstly you have to introduce using some resources that this is 3. Can you show me 3? Do this 3. Show the actual 3. They [learners] have to practice now, the actual 3. (Teacher 5)*

The teachers also found the pace of the new curriculum to be too fast. For example, Teacher 1 said:

*I personally think it's too much work for the learners because for them to make sense of the things we have taught them, it is a challenge since, for example, you do this page today, then tomorrow you do the next page, and one page contains a lot of activities, so it is difficult for the concepts to be understood and make sense in the learners' heads.*

**Preferences on the curriculum.** Four of the six teachers preferred the new curriculum, while two preferred the old curriculum. The four who preferred the new curriculum noted that the old curriculum was too easy and not challenging enough for learners. They found the pace of ten lessons each for introducing the numbers 1–3, and a total of 47 lessons to teach the numbers 0–5, to be too slow and boring. As Teacher 5 put it:

*I can say that when you take a lot of time ... for the learners to learn one number ... it can be tiresome, or boredom to them.*

These teachers liked the range of numbers used in the new curriculum but not the fact that multiple numbers are introduced at once. Teacher 3 said:

*In the old one, the learners were learning few numbers while in the new one, the learners are learning many numbers. This is a good thing because in this one [old syllabus] the learners had a boundary while in this one [new syllabus], they are giving the learners a chance to know many numbers.*

The two teachers who expressed a preference for the old curriculum explained that the number range was limited and not overly challenging. Teacher 1 said:

*I personally prefer the old syllabus because the child could understand what's happening since the numbers were not confusing to them because the numbers were not many ... They knew where we end, unlike in the new syllabus where there are too many numbers. So, the old syllabus was easy for the children to understand, unlike the new syllabus where the children get confused.*

And Teacher 2 said:

*I personally prefer the old curriculum because, for instance, when learning 1, there are a lot of activities for the whole week concerning the number 1—activities including writing on the ground before they write in the books. Hence, they will know fully about 1 before they write it in the books. The new curriculum was designed as if every child attended nursery school and already knows what is being done.*

## Introduction of Addition and Subtraction

Now we turn to teachers' perspectives on the old and new curriculums' approaches to addition and subtraction.

**Introduction of addition and subtraction.** We asked teachers about how addition and subtraction should be first introduced in grade 1. We then asked specifically about their thoughts regarding the different approaches between the new curriculum and the old one in terms of introducing these basic operations. As noted above, the old curriculum introduced addition and subtraction using concrete objects and real-life situations and introduced the symbols  $+$ ,  $-$ ,  $=$  early on in the lessons. Meanwhile, the new curriculum introduces addition and subtraction using part-whole models beginning in the first lesson, and does not integrate real-life problems in the beginning. The addition and subtraction symbols are introduced later in the sequence.

Teachers had differing opinions regarding the best way to introduce addition and subtraction. Some teachers reported relying on concrete objects and real-life situations to introduce these concepts, believing that it was the best way to help learners understand. For example, Teacher 2 said:

*For instance, if you have three mangoes and you give one to someone, that means you will be left with two. Meaning, when you eat the two, you will not be as full as you would have been if you had eaten three. Unlike when the question only has digits, for instance, 5 minus 3, the child will be overwhelmed by the question, even if they might use their fingers or bottle tops to calculate. Hence, we should always start with objects, then digits.*

Other teachers voiced a preference for part-whole models, especially because these models help learners understand the meaning of the symbols. Teacher 3 said:

*It becomes easier for the learners because they know part-part-whole, so when you are introducing the signs, you just tell them that to find the whole, you have to add the parts, or to find a part, you have to subtract the part from the whole.*

Teacher 5 shared that part-part-whole reasoning helps students understand the meaning of addition:

*The part-whole model ... can assist them to know that this is the composition of this number. "If I add this and this, I can produce this number."*

Given these answers, it appears that teachers see the utility of objects and real-life situations as well as the part-whole model, particularly the part-whole model because it offers a new way of introducing the concepts of addition and subtraction.

Teachers also had varying answers with the introduction of the symbols, although some felt that symbols should be introduced earlier because it helps learners understand the concept. Others felt that the part-whole model assists learners in understanding the meaning of the symbols.

**Combining addition and subtraction.** We asked teachers how they felt about addition and subtraction being taught together in the new curriculum, as opposed to separately in the old curriculum. Almost all teachers said that addition and subtraction should not be taught together. Two teachers did not clearly address this point. Most teachers noted that learners are confused by the two topics being taught together. For example, Teacher 2 said:

*It confuses the children when addition and subtraction is combined, because when you can start with addition, they will understand it, but the moment you switch to subtraction where we reduce the value they will not understand.*

Teacher 3 echoed these ideas:

*In the new curriculum, the learners get confused. It is good but it is also confusing for some children because addition and subtraction is done together. Even when we try explaining to them in different ways, some children still find it confusing.*

Teacher 1 referred to student knowledge:

*For gifted learners, it is easy for them to know that the signs are different at once, but the other learners get confused. The gifted learners know that this is the addition sign, this is the subtraction sign, this is the part-whole model, this is the less-than sign, and this is the greater-than sign. However, there are others who up to now don't know the equal sign. So, it's like the new curriculum is favoring much the gifted learners, especially where the addition and subtraction is combined in the teaching.*

**Preferences on the curriculum.** Throughout the interviews, we asked teachers several times about which curriculum they preferred. Two teachers consistently expressed a preference for the old curriculum, while another one consistently expressed a preference for the new curriculum. The other three teachers wavered between old and new at various points in the interviews.

The teachers who expressed a preference toward the old curriculum focused on the difficulty that their students have with the content. According to Teacher 1:

*The old syllabus was easier than the new syllabus because it was simple for the learners to take 9 counters rather than having them take 30 counters, which they will have a hard time collecting them and counting, hence getting confused. So, it is easy for the learners in the old syllabus ... unlike in the new one, where we teach them to find the part and then the whole. So, it is very challenging for young children to understand these two.*

Teacher 2 appreciated the progression in the old curriculum, noting:

*This one [the old syllabus] was better in terms of addition because it took learners step by step through.*

Teacher 3 preferred the new curriculum, although she admitted that it is harder for learners; however, she believed that learners were ready for it and that it was good to push them. She said:

*It is helping the learners to think critically because for example, here [old syllabus] they were just finding the whole while the new syllabus helps the learners realize that it is not only about finding the whole, but also rely on themselves—for example, if they have been given a whole and a part, they should know how to find the other part by themselves using the given information.*

Teacher 5 liked how the new curriculum does not guide the students step by step on anything, offering more opportunities for students to develop their own knowledge:

*They help learners to think on their own, or to find the way they can find the answers. But in those old curriculum [points to the old textbook and teacher's guide], it's just as straightforward that learners they just know that, "when it comes on this, we are adding. And when it comes from this, we are subtracting." Rather than this [points to the new workbook], they just ... they find on their own way.*

Two teachers wavered between the old and new curriculums, expressing preferences for certain aspects with the new curriculum, and other aspects with the older curriculum. For example, Teacher 4 at one point said:

*The new one it's much better ... it will be better just because it'll help the learner to think.*

At another point, she pointed to the old curriculum because of the inclusion of vertical and horizontal addition:

*This one, it is better. The old one. But only that it will take a long time. But in this old curriculum, they teach learners both the horizontally and vertically.*

Teacher 6 did not clearly explain why she liked the old and new, but she repeatedly expressed that she liked both.

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## Discussion

The evidence above reveals several ways in which teachers are thinking about how their students learn in grade 1 and their use of the government-supplied teaching and learning materials.

- We found that teachers used knowledge of their students to justify their statements about progressions around number sense and basic addition and subtraction. Teachers repeatedly referred to their students and what their students could and could not do to explain why they preferred a certain number range or way of introducing a topic. For example, teachers talked about students being confused if too many topics were introduced at once (such as addition and subtraction). At the same time, many teachers thought that the number range in grade 1 can cause their students to be bored because the pace is too slow, and that students are limited in what they are expected to achieve. Regardless of what they were saying, teachers repeatedly talked about the needs of their students and the expectations placed on them. Given this, it is reasonable to conclude that these teachers knew their students well and that meeting their students' needs was the foundation of their beliefs. While teacher beliefs were varied (e.g., regarding how to introduce addition and subtraction), their beliefs were grounded in their interpretation of their students' abilities.
- We found that teachers drew from the old curriculum when teaching the new curriculum. Not surprisingly, teachers taught based on what they knew worked and brought in activities to supplement the new curriculum. For example, teachers talked about the importance of writing numbers, and teachers mentioned bringing in tracing activities. They supplemented the introduction of addition and subtraction with objects, which some teachers believed provided more meaning to the concepts. As with any new reform, teachers continued to take aspects of the old curriculum and integrate them into the new curriculum.
- Teachers' responses varied and were not necessarily consistent throughout the interviews. Some teachers preferred the new curriculum for certain aspects, and the old curriculum for others. There was also some variation between what teachers said when asked the exploratory questions at the beginning of the interview in terms of what they thought progressions should be, and then later when asked to comment on specific examples of how the old and new curriculums approached a given topic. For example, Teacher 3, when asked how she introduced addition and subtraction, talked about using activities with objects. Later, when asked about

differences between how addition and subtraction were introduced in the old and new curriculums, she said that the part-whole model was good and talked about how it helped students make sense of the concept. While these comments are not necessarily contradictory, it was not clear how the teacher made sense of these two variations in introducing a concept, and whether she used both in her teaching. Overall, this type of variation points to the discrepancies that teachers must grapple with when being introduced to a reform. It may be that teachers themselves were not aware of these inconsistencies in their own beliefs.

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## Conclusion and Next Steps

This was an exploratory study that attempted to uncover how teachers are making sense of their beliefs about how students learn during unsettled times—the introduction of a new reform. Importantly, this study revealed that teachers are thinking about their students and are making decisions based on what they know about their students and how they learn. While there was variation among teachers about what they believed, all teachers referred to the needs of their students in justifying their statements. At the most basic level, we can conclude that these teachers know their students and use this knowledge to make decisions about their instruction.

There are several limitations to this study, which was exploratory. Our sample was small and convenience-based, limiting the reach of the study. In addition, one interview was likely not enough time to adequately probe teachers' understandings and beliefs. This study sets the groundwork for future work on probing teacher knowledge in very concrete, specific ways.

Despite these limitations, there are several takeaways. First, we believe that the data offer lessons for future implementers of reforms in foundational mathematics. Teachers are making decisions all the time based on what they know about their students and how they learn. When designing reforms, this type of information is crucial in order to ensure success. For example, all the teachers in our study felt that multiple numbers should not be introduced in one day (as the new curriculum does). While the new curriculum may be aligned with the most up-to-date research and evidence, it goes against the knowledge of the teachers. In this case, we might ask, what is the best way forward? Would it have been beneficial to create a hybrid approach, where the research and evidence and existing teacher knowledge meet in the middle? Perhaps this might mean introducing one number a day but moving at a much faster pace than the old curriculum (which called for multiple days to be spent on the same number). Or it could mean introducing initial numbers on separate days and then grouping them after a few days. In this way, a new reform may be more successful if it considers teachers' existing knowledge about learning.

This study also points to the importance of teacher training and approaches for teacher professional development that meets teachers where they are. As our findings indicate, teachers will be engaging with a new curriculum having developed ideas around how children learn and how best to support them, based in part on the existing curriculum. This should be taken into account when planning to roll out the new curriculum and provide teacher training, as well as ongoing support, as teachers grapple with it. Might it help to incorporate explicit discussion and explanation around the key differences and why things were changed? What kind of in-service training can best prepare teachers to begin trying the new curriculum, and what follow-up support will help them to not just implement a new curriculum but understand and embrace it? A hybrid approach (as discussed above), paired with strong teacher professional development that recognizes teacher knowledge and places it at the center, may lead to increased uptake of a new reform.

More research is needed. Future studies should explore how teachers talk about changes in the curriculum as well as how they enact these changes, using classroom observations. A follow-on study may also probe these understandings more, asking teachers specifically how they resolve discrepancies between what they believe and what they are being asked to do. Finally, a future study might follow teachers over time to understand how a new curriculum might contribute to changes in teacher knowledge.

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## Annex 1. Structured Interview Guide

### Question Set 1: Numbers

Exploratory questions	
Student outcome	<p>In grade 1, students learn about numbers. What numbers do you think they should learn? Why? What numbers do you think students should know in grade 1? And what should they know about the numbers?</p> <p>How high do you think should they go?</p> <p>What numbers do you think should they learn in grade 2? Why?</p>
Progression	<p>How do you think students learn about these numbers? How many numbers do you think should be introduced each lesson/day/week? Why?</p> <p>What types of things do they need to know about the numbers?</p> <p>What do they need to know about smaller numbers before moving to bigger numbers?</p> <p>(NOTE: Try to get teachers to think about the progression here—what's the first step to learning numbers? What are the particular skills involved?)</p>
Instruction	<p>What types of activities help them learn all these numbers?</p> <p>How should the numbers be grouped together during instruction? Why?</p>

Questions regarding specific examples			
		Question	What to show teacher
Student outcome	1	<p>Here you see the goals for students in grade 1. The old curriculum said that students should learn numbers 0–9 by the end of the school year. The new curriculum says that they should learn numbers 0–30 by the end of the school year.</p> <p>What do you think about the differences between the old curriculum and the new curriculum? How do they differ?</p> <p>Which one do you think is closer to what you think your students can do?</p>	<p><i>Old syllabus:</i></p> <ul style="list-style-type: none"> <li>• Students learn numbers 0–9</li> <li>• Teacher's guide, page vi (contents page showing all topics and number range)</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>• Students learn numbers 0–30</li> <li>• Term 1 teacher's guide, page 3 (table of all topics, the sequence, and number of lessons)</li> </ul>

Progression	2a	<p>There are several differences in how the old and new textbooks teach numbers in grade 1.</p> <p>First, you see the progression across terms in grade 1. What do you think of the differences between the old and new syllabus in how the numbers progress across the year?</p> <p>Which one aligns better with how you think your students learn? Which one do you prefer, and why?</p>	<p><i>Old syllabus:</i></p> <ul style="list-style-type: none"> <li>• Term 1: Numbers 0–5</li> <li>• Term 2: Numbers up to 9</li> <li>• Textbook, pages 54–55</li> <li>• Teacher's guide, pages 42–43</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>• Term 1: Numbers 0–5</li> <li>• Term 2: Numbers up to 10</li> <li>• Term 3: Numbers up to 20 and 30</li> <li>• Term 1 teacher's guide, pages 3 and 49</li> <li>• Term 2 teacher's guide, pages 3 and 39</li> <li>• Term 3 teacher's guide, pages 3, 29, and 97</li> </ul>
	2b	<p>Here is another example. Here you see the sequence of the first set of lessons in unit 1 for numbers 0–5 from the old textbooks and the new textbooks.</p> <p>What do you think about the differences?</p> <p>Which one do you prefer, and why?</p> <p>Which one is closer to how you think students learn numbers 0–5?</p>	<p><i>Old syllabus:</i></p> <ul style="list-style-type: none"> <li>• Ten lessons each for the numbers 1, 2, 3; teacher's guide, pages 2–8; textbook, pages 1–12</li> <li>• Eight lessons for the number 0 after 1, 2, 3, followed by eight lessons for the number 4 and nine lessons for the number 5</li> <li>• Teacher's guide, pages 8–15</li> <li>• Textbook, pages 13–22</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>• Five lessons for the numbers 1, 2, 3 taught together</li> <li>• Term 1 teacher's guide, pages 3 and 6–15</li> <li>• Term 1 workbook, pages 2–6 overviews</li> </ul>
Instruction	3	<p>Now let's talk about instruction. Here are some sample activities from the old and new textbooks for teaching numbers 0–9.</p> <p>What do you think about how they are different and similar?</p> <p>Are there activities that align better with how you think students learn? In what ways?</p> <p>What is challenging about these activities?</p> <p>What other activities do you do?</p>	<p><i>Old syllabus:</i></p> <ul style="list-style-type: none"> <li>• Textbook, pages 1–14,</li> <li>• Teacher's guide, pages 2–8, (activities for learning the numbers 1, 2, 3, 0)</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>• Term 1 workbook, pages 2–6, (activities for learning 1, 2, 3 and page 12 for learning 0)</li> </ul>

## Question Set 2: Addition and Subtraction

Exploratory questions	
Student outcome	<p>In grade 1, students learn about addition and subtraction. What do you think they should learn about addition and subtraction in grade 1?</p> <p>What do you think students should be able to do in addition and subtraction in grade 1?</p> <p>Can you provide specific examples?</p>
Progression	<p>What do you think students learn about first when learning addition and subtraction in grade 1?</p> <p>How do they start to learn about addition?</p> <p>How do they start to learn about subtraction?</p>
Instruction	<p>What types of activities help them learn addition and subtraction?</p> <p>Do you create any activities that are not in the textbooks?</p>

Questions regarding specific examples			
		Question	What to show teacher
Student outcome	1	<p>Students learn addition and subtraction in grade 1. There are several different outcomes related to addition and subtraction, seen here, such as part/whole, writing number sentences, and modeling stories.</p> <p>What do you think about differences in the old and new syllabus regarding what students need to know about addition and subtraction? How do they differ?</p> <p>Which one do you think is closer to what your students can do?</p> <p>How do you see the difference?</p>	<p><i>Old syllabus: summary of what they learn with + -</i></p> <ul style="list-style-type: none"> <li>Teacher's guide, page vi (contents page showing all topics and number range)</li> </ul> <p><i>New syllabus: summary of what they learn with + -</i></p> <ul style="list-style-type: none"> <li>Term 1 teacher's guide, page 49</li> <li>Term 2 teacher's guide, page 39</li> <li>Term 3 teacher's guide, pages 29 and 97</li> </ul>
Progression	2a	<p>There are several differences in how the old and new textbooks teach addition and subtraction.</p> <p>For example, students using the old textbooks started learning addition and subtraction in units 2 and 3 using concrete objects; addition and subtraction are introduced as separate topics (addition in unit 2 and subtraction in unit 3); and the symbols +, -, = are introduced in the first few lessons.</p> <p>With the new workbooks, students learn addition and subtraction in topic 2 using part-whole models; and the symbols + and = are introduced in</p>	<p><i>Old syllabus: intro to addition and subtraction</i></p> <ul style="list-style-type: none"> <li>Teacher's guide, pages 18–22 (addition) and 23–27 (subtraction)</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>Term 1 teacher's guide, pages 49–81 (focus on page 54)</li> <li>Term 1 workbook, pages 23–26</li> </ul>

		<p>lesson 4, while the symbol – is introduced in lesson 12 of the topic.</p> <p>What do you think about this difference in how students are taught these operations?</p> <p>Which one is closer to how your students learn?</p> <p>Which one do you prefer, and why?</p>	
	2b	<p>Here is another example:</p> <p>Old syllabus defines addition as “combining” and subtraction as “taking away.” There is no mention of other structures of addition and subtraction.</p> <p>New syllabus defines three structures of addition and subtraction (combine, change, and compare).</p> <p>What do you think about the differences?</p> <p>Which one do you prefer, and why?</p> <p>Which one is closer to how you think students learn addition and subtraction?</p>	<p><i>Old syllabus:</i></p> <ul style="list-style-type: none"> <li>Teacher’s guide, pages 19 (addition) and 25 (subtraction)</li> </ul> <p><i>New syllabus:</i></p> <ul style="list-style-type: none"> <li>Teacher’s guide, page 50</li> </ul>
Instruction	3	<p>Now let’s talk about instruction. Here are some sample activities from the old and new textbooks for teaching addition and subtraction.</p> <p>What do you think about how they are different and similar?</p> <p>Which activities align better with how you think students learn? Explain.</p> <p>Which activities do you think will help students achieve the objectives of addition and subtraction?</p> <p>What other activities do you do to help students learn addition and subtraction?</p>	<p><i>Old syllabus: a few activities with + –</i></p> <ul style="list-style-type: none"> <li>Textbook, pages 26–27 (addition) and 30–31 (subtraction)</li> </ul> <p><i>New syllabus: a few activities with + –</i></p> <ul style="list-style-type: none"> <li>Workbook, pages 23–24 (addition) and 32–33 (subtraction)</li> </ul>