Curriculum-Based Measurement

A Teacher's Guide

By John & Michelle Hosp

This reference guide provides an overview of the purposes and uses of curriculum-based measurement (CBM), a standardized approach to assessing student performance in order to inform educational and instructional decision making. This guide is designed for teachers, administrators, and other educators who are considering the use of CBM, want an introduction to CBM, or need a quick and easy reference. It is also helpful for educators to use with parents and students as an introduction to CBM.

What is CBM?

CBM, a standardized approach to assessing student performance in a number of content areas, was developed in the late 1970s/early 1980s at University of Minnesota Institute for Research on Learning Disabilities (IRLD) by Stanley Deno, Phyllis Mirkin, their colleagues and students. Additional research has refined the materials, methods and decision making that can be done with the scores. CBM is sometimes considered a specific type of curriculum-based assessment (CBA) when the term CBA is used to refer to a specific method of assessing or collecting information that is aligned closely with curriculum and content standards. Examples of CBMs are provided on pages 3 and 4 of this guide.

Why Use CBM?

There are many reasons to use CBM—some legal, some ethical, and some practical—but there are three main reasons that have been supported by research:

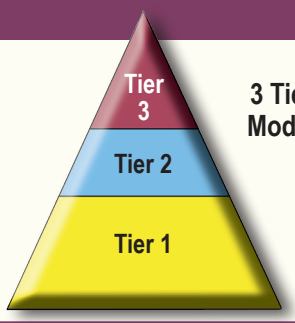
1. Teachers who use CBM make more frequent instructional changes, which result in better student performance;
2. CBM provides immediate feedback for the teacher and the student, which results in better student performance; and
3. CBM can be used to make screening and progress decisions about individuals, classrooms, and grade levels without having to collect additional information using different assessments.

What Makes an Assessment Tool a CBM?

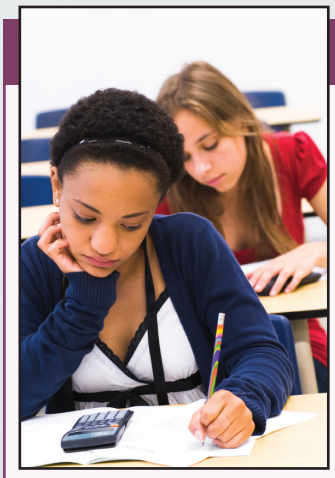
- **Standard Tasks and Materials:** Each content area in which CBMs have been developed includes consistent tasks and sets of materials.
- **Reliability and Validity:** In part due to the standard tasks and materials, CBMs generally demonstrate good *reliability* (i.e., stability or consistency of measurement of student performance) and *validity* (i.e., the accuracy of the decisions one makes based on student performance).
- **Dynamic:** The tasks are ones that are sensitive to change, which makes them useful for monitoring a student's progress over time.
- **Indicator:** Although some CBM tasks are direct measures of the broader area they are intended to provide information about, some are not actual direct measures but rather indicators. However, all CBMs serve as *predictors of performance* on meaningful outcome measures such as state-mandated high-stakes tests.
- **Fluency Based:** CBM is based on the notion of *automaticity*—that being able to perform skills accurately and rapidly frees up cognitive resources so that the student can focus on reasoning and understanding the content. As such, all CBM measures either provide accuracy and rate scores or take accuracy into account when calculating rate (i.e., the number of correct responses per minute).
- **Easy to Administer and Score:** Directions for administration and scoring rules are all standardized. Because the tasks are closely aligned with actual tasks that students perform regularly in their classrooms, there is little need for elaboration on how to do the task. Scoring generally involves counting the number of correct responses the student provided within the allotted time.
- **Time Efficient:** Each individual CBM takes 1-3 minutes to administer (with a couple of exceptions) and many can be administered to a whole class at one time. Scoring typically takes 1-2 minutes per task as well. This means an entire classroom can often be assessed within 20-30 minutes.

CBM and Response to Intervention (RTI)

A fundamental characteristic of Response to Intervention (RTI) is data-based decision making where educational decisions are based on assessment data. *Screening* and *progress* are two of the prime types of decisions educators make within an RTI model. *Screening* decisions (also called *universal screening* because they should include *all* students) are for deciding who needs additional or more intensive instruction or for grouping students for instruction based on the similarity of their educational needs. *Progress* decisions (also called *progress monitoring*) are for deciding if a student is making sufficient progress toward a goal, how an individual student is responding to instruction, or how effective an instructional plan is at increasing student learning. CBM can provide data for both *screening* and *progress* decisions—making it an effective use of time for assessment.



3 Tier Model



Types of CBM

The various sheets and passages used in CBM (often referred to as "probes" because they are quick, simple tools for sampling, or probing, student performance) can be categorized into three main types:

- **General Indicators (GIs):** A CBM is a GI (also sometimes referred to as *general outcome measures*, or GOM) when there is a single, "capstone" task that represents general performance in a content area. For example, fluent oral reading of connected text is a task that requires sufficient knowledge and application of foundational reading skills (such as phonological awareness and phonics), as well as activation of prior knowledge and understanding of the content. Therefore, Oral Reading Fluency (ORF) serves as a GI for reading. The same task is used at multiple grade levels, but with different complexity of text and with different standards for proficiency. GIs can be used for screening because of their relation to the broader content area and for progress monitoring because they can provide long-term outcomes (i.e., a full school year) toward which student progress can be compared and measured repeatedly.
- **Multiskill Indicators (MIs):** A CBM is a MI (also sometimes referred to as a *skills-based measure* or SBM) when a task can be developed by including a few items of each specific skill that should be mastered within a period of time (generally within a grade level). This method of development is sometimes referred to as *curricular sampling* because a MI samples the skills from within a curriculum year. For example, a mixed math computation probe would contain problems representing the various operations within a specific grade level math standard. Each item on the probe represents a specific operation (e.g., double-digit addition with regrouping) and all the skills expected to be mastered within the time period should be represented on the probe. MIs can be used for screening because of their relation to the broader content area, as well as for progress monitoring because they can provide long-term outcomes (i.e., a full school year) toward which student progress can be compared and measured repeatedly.
- **Subskill Indicator (SIs):** A CBM is a SI (also sometimes referred to as *mastery measures*, MMs, or *subskill mastery measures*, SMMs) when it requires a task that is a specific skill that is expected to be mastered within a relatively short period of time (i.e., less than one year or grade level) or one that is a component of a broader skill (e.g., addition or addition facts). SIs can be used for screening when they relate strongly to a broader content area (e.g., math), but do not work well for progress monitoring because the goal is shorter-term, possibly within a lesson, unit, or several month period. If a skill is expected to be mastered within a period of time shorter than a school year, it would require changing the materials used to monitor progress. This is problematic unless there is empirical support for the use of different goals and rates of progress within a specific curriculum sequence. The difference between MIs and SIs is that in MIs the skills are all contained in the same probes, whereas in SIs they are in different probes that are administered separately. This is what allows MIs to be used for progress monitoring but not SIs.

Standards for Comparison

Critical to understanding how CBM can be used to compare a student's performance against other measures, it is essential to understand two concepts:

- **Benchmarks:** A benchmark is a cut score that has been empirically determined to predict proficiency on an outcome measure (e.g., a state's high stakes achievement test). A student's performance can be compared to this score in order to determine the probability that this student will meet proficiency standards. When making screening decisions, benchmarks are used in order to identify the percentage of students who are expected to meet proficiency standards and the percentage expected to not meet proficiency standards. When making progress decisions, student rate of progress (shown graphically) is compared to the progress it would take for that student to go from the level of performance he/she achieved at the beginning (also referred to as baseline data) to the benchmark in a pre-determined amount of time (often from the Fall to Spring within a given school year).
- **Norms:** Norms are a set of scores that compare an individual's performance to the performance of a comparison group of peers, typically grade-level peers. When making screening decisions, norms are often used to compare a student's performance to that of a group of grade-level peers. They can also be used to compare average group performance to grade-level peers. When making progress decisions, student rate of progress is compared to that of his/her peers. If the peers are local (i.e., in the same school and classrooms), norms can be used to make decisions about grouping students or reintegrating students who have been receiving intervention in a separate setting (e.g., small group pull-out, resource room). Norms can be either nationally representative or locally representative, relating to the general performance of students in the same school or district.
- **Which to Use:** Benchmarks are the typical standard of choice because they allow decisions about student performance that relate directly to the outcome and the student's probability of demonstrating proficiency. When making screening and progress decisions, the prime focus should be on that probability of proficiency. Norms can be useful for resource allocation, such as determining which students are the most at-risk or the neediest in terms of severity of difficulty. However, benchmarks can also provide this information as well as descriptive statistics such as percentile rank. Local norms are especially troublesome as they require a great degree of time and effort to develop and provide a reference that separates the standard for comparison from an empirically derived cut score that indicates a student's probability of proficiency. When local norms are lower than national norms, they can be of special concern because they may lead to reduced expectations and less intensive educational programming.

Early Literacy CBMs

Early Literacy CBMs measure skills that align with phonological awareness, letter sounds, and word reading skills considered to be precursors to text reading. They are important to measure because they provide an indication of skills that are considered necessary although not sufficient for later reading achievement.

Type of Measure	Area Assessed	Grade Level Use
ISF/FSF—Initial Sound Fluency/ First Sound Fluency	Phonological Awareness	Beginning & middle of Kindergarten
PSF—Phoneme Segmentation Fluency	Phonological Awareness	Middle of Kindergarten through middle of 1st Grade
LSF—Letter Sound Fluency	Letter Sound Correspondence	Beginning through end of Kindergarten
NWF—Nonsense Word Fluency	Letter Sound Correspondence	Middle of Kindergarten through beginning of 2nd Grade
WIF—Word Identification Fluency	Reading High Frequency Words	Beginning through end of 1st Grade

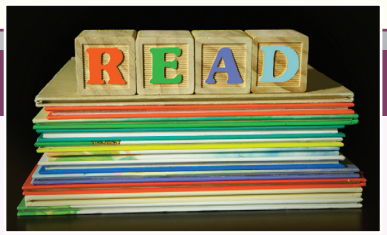
Administration: It takes between 1 and 3 minutes to administer and score each measure. These measures must be given individually and scored during administration.

Early Numeracy CBMs

Early Numeracy CBMs measure skills that align with early identification of numbers and concepts aligned with counting, value of quantity, and sequencing of numbers. They are important to measure because they provide an indication of early math skills considered to be precursors to later math skills.

Type of Measure	Area Assessed	Grade Level Use
OCF—Oral Counting Fluency NIF—Number Identification Fluency	Naming numbers	Beginning of Kindergarten through end of 1st Grade
QDF—Quantity Discrimination Fluency	Determining which of two numbers is larger	Beginning of Kindergarten through end of 1st Grade
MNF—Missing Number Fluency	Completing an array of three numbers where one is missing	Beginning of Kindergarten through end of 1st Grade

Administration: It takes between 1 and 3 minutes to administer and score each measure. These measures must be given individually and scored during administration.



Reading CBMs

To measure overall reading skills that are needed to support decoding and comprehension of text, Reading CBMs are important to measure because they provide an indication of how well a student can read words and understand what they have read.

Type of Measure	Area Assessed	Grade Level Use
ORF*—Oral Reading Fluency PRF*—Passage Reading Fluency CBM-R*—Curriculum-Based Measurement in Reading	Reading of connected text accurately and fluently	1st Grade through 8th Grade
Maze Passages	Reading Comprehension	3rd Grade through 12th Grade

*** ORF, PRF, and CBM-R are all terms to describe the same task.**

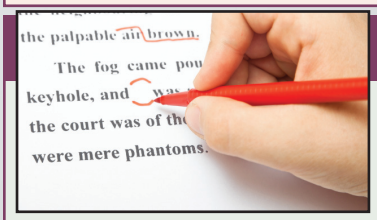
Administration: It takes between 1 and 4 minutes to administer and score each measure. ORF, PRF, and CBM-R all must be given individually and scored during administration. Maze can be group administered and scored later.

Math CBMs

To measure skills that align with basic math facts as well as more complex concepts and applications, Math CBMs are important to measure because they provide an indication of how quickly and accurately students can perform foundational math skills as well as more complex math skills.

Type of Measure	Area Assessed	Grade Level Use
CBM-COMP--Math Computation	Addition, subtraction, multiplication & division	1st Grade through 8th Grade
CBM-C&A--Math Concepts & Applications	Reading graphs, geometry, algebra, measurement, data analysis & probability	2nd Grade through 12th Grade

Administration: It takes between 1 and 10 minutes to administer and score each measure. These measures can be group administered and scored later.



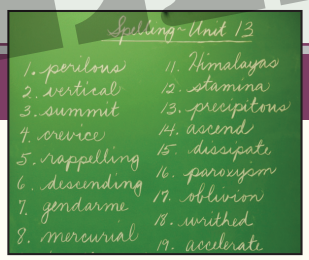
Writing CBMs

Writing CBMs measure skills that align with writing. They are important to measure because they provide an indication of how quickly and accurately students can perform foundational writing skills

Type of Measure	Area Assessed	Grade Level Use
CBM-W--Writing	Generation of written words and sentences and correct spelling	1st Grade through 12th Grade

Administration: It takes between 7 and 10 minutes to administer and score each measure. This measure can be group administered and scored later.

Spelling CBMs



To measure skills that have to do with spelling, Spelling CBMs are important to measure because they provide an indication of how quickly and accurately students can spell words that are dictated to them.

Type of Measure	Area Assessed	Grade Level Use
CBM-S-- Spelling	Accurate and fluent spelling	1st Grade through 12th Grade

Administration: It takes between 7 and 10 minutes to administer and score each measure. This measure can be group administered and scored later.

Content-Area CBMs

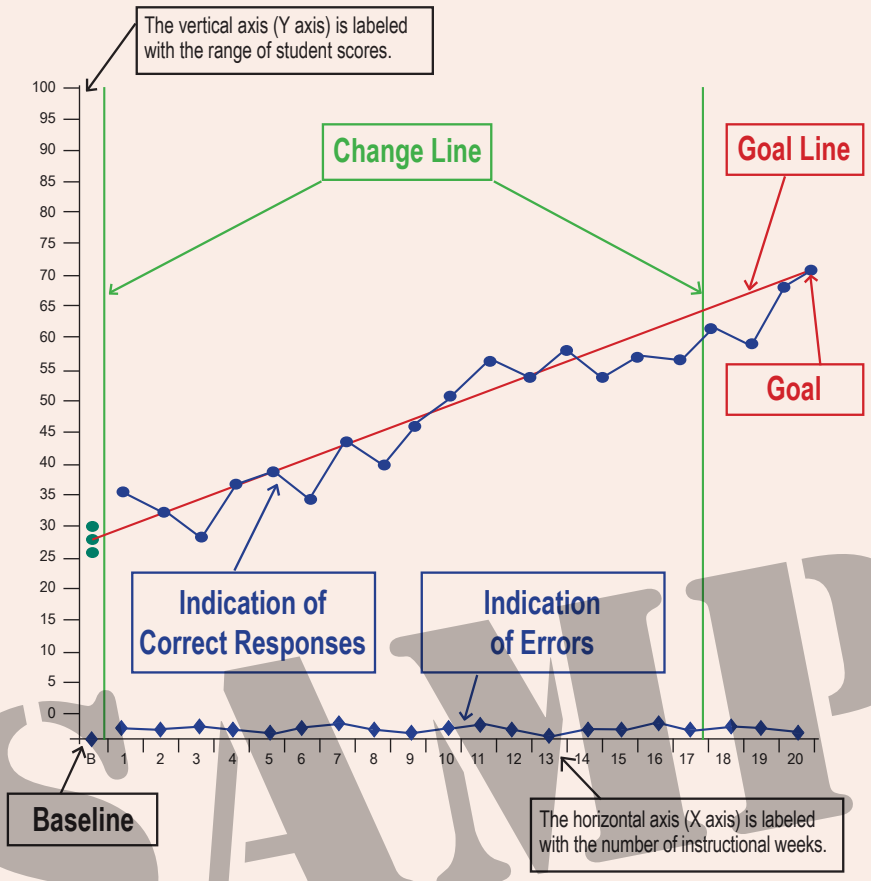
The purpose of Content-Area CBMs is to measure skills such as vocabulary and reading comprehension in relation to a specific content area such as science or history. Content-Area CBMs are important to measure because they relate to the content being assessed as well as the foundational skills.

Type of Measure	Area Assessed	Grade Level Use
Vocabulary Matching	Content vocabulary	4th Grade through 12th Grade
Project AAIMS (Algebra Assessment and Instruction—Meeting Standards	Algebra	9th Grade through 12th Grade

Administration: Typically between 5 and 10 minutes to administer and score each measure. These measures can be group administered and scored later.

Graphing Student Data

Graphing student data is just as important as collecting the data in the first place. It provides a platform to visually represent the data over time that is also easy to interpret. The number graphed represents a direct measure of student skill. Therefore, student learning over time can be followed and decision rules can be applied to aid in determining whether or not the student is making adequate progress toward a goal.



The graph itself should include the following components:

- Y axis (vertical axis) represents the number correct on a CBM probe or skill.
- X axis (horizontal axis) represents the number of weeks or time.
- Baseline score(s) indicates where the student is starting from.
- Goal score indicates where the student should end up.
- Goal Line or Aim Line is a line drawn from the baseline score to goal score.
- Two sets of data points per each entry. One is the number of correct responses and the other is the errors.
- Connecting the data points so that two lines start to form on the graph; one for correct responses and one for errors.
- Change Lines to indicate break from baseline as well as any instructional changes.

Decision-Making Using Graphed CBM Data

A critical feature for monitoring progress and graphing a student's performance is to determine an appropriate goal. Once the goal is determined (using the appropriate standard for comparison) and the goal line (sometimes called the aim line) is drawn, it then becomes time to start collecting the data. A key feature of the data collection is to make certain that both the rate and the accuracy are graphed together. How many words a student correctly reads in one minute, a common metric for CBM-R, captures only half the skill, the other half relates to how many errors the student is making. To get a complete picture of a student's performance on a graph, both pieces of information need to be provided. The easiest way to do this is to graph both data points on the same Y axis. If the student is improving in the number of words correctly read but is also increasing in the number of errors made, can we really say that the student's reading is improving? The answer is "No."

Student skill is typically assessed weekly or biweekly for students who are most at risk or on an IEP, and less often for other students. If the student is on the right path or trajectory for learning can be determined using the following criteria: (a) at least three weeks of instruction have occurred, (b) at least six to ten data points have been graphed, and (c) a visual inspection of the last four consecutive data points for rate and accuracy is made and a decision is made about the goal and instruction. These decisions can be broken down into raising the goal, keeping the goal, or changing the instruction. To raise the goal, the four most recent scores would need to fall above the goal line and the rate of errors would need to be low. To keep the goal, the four most recent scores would need to fall around or on the goal line and errors would need to be low. To change the instruction, one of the following would need to be observed: a) the four most recent scores would need to fall below the goal line and/or b) the rate of errors on the four most recent scores would need to be high.

Collecting, graphing, and then making some type of decision rule about the data is what makes CBM so powerful. All of these tasks need to occur together in order for educators to make good decisions about students' learning needs.

CBM in Standards-Based Education

There has been a lot of emphasis on standards and a movement called standards-based education (SBE) that has been increasing since the early 2000s. The basis of SBE is that there is a common set of knowledge and skills that should be learned by all students at each grade level. To this end, The Council of Chief State School Officers has developed Common Core State Standards (CCSS) for English/Language Arts and Mathematics (released in 2010), with other subjects currently in development. The standards are for grades K-12, but have accessibility documents for application to English learners and students with disabilities.

Use of a common set of standards for each grade level facilitates the use of CBM which aligns well and provides a consistent, meaningful outcome with which to align. This is one of the original purposes of CBM—to provide a set of general outcomes that could serve as indicators of general proficiency. Previously, there was not this type of consistency across districts or states. Now that there is, CBM can be a useful tool for making screening decisions (i.e., which students might not meet the standard by the end of the year) and progress decisions (i.e., if a student or group of students is on track to meet the standards by the end of the year).

SBE shifts the focus on standards away from norm-referencing to criterion-referencing (being based in the standards) or benchmarks. If the benchmark is the level of performance needed to be considered "proficient" in an area or having met a standard, this provides the perfect target to CBM.

Resources

Web Resources

Product Websites:

fast.cehd.umn.edu
www.aimsweb.com
www.ci.hs.iastate.edu/aaims/ (Project AAIMS)
www.dibels.com
www.easycbm.com
www.edcheckup.com
www.isteep.com
terpconnect.umd.edu/~dlspeece/cbmreading/ (Project AIM)
www.yearlyprogresspro.com

Informational Websites:

www.corestandards.org\
www.interventioncentral.org/index.php/cbm-warehouse
www.progressmonitoring.net/ (Research Institute on Progress Monitoring)
rti4success.org (National Center for Response to Intervention)

Print Resources

Hosp, M., Hosp, J., & Howell, K. (2007). *The ABCs of CBM: A Practical Guide to Curriculum-Based Measurement.* New York: Guilford Press Inc.

Shinn, M. (ed.)(1989). *Curriculum-Based Measurement: Assessing Special Children.* New York: Guilford Press Inc.

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Batsche, G., Elliott, J., Graden, J., Grimes, J., Kovaleski, J., Prasse, D., Reschly, D., Schrag, J., & Tilly, W. (2005). Response to Intervention: Policy Considerations and Implementation. Alexandria, VA: National Associate of State Directors of Special Education.

National Center on Response to Intervention. (March 2011). *Essential Components of RTI—A Closer Look at Response to Intervention.* Washington DC: U.S. Department of Education, Office of Special Education Programs, National Center on Response to Intervention.

Other Resources

Love, N. (2011). *Data Literacy for Teachers.* (laminated reference guide). Port Chester, NY: Dude Publishing.

Fisher, D. & Frey, N. (2012). *Formative Assessment in Elementary Schools.* (laminated reference guide). Port Chester, NY: Dude Publishing.

Fisher, D. & Frey, N. (2012). *Formative Assessment in Secondary Schools.* (laminated reference guide). Port Chester, NY: Dude Publishing.

Casbarro, J. (2010). *Response to Intervention (RTI) Classroom Reference Guide.*(laminated reference guide). Port Chester, NY: Dude Publishing.

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