Improving Literacy and Numeracy in Developing Countries: Working with a Sense of Urgency

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40% of the world’s primary age children do not have access to literacy and numeracy instruction.

57% of the world’s children do not attend school.

Since 2008, financial support for developing countries has dropped precipitously.
Host of Reasons

- Humanitarian
  - Education = Less Hunger

- Economic
  - Education = Less Dependence and Growing Global Capital

- Security
  - Education = Less Fighting
Education For All

- Access to high quality education for all children

- Increased expectations for teaching and learning (International Learning Standards)

- Efforts to build specific literacy and numeracy skills worldwide
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Counting Fluency</td>
<td>Student is asked to count as high as they can.</td>
<td></td>
</tr>
<tr>
<td>One-to-one correspondence</td>
<td>Student is asked to count circles on a page and then asked how many there are.</td>
<td><img src="image" alt="Example" /></td>
</tr>
<tr>
<td>Number naming fluency</td>
<td>Student is presented with a series of numbers and asked to say what the numbers are.</td>
<td>12 6 9 2 16 25</td>
</tr>
<tr>
<td>Quantity Discrimination</td>
<td>Students are presented with two numbers and asked to choose the one that is bigger.</td>
<td>10 4 8 12</td>
</tr>
<tr>
<td>Number Line Estimation</td>
<td>Students are presented with an ungraded number-line and asked to place a given number on the number-line.</td>
<td><img src="image" alt="Number Line" /></td>
</tr>
<tr>
<td>Missing Number</td>
<td>Students are presented with a series of numbers, with one number missing, and asked what number should be there.</td>
<td>17,<em><strong>,19, 20 20, 30 ,</strong></em>, 50</td>
</tr>
<tr>
<td>Word Problems</td>
<td>Students listen to a simple addition and/or subtraction story problem and are asked to solve it.</td>
<td></td>
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<tr>
<td>Addition and Subtraction</td>
<td>Student is presented with a series of simple addition and subtraction problems and asked to solve them.</td>
<td>4 + 5 = 8 - 3 =</td>
</tr>
</tbody>
</table>
Fast Facts

- In Liberia, literacy and numeracy skills in young adults were similar to those in early primary grades.

- In Mali, between 80-90% of 8th graders were not literate in any language.

- In sub-saharan Africa, access to education has been achieved; quality education is elusive.
The current emphasis on early mathematics instruction is due in large part to a rise in the understanding that participation in the modern world requires competence in mathematics (Kilpatrick, Swafford, & Findell, 2001; NRC, 2009; RAND, 2003).

Recent meta-analyses of longitudinal data show that early math skills have the greatest predictive power of later academic achievement (Duncan et al, 2007; Romano et al, 2010)
Mathematical Knowledge

- Future success in mathematics is related to an early, strong conceptual foundation (Duncan et al., 2007; National Mathematics Advisory Panel, 2008)

- Strong early numeracy is marked by a child’s fluidity and flexibility with numbers, an understanding of what numbers mean and how to use them (Berch et al., 2008; Gersten & Chard, 1999)
Cross-national studies demonstrate links between low socioeconomic status and lower mathematical achievement (Baker, Goesling, & Letendre, 2002).

Assessments of students’ mathematical knowledge and skill are needed to determine the level of support required.

In developing countries, where large numbers of students may be underperforming, interventions must be geared toward entire systems.
Framework

Development of Mathematical Concepts & Models

Vocabulary and Reasoning

Procedural Fluency and Flexibility

Liberian National Curriculum
Liberian National Curriculum

- Built in alignment with the Liberian Curriculum for Mathematics
- Consistent with research on effective development of children’s knowledge of mathematics
- Designed with Liberian educators to reflect Liberian cultural heritage, tradition, and contexts
Recent research recommends a focused, coherent progression of mathematics learning with emphasis on proficiency with key topics.

The proposed instructional program focuses on key strands rather than a broad array of mathematical content:

- Numbers and Operations
- Geometry
- Measurement
- Vocabulary
Goal of instruction program is to help children develop multiple representations of number through a focus on number sense, a child’s fluidity and flexibility with using and manipulating numbers...to look at the world and make quantitative comparisons (Berch, 1998; Gersten & Chard, 1999;).
Vocabulary and Reasoning

- Explicit, targeted vocabulary development
- Instruction focused on translating mathematics to English (or other language of instruction) and English to mathematics
- Regular problem-solving opportunities with Kenyan contexts
Instructional strands provide daily practice across lessons
Children have frequent opportunities to respond in different formats
Teacher monitors for understanding and provides feedback
Automaticity with number concepts and procedures
# Program Structure

## WEEK 12

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Counting</td>
<td>Introduce: Counting for 2s to 20 (without numerals visible)</td>
<td>Guided Practice: Counting for 2s to 20 (without numerals visible)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparing Numbers</td>
<td>Introduce: Number concepts 1 to 10</td>
<td></td>
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<tr>
<td>Place Value and Composing/Decomposing</td>
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<tr>
<td>Number Patterns</td>
<td>Introduce: Missing number concept, backward fill in missing number, even numbers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representation and Notation</td>
<td>Introduce: Using ordinals and equal signs to recognize equivalent representations (e.g., 4 = 9 - 5)</td>
<td>Guided Practice: Using ordinals and equal signs to recognize equivalent representations (e.g., 4 = 9 - 5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalence</td>
<td>Independent Practice: Drawing objects to match a set of drawn objects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations</td>
<td>Introduce: Writing subtraction problems using objects (e.g., 9 - 1 = 8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td>Review: Drawing circles, rectangles, and triangles</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Geometry</td>
<td></td>
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</tr>
</tbody>
</table>

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### Two-Week Skill Planners

The biweekly skill planners are instructional planners and organizing tools. Each planner traces skills through a two-week period of the program and indicates where those skills are introduced, practiced, and applied. The teacher guides contain a total of 26 planners per grade and are designed to provide teachers with an overview of the mathematical strands, skills, and concepts covered in each day of a two-week period.

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**Lesson week and day indicators**

- Page numbers of the full lesson plans.

**Each row is one of the nine mathematics strands.**

**Each cell shows skills and concepts introduced, practiced, and/or applied**

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**WEEK 4**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Counting</td>
<td>Review: Counting up to 10 with and without objects</td>
<td>Introduce: Counting up to 10 starting with a number from 3-9</td>
<td>Guided Practice: Counting up to 10 starting with a number from 3-9</td>
<td>Independent Practice: Counting up to 10 starting with a number from 3-9</td>
<td></td>
</tr>
<tr>
<td>Counting</td>
<td></td>
<td></td>
<td></td>
<td>Guided Practice: Counting up to 10 starting with a number from 3-9</td>
<td>Independent Practice: Counting up to 10 starting with a number from 3-9</td>
</tr>
<tr>
<td>Counting</td>
<td></td>
<td></td>
<td></td>
<td>Guided Practice: Counting groups up to 10</td>
<td>Independent Practice: Counting groups up to 10</td>
</tr>
</tbody>
</table>

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**Measurement**

| centimeters | centimeters | and centimeters |
Lessons begin with fields for Subject, Class, Date, Time, Roll, and Duration.

**LESSON PLAN  WEEK 12, DAY 1**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Roll</th>
<th>Date</th>
<th>Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>50</td>
<td>min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Topics**
- Representation and Notation, Equivalence

**Subtopics**
- Writing numerals 1 and 2
- Creating groups with 1 and 2 objects

**Objectives**
By the end of the lesson, students will be able to:
- write the numerals 1 and 2.
- create groups with 1 and 2 objects.

**Learning Resources**
1. Objects with different colors (such as bottle caps with different colors, 1 and 2 objects per color).
2. Student composition books.

**Student Activity Book**
Step 7: page 2

Using the instructional model below, teach students to count by 2s from 0 to 20. Then teach them to use the subtraction and equal signs to represent subtraction. Gather the learning resources you need before you begin.

**Teacher Activities**
"I do!"

**We have practiced counting from 0 to 20 by 2s already. Now we’ll count by 2s from 0 to 20.**

**Step 1**
I will now count by 2s from 0 to 20 a couple of times to help me remember.
Count by 2s from 0 to 20 twice, saying each number clearly and slowly.

**Step 2**
Now I will use the minus and equal signs to show a subtraction problem.
Show students 9 beans.
I have 9 beans. If I subtract 4 of the beans, how many will I have left? I can count that I have 5 left if I can subtract 9 minus 4 equals 5. I will now write this with a minus sign and an equal sign.
Write 9 - 4 = 5 on the board.
I can also write that 5 is equal to 9 minus 4. I put the signs in different places when I write this.
Write 5 = 9 - 4 on the board.
Lesson Plans

The Development section sets up a three-part lesson that introduces, reviews, and applies skills.

Teacher icons indicate that a section contains scripting and instructional strategies for teachers to follow.

Teacher and student symbols indicate guided practice activities for teachers and students to work through together.

“Do” lesson steps include scripted instruction and activities.

“Do” lesson steps focus on newly introduced and review skills.

Lesson end with a quick review activity. Activities include teacher scripting and instructions.

Evaluation

Notes:

This section holds your brief notes of student performance or tips that will help you use this lesson in future classes.

Teacher and Student Activities “Do”

Student symbols alert you to independent practice activities for students.

“Do” lesson steps include independent practice activities that students perform on their own or in groups in the classroom.

Step 1

Let’s look at some groups together.
Remagine the objects to make groups of 1 or 2 objects. Point to a group with 1 object.

How many objects are here? (1)
Point to a group with 2 objects.

How many objects are in this group? (2)

Step 2

Let’s look at how to write the numerals 1 and 2.
Write the numeral 1 on the board. Show students how to draw a 1 in the air.

This is the numeral 1. The point finger to draw 1 in the air. (1)
Write the numeral 2 on the board. Show students how to draw a 2 in the air, facing the same way (the-air facing the same way students face their mirrors and they will be the same).

This is the numeral 2. The point finger to draw 2 in the air. (2)

Step 3

Gather the colored objects you used before and choose a student to make groups of 1 or 2 objects. Then have the student point to each group as the other student says the number of objects. Ask another student to write the numerals 1 and 2 on the board as other students say them.

How many objects are in each group? Can you write 1 and 2?

Step 4

Practice Exercise

Have students work in pairs. Tell them that one student will be the other student should say and write how many objects are in the group.

Application: (Page 2)

Ask students to complete the page in class. Move around the classroom and review their work as they complete the exercises.

Conclusion (10 min.)

Review:

Today we learned how to create groups of 1 and 2 objects and to write the numerals 1 and 2. Now you can show me what you have learned.

Make new groups of 1 or 2 objects. Choose a student to point to a group with 1 object and to write the numeral 1 on the board. Choose another student to find a group with 2 objects and write the numeral 2. Then, ask the student to label the groups.

Homework

Ask students to use their composition books to draw objects that they drew. Ask them to label the groups with numerals.
Week 3, Day 1

Number what happens first (1), second (2), third (3).

1. ☀ 2 ☀ 3

2. ☐ ☐ ☐ 

Write the number of shapes.

3. ☐ ☐ ☐ ☐ 3

4. ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

5. ★ ★ ★ ★ ★

6. ★ ★ ★ ★ ★

Write the numerals that come next.

7. 1 2 3 4 5

8. 1 2 3 4

9. 

Draw lines through the circles.

10. ◯ □ □ □ □ □

There is an activity page for each day of the program and a Check-Up Quiz at the end of every four weeks. Each page is clearly labeled with the week and day of the program.

Week 12, Day 4

Order from lowest to highest.

1. 4 6 7

2. 9 3 5

3. △ △ △ △ △ = ○ ○ ○ ○ ○

4. □ □ □ □ □ □ □ □ □ □ =

Draw circles to make equal groups.

Write the missing numeral.

5. 6 + □ = 10

6. 3 + □ = 10

Draw lines through the shapes to show subtraction.

Write the answer.

7. ○ ○ ○ ○ ○ ○ ○ ○

8. ○ ○ ○ ○ ○ ○ ○ ○

9. 9 - 4 = □ 8 - 6 = □

10. ○ ○ ○ ○ ○ ○ ○ ○

10 - 5 = □ 7 - 3 = □
**Weekly Test, Week 12**

Write the following questions on the board. Have students write or draw answers in their composition books. Correct answers appear in parentheses—when these are underlined, draw blank lines on the board.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Count by 2s. Write the numerals that come next.</td>
<td>0 2 4 (6) (8) (10) (12) (14) (16) (18) (20)</td>
</tr>
<tr>
<td>2. Write the numerals from the cards in order from lowest to highest.</td>
<td>8 6 7 (6) (7) (8)</td>
</tr>
<tr>
<td>3. Write the missing number.</td>
<td>20, 15, 16, 14, (12), 10</td>
</tr>
<tr>
<td>4. Write the number you need to make 10.</td>
<td>3 + (7) = 10</td>
</tr>
<tr>
<td>5. Draw lines through shapes to show the subtraction. Write the answer.</td>
<td>7 - 2 = (5)</td>
</tr>
</tbody>
</table>
| 6. Write the missing signs – and = in the subtraction sentence.           | ○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○○leveland
Numeral Cards

The following is a level. Note all students.

Week 1
- 14 sets of objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 11 objects with different colors (e.g., sticks, pencils, beads, shells)
- 11 objects with different textures (e.g., sticks, pencils, beads, shells)
- 11 objects with different sizes (e.g., sticks, pencils, beads, shells)
- 11 objects with different materials (e.g., sticks, pencils, beads, shells)
- 11 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 2
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
- 14 objects with different textures (e.g., sticks, pencils, beads, shells)
- 14 objects with different sizes (e.g., sticks, pencils, beads, shells)
- 14 objects with different materials (e.g., sticks, pencils, beads, shells)
- 14 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 3
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
- 14 objects with different textures (e.g., sticks, pencils, beads, shells)
- 14 objects with different sizes (e.g., sticks, pencils, beads, shells)
- 14 objects with different materials (e.g., sticks, pencils, beads, shells)
- 14 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 4
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
- 14 objects with different textures (e.g., sticks, pencils, beads, shells)
- 14 objects with different sizes (e.g., sticks, pencils, beads, shells)
- 14 objects with different materials (e.g., sticks, pencils, beads, shells)
- 14 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 5
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
- 14 objects with different textures (e.g., sticks, pencils, beads, shells)
- 14 objects with different sizes (e.g., sticks, pencils, beads, shells)
- 14 objects with different materials (e.g., sticks, pencils, beads, shells)
- 14 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 6
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
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- 14 objects with different materials (e.g., sticks, pencils, beads, shells)
- 14 objects with different weights (e.g., sticks, pencils, beads, shells)

Week 7
- 14 objects with different cultural groups (e.g., bottle caps, beads, shells)
- 14 objects with different shapes (e.g., sticks, pencils, beads, shells)
- 14 objects with different colors (e.g., sticks, pencils, beads, shells)
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