

Early Math Assessment (EMA) Screener Information

The Early Math Assessment @ School (EMA@School) is a teacher-administered screener of early numeracy developed by Carleton University. The screener was designed to identify students in kindergarten to grade 4 who are not achieving at their developmental age range.

A screening measure is a quick and informal evidence-based test that provides information about strengths or possible difficulties in concepts or learning, so a student can receive further instruction or immediate intervention.

The goal of this screener is to be used as a tool to inform educators with which areas their students may require extra support in the classroom.

The screener is used because it can help identify the students who are likely to experience difficulty in math in future years. **Early math skills are more predictive of future academic success than early literacy skills** (Duncan et. al., 2007).

This assessment measures vital skills in numeracy development. For students in grade 1, the assessment measures include verbal counting, next numbers, number naming, number writing, number comparison, number lines, and arithmetic fluency. Verbal counting, naming numbers and next numbers sections are individually administered tasks as oral responses.

For students in grade 3, it includes four foundational skills: number comparison, writing numbers from dictation, placement of numbers on a 0-1000 number line, ordering numbers. It also includes one mathematical outcome: arithmetic fluency.

Individually Administered Tasks:

Verbal counting: Assesses students' highest verbal count, knowing and using the number words in order.

Next Number subtask: Requires that students complete a counting sequence. These sequences get progressively more complex, tapping into children's knowledge of the rules for generating higher numbers.

Number Naming subtask: Students are asked to use verbal number words to name digits.

Comparing Numbers Subtask:

Measures how quickly and efficiently students can compare magnitudes. Students were instructed to cross out the larger digit of a pair of digits (e.g., which is larger, 4 or 7?).

Writing Numbers Subtask:

Assesses students' abilities to translate between verbal number words and Arabic numerals; also known as 'transcoding'. Students were asked to write down a total of 13 numerals as teachers read them aloud.

Numbers on the Number Line Subtask:

Used to assess students' estimation accuracy when placing a target number along a number line ranging from 0-1000. This measures students' understanding of ordinal relations among numbers (i.e., 5 comes after 4 and before 6) and their proportional reasoning skills (i.e., 75 is three-quarters of 100 so one must divide the number line into fourths).

Ordering of Numbers Subtask:

Measures how quickly and efficiently students can judge whether three-digit number sequences are increasing in order (e.g., is 2, 4, 6 in ascending order?). Students were instructed to draw a check mark beside the sequence if the numbers were all increasing, or an X if the numbers were not all increasing.

Number Facts Subtask:

Assesses students' abilities to solve addition and subtraction facts to 18 (e.g., $2 + 3$, $12 - 6$), including equations (e.g. $_ + 4 = 2 + _$).

Fluency and Timed Tasks

Children's learning of the basic number facts are foundational predictors of later fraction and algebra skills (Schneider et al., 2017). Fluency shows how flexibly, efficiently and accurately students can retrieve number facts or apply strategies. "When students only learn a single procedure, regardless of how quickly and accurately they can use it, they are denied the opportunity to develop procedural fluency. Strategy selection, adaptation, and transference are critical to both procedural fluency and mathematical proficiency and must be a significant part of students' experience with the operations right from the beginning, with learning basic facts" (Bay-Williams, 2019).

Fluency is a measure of both accuracy and speed and therefore it taps into the students' skill mastery. In the number facts addition task, students answer up to 39 single-digit addition questions in one minute. Because single-digit addition is in the students' abilities, most students in grades 1 to 4 could correctly answer all the questions. So accuracy alone cannot be used to measure mastery or growth in learning, that is why it is a timed section.

Small-group Instruction

Foundational early mathematical skills include knowledge of numbers, number relations, and number operations. Each section separately provides insight into children's number skill development. Teachers can work with students to help develop these foundational skills and understanding to improve present and future math learning and achievement.

The focus can be on number lines, spatial reasoning, number ordering, comparing numbers and number operations (facts) including addition, subtraction, multiplication and division.