Curriculum-Based Measurement: A Manual for Teachers

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1 An Overview of Curriculum-based Measurement

Introduction

A major responsibility of schools is to teach children the academic skills that they will eventually need to take their place as responsible members of society. But schools not only teach crucial academic skills, they are also required to measure individual children's acquisition and mastery of these skills. The measurement of a child's school abilities is just as important as the teaching of those skills. After all, only by carefully testing what a child has learned can the instructor then draw conclusions about whether that student is ready to advance to more difficult material.

In the past, routine classroom testing has often involved the use of commercially prepared tests. These tests have significant limitations, as we shall soon see. An alternative approach to academic assessment has recently become available, however, that allows teachers to closely monitor the rate of student educational progress. Educational researchers have devised a simple, statistically reliable, and practical means of measuring student skills in basic subject areas such as reading, writing, and arithmetic. In this approach, called curriculum-based measurement, or CBM, the student is given brief, timed exercises to complete, using materials drawn directly from the child's academic program. To date, teachers using CBM have found it to be both a powerful assessment tool for measuring mastery of basic skills and an efficient means of monitoring short-term and long-term student progress in key academic areas.

This manual has been designed for use in a CBM teacher-training course. When you have completed the course, you will be able to use CBM independently to monitor the academic skills of children in your classroom. You will be trained to give CBM probes, chart the resulting data, and consult charted CBM information collected over time to make decisions about the effectiveness of instructional interventions. The remainder of the present chapter provides answers to questions that educators commonly ask about curriculum-based measurement.

Q: What is curriculum-based measurement?

A: Curriculum-based measurement, or CBM, is a method of monitoring student educational progress through direct assessment of academic skills. CBM can be used to measure basic skills in reading, mathematics, spelling, and written expression. It can also be used to monitor readiness skills. When using CBM, the instructor gives the student brief, timed samples, or "probes," made up of academic material taken from the child's school curriculum.

These CBM probes are given under standardized conditions. For example, the instructor will read the same directions every time that he or she gives a certain type of CBM probe. CBM probes are timed and may last from 1 to 5 minutes, depending on the skill being measured. The child's performance on a CBM probe is scored for speed, or fluency , and for accuracy of performance. Since CBM probes are quick to administer and simple to score, they can be given repeatedly (for example, twice per week). The results are then charted to offer the instructor a visual record of a targeted child's rate of academic progress.

Q: What are the drawbacks of traditional types of classroom testing?

A: Traditional academic testing methods often rely on norm-referenced tests. Norm-referenced tests are developed by testing companies to be used in schools across the country. While these traditional academic achievement tests can yield useful information in some situations, they also have several significant drawbacks:

Normed to a national "average"

First, to ensure that their tests can be used by schools across the country, most testing companies set the performance standards for their academic achievement tests according to a national average. However, as every teacher knows, the average skill levels in a particular classroom or school may vary a great deal from national averages. As a result, information from norm-referenced tests will probably not give the instructor a clear idea of what the typical skill-levels might be in his or her own classroom.

Lack of overlap with local, or classroom, curriculum

Also, because norm-referenced tests are designed to measure skills across a national population, the skills that they measure will not completely overlap those of the local classroom curriculum. Over the course of several months, for example, one student may gain skills in certain math computation problems that are not measured on a particular achievement test. The test information might then mislead a teacher into believing that a child has made less progress than is actually the case.

Given infrequently

In addition, norm-referenced tests cannot be given very often to determine student academic progress. Teachers who depend on these tests usually have to wait a number of months before they can learn whether a student is really benefiting from an academic program.

Less sensitive to short-term academic gain

Norm-referenced tests are not very sensitive to short-term gains in school skills. As a result, a teacher who relies solely on these tests to judge student growth may miss evidence of small, but important, improvements in a child's academic functioning.

Q: What are the advantages of CBM over other testing methods?

A: In contrast to norm-referenced academic achievement tests, CBM offers distinct advantages. Using CBM, an instructor can quickly determine the average academic performance of a classroom. By comparing a given child's CBM performance in basic skill areas to these classroom, or local, norms, the teacher can then better judge whether that child's school-skills are significantly delayed in relation to those of classmates. CBM has other benefits as well:

Good overlap with curriculum

Because CBM probes are made up of materials taken from the local curriculum, there is an appropriate overlap between classroom instruction and the testing materials used. In effect, CBM allows the teacher to better test what is being taught.

Quick to administer

CBM probes are quick to administer. For example, to obtain a single CBM reading fluency measure, the instructor asks the student to read aloud for 3 minutes. CBM measures in math, writing, and spelling are also quite brief.

Can be given often

CBM probes can be given repeatedly in a short span of time. In fact, CBM probes can be given frequently, even daily if desired. The resulting information can then be graphed to demonstrate student progress.

Sensitive to short-term gain in academic skills

Unlike many norm-referenced tests, CBM has been found to be sensitive to short-term student gains. In fact, CBM is so useful a measure of student academic progress that teachers employing it can often determine in as short a span as several weeks whether a student is making appropriate gains in school skills.

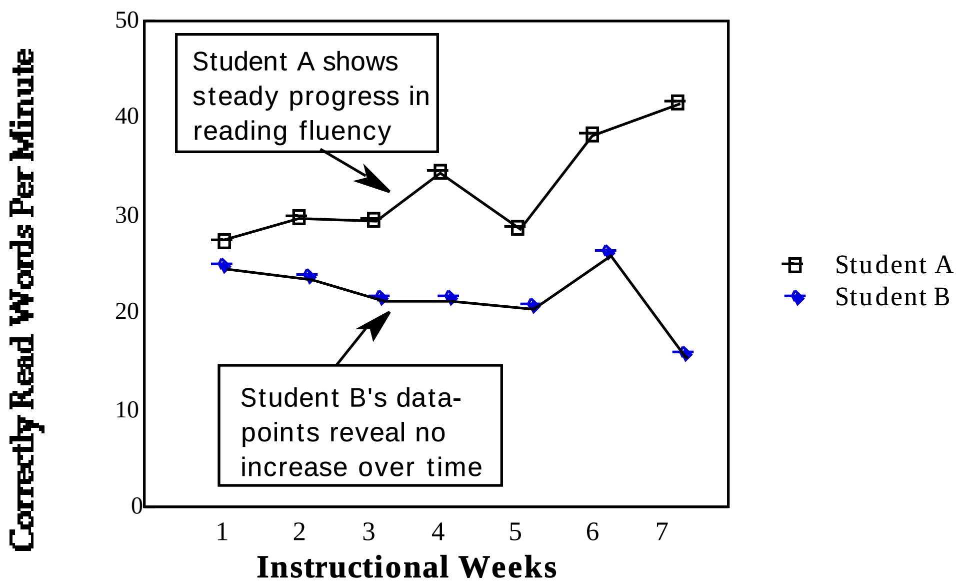
Q: What effect does CBM have on academic progress?

A: Instructors are faced with a central problem: they cannot predict with complete assurance that a particular instructional intervention will be effective with a selected student. The truth is that only through careful observation and data gathering can teachers know if a child's educational program is really effective.

Much of the power of CBM, therefore, seems to lie in its ability to predict in a short time whether an intervention is working or needs to be altered. By monitoring students on a regular basis using CBM the teacher can quickly shift away from educational programming that is not found to be sufficiently effective in increasing a child's rate of learning. In fact, research has shown that teachers who use CBM to monitor the effectiveness of instructional interventions tend to achieve significantly higher rates of student learning than those instructors who rely on more traditional test measures.

Imagine, for example, that 2 students were given the identical reading program in a classroom. If the children were also monitored using CBM reading probes, their reading fluency could be charted over several instructional weeks to judge whether the reading programming was effective. A teacher examining the

Fig. 1.1: Comparison of CBM reading data for two students



graph above would have little difficulty judging that student A had made considerable progress in reading, whereas student B did not increase reading fluency. The difference in progress would be so obvious that the teacher would probably want to change student B's instructional program to foster greater reading growth. By using CBM as a tool to track academic progress, instructors can judge in a shorter period whether students are learning at an optimal rate and change their teaching approach as necessary.

CBM progress-monitoring also brings other benefits. Teachers using CBM tend to be more realistic when estimating a student's rate of progress in the curriculum. CBM data are also very useful for teachers when consulting with parents, school support staff, or the Committee on Special Education. In addition, many instructors report that sharing CBM graphs with students can be highly motivating, as this sharing can encourage children to try to increase their performance from week to week.

Q: If CBM measures only fluency, how can this approach serve as an accurate indicator of a student's true academic abilities?

A: Fluency can be thought of as the speed with which a student is able to produce correct answers on an academic task. In reading, for example, fluency can be defined in concrete terms as number of words correctly read aloud in one minute, while in math, a fluency measure would be the number of digits correctly computed on a worksheet in two minutes. Two major assumptions underlie the choice of fluency as a useful measure of academic mastery. First, children must acquire basic skills before they can move into more challenging curriculum demands. Those students, for example, who have not yet learned to decode words obviously are not ready to work on advanced comprehension of passages. As a screening instrument, CBM allows the instructor to single out children that have failed to acquire fundamental skills crucial to more advanced schoolwork. These children can then be given extra instruction.

Second, a student's speed, or proficiency, in an academic skill is also of great importance. For example, two children might be able to read an identical passage with equal accuracy, but if one student needs triple the amount of time required by her classmate to decode the passage, the slower reader is going to be at a disadvantage in the classroom. While many commercial achievement tests are able to measure some of the skills that a child has acquired, they typically do not measure how quickly a student can carry out a given academic skill. In contrast, CBM gives the instructor accurate information about the rate at which individual children are able to complete academic tasks. CBM also can be used to directly compare the performance of targeted students to classroom or grade-wide norms to determine whether a particular child is as fluent as classmates in a given skill-area.

A final argument can be offered supporting CBM (with its emphasis on fluency) as an accurate measure of academic achievement. Extensive research has shown that CBM can reliably track children's academic growth. Furthermore, teachers who rely on CBM data when evaluating the effectiveness of instructional interventions generally have improved achievement rates in their classrooms.

Q: How much instructional time does CBM require?

A: CBM probes take only a few minutes to give to a student (with the specific amount of time spent depending on the basic skill that the teacher has decided to monitor). For instance, CBM probes that measure reading fluency are given individually. These reading probes typically require about 5 minutes for the instructor to give, score, and chart the results of one measurement session. CBM probes in math, spelling, and writing are quite time-efficient, as they can be given simultaneously to whole groups of children. Probes in these skill areas require from 3-5 minutes of instructional time to administer to an entire class. In some cases, teachers have trained children to score their own CBM probes and regularly chart their own results, reducing the instructor's time involvement. There are also computer software programs available that can streamline the charting and interpreting of CBM data.

Q: What are some examples of CBM probes?

A: Well-researched CBM procedures have been developed for monitoring basic skills in reading, mathematics, spelling, and writing.

Reading

When using CBM to measure reading fluency, the examiner sits down individually with the child and has the student read aloud for 1 minute from each of 3 separate reading passages randomly chosen from a reading book. During the student's reading, the examiner makes note of any decoding errors made in each passage. Then the examiner calculates the number of words correctly read in the passage. Next, the examiner compares the word-totals correctly read for the 3 passages and chooses the middle, or median, score. This median score serves as the best indicator of the student's "true" reading rate in the selected reading material.

Mathematics

When giving CBM math probes, the examiner can choose to administer them individually or to groups of students. There are 2 types of CBM math probes. Single-skill worksheets contain a series of similar problems, while multiple-skill worksheets contain a mix of problems requiring different math operations. No matter which type of math probe is used, the student is given the worksheet and proceeds to complete as many items as possible within 2 minutes.

More traditional approaches to scoring computational math problems usually give credit for the total number of correct answers appearing on a worksheet. In contrast to this all-or-nothing marking system, CBM assigns credit to each individual correct digit appearing in the solution to a math fact. By separately scoring each digit in the answer of a computation problem, the instructor is better able to recognize and to give credit for a student's partial math competencies.

For example, this addition problem has a 2-digit answer:

$$\boxed{\begin{array}{r} 13 \\ \underline{+\ 6} \\ 19 \end{array}}$$

If a student correctly gave the answer to the problem as "19," that student would receive a score of 2 correct digits.

In this subtraction problem, the student placed an incorrect digit in the ones place. However, the numeral 2 that appears in the tens place is correct.

46 -18 27

So this student receives credit for a single correct digit in the subtraction problem.

Spelling

In spelling assessments using CBM, the instructor reads aloud words that students are to try to spell correctly within a time-limit. The teacher may give 12 to 17 spelling words within a 2-minute period. According to the CBM scoring technique, spelling words are scored for correct letter-sequences. Correct letter-sequences are pairs of letters in a word that are placed in the proper sequence. Let's look at an example.

The word '**talk**' contains 4 letters. However, it is considered to have 5 possible correct-letter sequences. First, the examiner assumes that there is a

_ T A L K _

"phantom" letter, or space-holder, at the beginning and end of each spelling-word. Phantom letters are represented here as spaces.

1. When the phantom letter at the start of the word is paired with **T**, it makes up the first correct letter-sequence.
2. **T A** makes up the second letter-sequence
3. **A L** makes up the third letter-sequence.
4. **L K** makes up the fourth letter-sequence.
5. And **K** paired with the final phantom letter makes up the fifth correct letter-sequence.

So the word **talk** has 5 correct letter-sequences in all. For each spelling word given, a student gets credit only for those letter-pairs, or sequences, that are written in the correct order.

Writing

CBM probes that measure writing skills are simple to administer but offer a variety of scoring options. As with math and spelling, writing probes may be given individually or to groups of students. The examiner prepares a lined composition sheet with a story-starter sentence at the top. The student thinks for 1 minute about a possible story to be written from the story-starter, then spends 3 minutes writing the story. Depending on the preferences of the teacher, the writing probe can be scored in several ways. For example, the instructor may decide to score the writing probe according to the total number of words appearing in a student's composition or for the number of correctly spelled words in the writing sample.

Summary

The accurate measurement of academic skills is a key component of a well-run classroom. However, traditional, norm-referenced tests such as those used most often in schools have several drawbacks. They reflect a national, rather than local, average, do not overlap substantially with the curriculum of a particular classroom, can only be given infrequently, and are not sensitive to short-term gains in student skills. In contrast, curriculum-based measurement, or CBM, is a means of tracking educational progress through direct assessment of academic skills in reading, mathematics, writing, and spelling. CBM probes are created to match curriculum objectives and are administered under timed, standardized conditions. CBM uses probes that overlap closely with a school's curriculum, are quick to administer, can be given frequently, and are quite sensitive to short-term student gains. Reading probes are scored according to the number of words correctly read, while math probes measure the number of correctly computed digits. Spelling probes assign credit for correct letter-sequences; writing probes offer several scoring options, including total words written and number of correctly spelled words.

When used to monitor an instructional intervention, CBM can give the instructor timely feedback about the effectiveness of that intervention. The measurement of fluency in basic skills is central to CBM. By assessing the fluency, or speed, of a child's skills, CBM first allows the teacher to see if the student has acquired the skill in question and then gives the instructor an indication of the proficiency that the child has in the targeted skill. Considerable research indicates that CBM is a reliable means of estimating the academic growth of children in basic skills.

2 Administration & Scoring of CBM Probes

Introduction

In contrast to less formal methods of monitoring classroom academic skills, the hallmark of CBM is that it follows standardized procedures of administration and scoring. Because CBM does make use of a standardized format, the instructor can have confidence that the information provided by this direct-assessment approach will serve as a reliable and valid indicator of school skills. In effect, results obtained from CBM probes are replicable (that is, separate adults independently giving similar CBM probes to the same child within a short span of time can be expected to come up with closely matching results).

Before moving to specific instructions for giving and scoring CBM probes, however, it might be useful to examine two more general decisions to be made by an instructor who wishes to use CBM in the classroom. First, of course, the teacher must select one or more areas of basic academic skills that the instructor wishes to assess through CBM. Well-researched CBM procedures are presently in place for reading, mathematics, spelling, and writing. Next, the teacher will need to define a measurement pool of items to be included in CBM probes. As Table 2.1 illustrates, the term **measurement pool** simply refers to the specific range of instructional materials from which the instructor has decided to draw the content of CBM probes:

Table 2.1: Examples of measurement pools to be used in creating CBM probes in basic-skill areas:

Reading: Passages drawn at random from a single basal reading text.

Math: Addition problems with single-digit terms and sums no greater than 18.

Spelling: A summary list of words presented in a grade-appropriate spelling book.

Writing: Story-starters suitable for a specific grade-level.

A few examples may help to give a clearer idea of the concept of the measurement pool. If a teacher wishes to assess a younger child's reading fluency, he might choose to track her progress using CBM passage-probes taken at random from a 2nd-grade reader. The measurement pool in this case would be the range of suitable passages contained in a single reading book. Similarly, a 5th-grade instructor may decide to collect classroom CBM spelling norms on a regular basis. If she is using a specific spelling curriculum in her class (e.g., Scott Foresman spelling text), she could list all of the words to be taught from that book during the school year. Random CBM spelling probes could then be drawn repeatedly from this measurement pool of collected words.

Once the instructor has established a pool of items to be randomly selected for basic-skill probes, that teacher is now ready to prepare, administer, and score CBM probes according to standardized procedures. The important elements of CBM probes that are standardized include the following: **materials, directions for administration, time limit,** and **scoring rules**. The remainder of this chapter will review the standardized procedures for CBM in reading, mathematics, spelling, and writing.

Reading

Description

To complete a CBM reading fluency probe, the examiner sits down individually with the child and has the student read aloud for 1 minute from each of 3 separate reading passages. During the student's reading, the examiner makes note of any reading errors in each passage. Then the examiner calculates the number of words correctly read in the passage. Next, the examiner ranks in ascending order the word-totals correctly read for the 3 passages and chooses the middle, or median, score as the best indicator of the student's "true" reading rate in the selected reading material.

Creating a measurement pool for reading-fluency probes

If a teacher's classroom reading program is based upon a basal reading series (e.g., Houghton Mifflin, Silver Burdett & Ginn), the instructor can treat the sum of passages contained within each basal text as a separate measurement pool. When creating probes, the instructor would simply select passages at random from a designated basal text.

If a reading program makes use of other materials instead (e.g., novels or short stories drawn from a number of sources), the instructor may choose one of two approaches. First, the teacher may still select passages from a basal reading series to use as CBM probes for reading fluency. In essence, the teacher would be using the basal series as a reading-fluency measurement tool--a common collection of passages of graded difficulty in which to monitor the reading progress of students participating in an independent reading program. This approach is convenient because the passages within a single basal are presumed to be of a similar level of difficulty, a necessary consideration for the instructor who plans to create standardized reading probes. Instructors who have put together their own reading programs can also assume that students in <u>any</u> effective reading program should show generalized growth in reading fluency--growth that will be apparent even when tracked in basal reading passages.

Alternatively, the teacher who follows a non-basal reading program may decide to apply one of several readability formulas (e.g., Fry's Readability Index) to the reading materials used in the classroom. In this manner, the instructor should be able to group novels of similar difficulty together into several successive levels. These levels would resemble separate "basal" reading texts. When preparing CBM reading probes, the instructor can simply draw passages randomly from those novels grouped at the desired level of difficulty and use those passages to track the child's reading progress.

Preparing CBM reading-fluency probes

When assessing the fluency skills of students placed in a basal reading series, the instructor chooses 3 passages at random from the basal text chosen for assessment. For children in the 1st and 2nd grades, each passage should be approximately 150 words long, while passages of about 250 words should be prepared for older students. Passages selected should not contain too much dialog and should avoid an excessive number of foreign words or phrases. In addition, only prose passages should be used in CBM assessments. Poetry and drama should be avoided because they tend to vary considerably and do not represent the kind of text typically encountered by students.

For ease of administration, the instructor will want to prepare examiner and student copies of each passage. Ideally, reading passages should be free of illustrations that may help a child to interpret the content of the text. While the teacher may type out

Fig. 2.1: An example of a CBM reading probe

Examiner Copy

Summertime! How lovely it was out	6
in the country, with the wheat	12
standing yellow, the oats green,	17
and the hay all stacked down in the	25
grassy meadows! And there went the	31
stork on his long red legs,	37
chattering away in Egyptian, for he	43
had learnt that language from his	49
mother. The fields and meadows	54

Student Copy

Summertime! How lovely it was out
in the country, with the wheat
standing yellow, the oats green,
and the hay all stacked down in the
grassy meadows! And there went the
stork on his long red legs,
chattering away in Egyptian, for he
had learnt that language from his
mother. The fields and meadows

copies of a passage, another often-used method is to photocopy a selection from the basal and to cut-and-paste a version of the passage that omits any illustrations but retains the letter-size and font found in the original story. The examiner copy should have a cumulative word total listed along the right margin of the passage for ease of scoring (see Figure 2 above).

Materials needed for giving CBM reading probes

- o Numbered and unnumbered copies of reading passage
- o Stopwatch
- o Pen or marker

Administration of CBM reading probes

The examiner and the student sit across the table from each other. The examiner hands the student the unnumbered copy of the CBM reading passage. The examiner takes the numbered copy of the passage, shielding it from the student's view.

The examiner says to the student:

> *When I say, 'start,' begin reading aloud at the top of this page. Read across the page* [demonstrate by pointing]. *Try to read each word. If you come to a word you don't know, I'll tell it to you. Be sure to do your best reading. Are there any questions?*
>
> [Pause] *Start.*

The examiner begins the stopwatch when the student says the first word. If the student does not say the initial word within 3 seconds, the examiner says the word and starts the stopwatch. As the student reads along in the text, the examiner records any errors by marking a slash (/) through the incorrectly read word. If the student hesitates for 3 seconds on any word, the examiner says the word and marks it as an error. At the end of 1 minute, the examiner says, *Stop* and marks the student's concluding place in the text with a bracket ( ]).

Scoring

Reading fluency is calculated by first determining the total words attempted within the timed reading probe and then deducting from that total the number of incorrectly read words.

The following scoring rules will aid the instructor in marking the reading probe:

➤ Words read correctly are scored as correct:
--Self-corrected words are counted as correct.
--Repetitions are counted as correct.
--Examples of dialectical speech are counted as correct.
--Inserted words are ignored.

➢ Mispronunciations are counted as errors.

> Example
> Text: The small gray fox ran to the cover of the trees.
> Student: "The smill gray fox ran to the cover of the trees."

➢ Substitutions are counted as errors.

> Example
> Text: When she returned to the house, Grandmother called for Franchesca.
> Student: "When she returned to the home, Grandmother called for Franchesca.

➢ Omissions are counted as errors.

> Example
> Text: Anna could not compete in the last race.
> Student: "Anna could not in the last race."

➢ Transpositions of word-pairs are counted as 1 error.

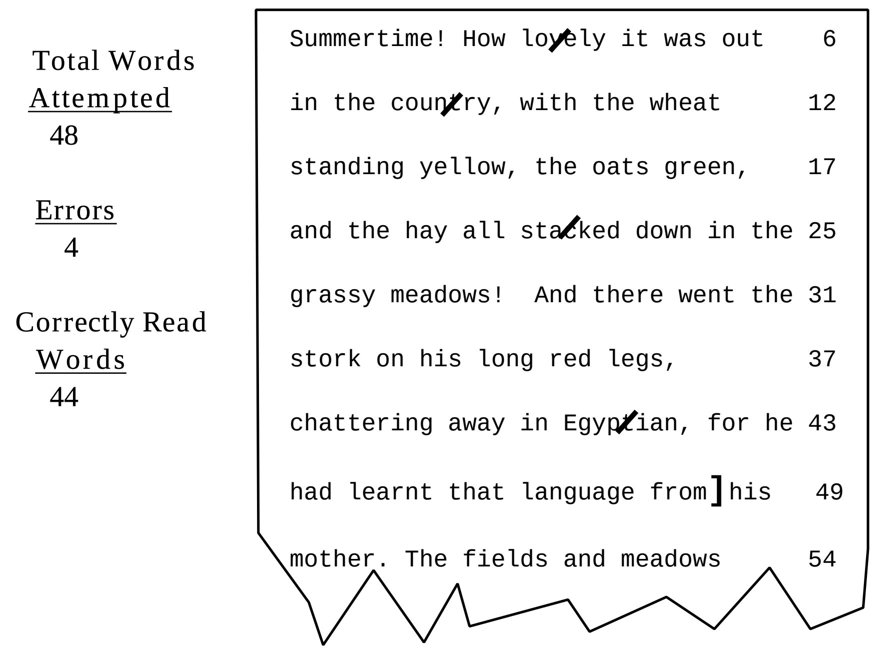
> Example
> Text: She looked at the bright, shining face of the sun.
> Student: "She looked at the shining bright face of the sun."

➢ Words read to the student by the examiner after 3 seconds have gone by are counted as errors.

Computing reading-fluency rate in a single passage

The scoring of a reading probe is straightforward. The examiner first determines how many words the reader actually attempted during the 1-minute reading sample. On the completed probe in Fgure 2.2, for instance, the bracket near the end of the text indicates that the student attempted 48 words before his time expired. Next, the examiner counts up the number of errors made by the reader. On this probe, the student committed 4 errors. By deducting the number of errors from the total words attempted, the examiner arrives at the number of correctly read words per minute. This number serves as an estimate of reading fluency, combining as it does the student's speed and accuracy in reading. So by deducting the errors from total words attempted, we find that the child actually read 44 correct words in 1 minute.

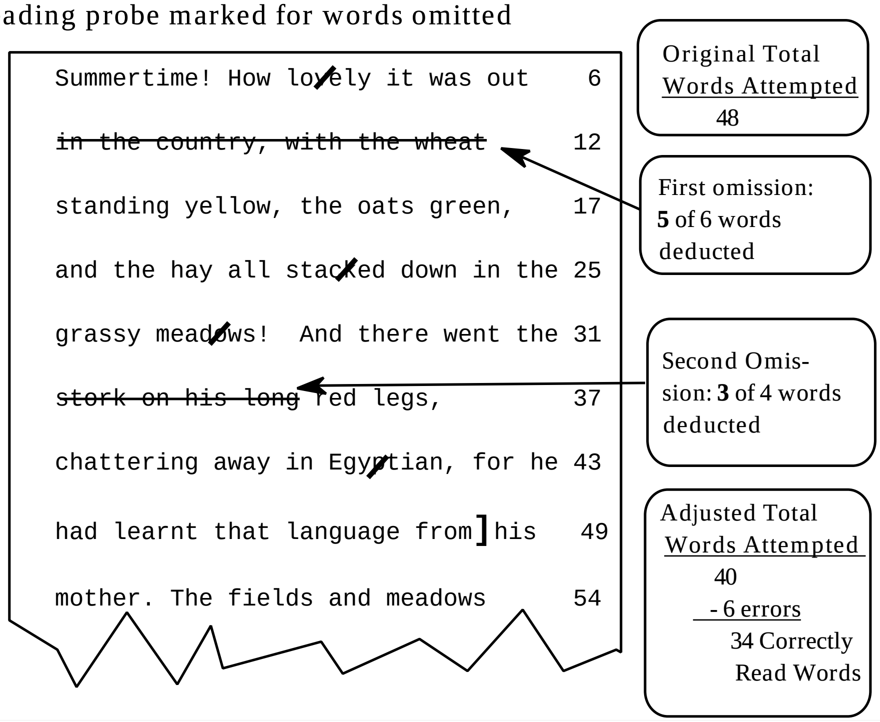
Fig. 2.2: Example of a scored reading probe



Accommodating omissions when scoring. . .

When a student skips several connected words or even an entire line during a reading probe, that omission creates a special scoring dilemma. An omission, after

Fig. 2.3: A reading probe marked for words omitted



all, is considered to be a single error of tracking, no matter how many words were skipped at one time. However, if all words omitted in a line were individually counted as errors, the student's error rate would be greatly inflated. The solution is for the examiner to subtract all but one of the words in each omission before computing the total words attempted.

Let's see how that score adjustment would work. On the completed probe in Figure 2.3, the student omitted text in 2 places while reading aloud. The examiner drew a line through all the connected words skipped by the child. The first omission (words 7-12) was an entire line. Keeping in mind that 6 words were omitted, the examiner drops 5 of those words before calculating the total words attempted. Similarly, the student omitted words 32-35. Using the same rule, the examiner drops 3 of those 4 words.

When finally calculating the number of words the child attempted to read, the examiner notes that the child reached word 48. Eight words are then deducted from the omitted lines to avoid inflating the error count. The adjusted figure for total words attempted is found to be 40 words. The child committed 6 errors (4 marked by slashes and 2 omissions). These errors are subtracted from the revised figure of 40 total words attempted. Therefore, the number of correctly read words in this example would be 34.

Selecting the median reading-fluency rate in a basal

A major difference between basal reading probes and CBM probes in other basic-skill areas is that the examiner is required to give 3 reading probes to arrive at a single estimate of a student's reading fluency in a basal text. In contrast, single administrations of CBM probes in mathematics, spelling, and writing are usually sufficient to yield accurate estimates of student skills. Why does CBM reading alone require 3 probes for each administration? The answer can be found in the nature of basal reading texts.

Although publishers select the contents of a basal reading book to fall within a restricted range of difficulty, instructors know that the material within a basal reader will actually vary somewhat in level of difficulty from story to story. Given the potential variability of text samples taken at random from a basal, there is some danger that reading probes using only a single passage would provide a distorted picture of a child's "true" reading rate. For instance, if the child happened by chance to be given 2 excessively difficult reading probes during successive CBM assessments, the examiner might be misled into believing that the student was making slower reading progress than was actually the case.

To safeguard CBM reading probes against the possibility of faulty estimates of reading ability, the examiner relies on a concept known as central tendency. While this term is adopted from statistics, it means simply that when several samples of a varying behavior are gathered (in this case, samples of reading fluency), there is a much greater chance that one of those samples will be an accurate reflection of a child's "true" ability. But when 3 reading probes are given from a single basal, how does the examiner decide which of the probes represents the "best" estimate of the student's proficiency in reading?

First, the examiner mentally ranks the scores for words read correctly in ascending order (from lowest to highest). Next, the examiner discards the lowest and highest scores, retaining only the middle, or median, score. By dropping low and high scores for each series of 3 reading robes, the examiner is able to greatly enhance the accuracy of the CBM reading probe. The same approach allows the teacher to accurately estimate the number of reading errors that a child makes in each basal.

An example may be helpful here. Let's assume that Jane, a 2nd-grade student, sat down with her teacher one afternoon and was given 3 CBM reading probes taken from basal 6 (early 2nd-grade reader) of the Silver Burdett & Ginn reading series. The instructor then records the results on a recording sheet, as in Figure 2.4:

Fig. 2.4: Example of a completed score sheet for a CBM reading probe

Student Name Janet Randall Grade/Unit 2

Reading Level 1B Current Basal Placement 5 / SB&G

Basal Number: 6 / SB&G Date 4/9/92

	Correctly Read Words	Errors	Percent Accuracy
Story Name: Frog and Toad	64	4	94
Story Name: Daniel's Duck	46	9	84
Story Name: Too Many Babas	38	7	84

In order to arrive at the best estimate of the child's actual reading rate, the teacher first decides which of the 3 reading rates is the middle, or median, score. Since 38 correct words per minute is the lowest score, she discards it. In the same fashion, the instructor eliminates 64 words per minute, the highest score. She is then left with the median, or middle, score of 46 words per minute as the most accurate estimate of Jane's reading fluency in basal 6. Notice that the teacher also uses the concept of the median score to find the best estimate of how many reading errors Jane makes in basal 6. By dropping the low error score of 4 and the high error score of 9, her teacher finds that the most accurate estimate is that Jane makes approximately 7 errors per minute in the early 2nd-grade reader.

In this example, the teacher also computed the child's accuracy of decoding for each reading probe. Strictly speaking, the calculation of a student's accuracy of academic performance is not a part of CBM. However, many instructors find an estimate of student accuracy to be useful diagnostic information. To determine the percent accuracy of a child's reading, the teacher divides the number of words correctly read by the total words attempted. The resulting figure will be a decimal ranging between 0.0 and 1.0. That decimal figure is then multiplied by 100 to give the instructor the percent accuracy of the child's reading sample.

Referring back to the Figure 2.4, the instructor administered a reading probe taken from the story Daniel's Duck. In that passage, the student managed to read 46 correct words out of a total of 55 words attempted. Dividing 46 words by 55 words, the teacher came up with a quotient of 0.84. She then multiplied that decimal figure by 100 (0.84 x 100) to come up with 84 percent as an index of the child's reading accuracy in this individual reading probe. As with number of correctly read words and errors, measures of reading accuracy may be reported as a median figure. However, teachers often choose instead to present reading accuracy as a range of performance. In the above example, the child could be said to read within a range of 84 to 94 percent accuracy in basal 6 of the Silver Burdett & Ginn reading series.

Mathematics

Description

There are 2 types of CBM math probes, single-skill worksheets (those containing like problems) and multiple-skill worksheets (those containing a mix of problems requiring different math operations). Single-skill probes give instructors good information about students' mastery of particular problem-types, while multiple-skill probes allow the teacher to test children's math competencies on a range of computational objectives during a single CBM session.

Both types of math probes can be administered either individually or to groups of students. The examiner hands the worksheet(s) out to those students selected for assessment. Next, the examiner reads aloud the directions for the worksheet. Then the signal is given to start, and students proceed to complete as many items as possible within 2 minutes. The examiner collects the worksheets at the end of the assessment for scoring.

Creating a measurement pool for math computational probes

The first task of the instructor in preparing CBM math probes is to define the computational skills to be assessed. Many districts have adopted their own math curriculum that outlines the various computational skills in the order in which they are to be taught. Teachers may also review scope-and-sequence charts that accompany math textbooks when selecting CBM computational objectives.

The order in which math computational skills are taught, however, probably does not vary a great deal from district to district. Instructors seeking a quick review of computational goals arranged in order of increasing difficulty may want to consult the computational-skills chart included in Appendix D. This chart was adapted from Shapiro (1989) and summarizes the math curriculum of a typical school district. When consulting the chart, teachers can mark in the appropriate place those skills which their students have mastered, those skills in which their students are presently placed instructionally, and those skills which their students have not yet been taught. In the sample chart below, for example, the instructor of a 2nd-grade math group has completed a skills-profile for his math group:

Fig. 2.5: Sample Computational Skills Chart for 2nd-Grade Math Group

MASTERY	INSTRUCTIONAL	DIFFICULTY	
			Grade 1
●			1. Add two one-digit numbers: sums to 10.
	●		2. Subtract two one-digit numbers: combinations to 10.
			Grade 2
	●		3. Add two one-digit numbers: sums 11 to 19.
	●		4. Add a one-digit number to a two-digit number--no regrouping.
		●	5. Add a two-digit number to a two-digit number--no regrouping.
		●	6. Add a three-digit number to a three-digit number--no regrouping.

Instructors typically are interested in employing CBM to monitor students' acquisition of skills in which they are presently being instructed. However, teachers may also want to use CBM as a skills check-up to assess those math objectives that students have been taught in the past or to "preview" a math group's competencies in computational material that will soon be taught.

<u>Preparing CBM Math Probes</u>

After computational objectives have been selected, the instructor is ready to prepare math probes. The teacher may want to create single-skills probes, multiple-skill probes, or both types of CBM math worksheets.

Creating the Single-skill Math Probe

As the first step in putting together a single-skill math probe, the teacher will select one computational objective as a guide. The measurement pool, then, will consist of problems randomly constructed that conform to the computational objective chosen. For example, the instructor may select the following goal from the math skills chart as the basis for a math probe:

Fig. 2.6: Single-skill math probe

ˆ 3. Add two one-digit numbers: sums 11 to 19.

9	6	8	4	17
+7	+5	+3	+9	+ 2

The teacher would then construct a series of problems which match the computational goal, as in Figure 2.6. In general, single-skill math probes should contain between 80 and 200 problems, and worksheets should have items on both the front and back of the page. Adequate space should also be left for the student's computations, especially with more complex problems such as long division.

Creating the Multiple-skill Math Probe

To assemble a multiple-skill math probe, the instructor will first select the range of math operations and of problem-types that will make up the probe. The teacher will probably want to consult the district math curriculum, appropriate scope -and-sequence charts, or the computational-goal chart included in this manual when selecting the kinds of problems to include in the multiple-skill probe. Once the computational objectives have been chosen, the teacher can make up a worksheet of mixed math facts conforming to those objectives. Using our earlier example, the teacher who used the math-skills chart to estimate the proficiency of his 2nd-grade math group may then decide to create a multiple-skills CBM probe. He could choose to sample only those problem-types which his students have either mastered or are presently being instructed in. Those skills are listed in Figure 2.7, with sample problems that might appear on the worksheet of mixed math facts:

Fig. 2.7: Multiple-skill math probe

1. Add two one-digit numbers: sums to 10. (Mastered)
2. Subtract two one-digit numbers: combinations to 10. (Mastered)
3. Add two one-digit numbers: sums 11 to 19.(Instructional)
4. Add a one-digit number to a two-digit number--no regrouping. (Instructional)

23	7	4	9	36	7
+6	+4	+9	+9	+2	+1

Materials needed for giving CBM math probes

- o Student copy of CBM math probe (either single- or multiple-skill)
- o Stopwatch
- o Pencils for students

Administration of CBM math probes

The examiner distributes copies of one or more math probes to all the students in the group. (Note: These probes may also be administered individually). The examiner says to the students:

The sheets on your desk are math facts.

If the students are to complete a single-skill probe, the examiner then says: *All the problems are [addition or subtraction or multiplication or division] facts.*

If the students are to complete a multiple-skill probe, the examiner then says: *There are several types of problems on the sheet. Some are addition, some are subtraction, some are multiplication, and some are division* [as appropriate]. *Look at each problem carefully before you answer it.*

When I say 'start,' turn them over and begin answering the problems. Start on the first problem on the left on the top row [point]. *Work across and then go to the next row. If you can't answer the problem, make an 'X' on it and go to the next one. If you finish one side, go to the back. Are there any questions?*

Say, *Start.* The examiner starts the stopwatch.

While the students are completing worksheets, the examiner and any other adults assisting in the assessment circulate around the room to ensure that students are working on the correct sheet, that they are completing problems in the correct order (rather than picking out only the easy items), and that they have pencils, etc.

After 2 minutes have passed, the examiner says *Stop.* CBM math probes are collected for scoring.

Scoring

Traditional approaches to computational assessment usually give credit for the total number of correct answers appearing on a worksheet. If the answer to a problem is found to contain one or more incorrect digits, that problem is marked wrong and receives no credit. In contrast to this all-or-nothing marking system, CBM assigns credit to <u>each</u> <u>individual</u> <u>correct</u> <u>digit</u> appearing in the solution to a math fact.

On the face of it, a math scoring system that awards points according to the number of correct digits may appear unusual, but this alternative approach is grounded in good academic-assessment research and practice. By separately scoring each digit in the answer of a computation problem, the instructor is better able to recognize and to give credit for a student's partial math competencies. Scoring computation problems by the digit rather than as a single answer also allows for a more minute analysis of a child's number skills.

Imagine, for instance, that a student was given a CBM math probe consisting of addition problems, sums less than or equal to 19 (incorrect digits appear larger than correct digits):

Fig. 2.8: Completed math probe

13	9	4	5	12	14
+ 6	+ 7	+2	+4	+ 2	+ 4
1**8**	1**7**	6	9	14	1**9**

If the answers in Figure 2.8 were scored as either correct or wrong, the child would receive a score of 3 correct answers out of 6 possible answers (50 percent). However, when each individual digit is scored, it becomes clear that the student actually correctly computed 7 of 10 possible digits (70 percent). Thus, the CBM procedure of assigning credit to each correct digit demonstrates itself to be quite sensitive to a student's emerging, partial competencies in math computation.

The following scoring rules will aid the instructor in marking single- and multiple-skill math probes:

➢ Individual correct digits are counted as correct.

--Reversed or rotated digits are not counted as errors unless their change in position makes them appear to be another digit (e.g., 9 and 6).

➢ Incorrect digits are counted as errors.

--Digits which appear in the wrong place value, even if otherwise correct, are scored as errors.

Example:

```
  97
 x 9
8730
```

"873" is the correct answer to this problem, but no credit can be given since the addition of the 0 pushes the other digits out of their proper place-value positions.

➢ The student is given credit for "place-holder" numerals that are included simply to correctly align the problem. As long as the student includes the correct space, credit is given whether or not a "0" has actually been inserted.

Example:

```
  55
x 82
 110
4400
4510
```

Since the student correctly placed 0 in the "place-holder" position, it is given credit as a correct digit. Credit would also have been given if the space were reserved but no 0 had been inserted.

- In more complex problems such as advanced multiplication, the student is given credit for all correct numbers that appear below the line.

Example:

```
  33
x 28
 264
 660
 924
```

Credit is given for all work below the line. In this example, the student earns credit for 9 correct digits.

- Credit is not given for any numbers appearing above the line (e.g., numbers marked at the top of number columns to signify regrouping).

Example:

```
   1
  46
+ 39
  85
```

Credit is given for the 2 digits below the line. However, the carried "1" above the line does not get credit.

Written Expression

Description

CBM Writing probes are simple to administer but offer a variety of scoring options. As with math and spelling, writing probes may be given individually or to groups of students. The examiner prepares a lined composition sheet with a story-starter sentence or partial sentence at the top. The student thinks for 1 minute about a possible story to be written from the story-starter, then spends 3 minutes writing the story. The examiner collects the writing sample for scoring. Depending on the preferences of the teacher, the writing probe can be scored in several ways (see below).

Creating a measurement pool for writing probes

Since writing probes are essentially writing opportunities for students, they require minimal advance preparation. The measurement pool for writing probes would be a collection of grade-appropriate story-starters, from which the teacher would randomly select a story-starter for each CBM writing assessment. Writing texts are often good sources for lists of story-starters; teachers may also choose to write their own.

Preparing CBM writing probes

The teacher selects a story-starter from the measurement pool and places it at the top of a lined composition sheet. The story-starter should avoid wording that encourages students to generate lists. It should also be open-ended, requiring the writer to build a narrative rather than simply to write down a "Yes" or

Fig. 2.9: Example of a writing probe

CBM Written Language

Name_______________________ Grade____ Date_______

One day, I was out sailing. A storm carried me far out to sea and

wrecked my boat on a desert island. _______________________________

____

____

"No" response. The CBM writing probe in Figure 2.9 is a good example of how a such a probe might appear. This particular probe was used in a 5th-grade classroom.

Materials needed for giving CBM writing probes

- o Student copy of CBM writing probe with story-starter
- o Stopwatch
- o Pencils for students

Administration of CBM writing probes

The examiner distributes copies of CBM writing probes to all the students in the group. (Note: These probes may also be administered individually). The examiner says to the students:

> *I want you to write a story. I am going to read a sentence to you first, and then I want you to write a short story about what happens. You will have 1 minute to think about the story you*

will write and then have 3 minutes to write it. Do your best work. If you don't know how to spell a word, you should guess. Are there any questions?

For the next minute, think about . . . [insert story-starter]. The examiner starts the stopwatch.

At the end of 1 minute, the examiner says, *Start writing.*

While the students are writing, the examiner and any other adults helping in the assessment circulate around the room. If students stop writing before the 3-minute timing period has ended, monitors encourage them to continue writing.

After 3 additional minutes, the examiner says, *Stop writing.* CBM writing probes are collected for scoring.

Scoring

The instructor has several options when scoring CBM writing probes. Student writing samples may be scored according to the (1) number of words written, (2) number of letters written, (3) number of words correctly spelled, or (4) number of writing units placed in correct sequence. Scoring methods differ both in the amount of time that they require of the instructor and in the quality of information that they provide about a student's writing skills. Advantages and potential limitations of each scoring system are presented below.

1. Total words--The examiner counts up and records the total number of words written during the 3-minute writing probe. Misspelled words are included in the tally, although numbers written in numeral form (e.g., 5, 17) are not counted. Calculating total words is the quickest of scoring methods. A drawback, however, is that it yields only a rough estimate of writing fluency (that is, of how quickly the student can put words on paper) without examining the accuracy of spelling, punctuation, and other writing conventions. The CBM writing sample in Figure 2.10 was written by a 6th-grade student:

Fig. 2.10: CBM writing sample scored for total words

```
I woud drink water from the ocean.....07
and I woud eat the fruit off of.......08
the trees.  Then I woud bilit a.......07
house out of trees, and I woud........07
gather firewood to stay warm.  I......06
woud try and fix my boat in my........08
spare time.  .........................02
                       Word total = 45
```

Using the total-words scoring formula, this sample is found to contain 45 words (including misspellings).

2. Total letters--The examiner counts up the total number of letters written during the 3-minute probe. Again, misspelled words are included in the count, but numbers written in numeral form are excluded. Calculating total letters is a reasonably quick operation. When compared to word-total, it also enjoys the advantage of controlling for words of varying length. For example, a student who writes few words but whose written vocabulary tends toward longer words may receive a relatively low score on word-total but receive a substantially higher score

Fig. 2.11: CBM writing sample scored for total letters

```
I woud drink water from the ocean.....27
and I woud eat the fruit off of.......24
the trees.  Then I woud bilit a.......23
house out of trees, and I woud........23
gather firewood to stay warm.  I......25
woud try and fix my boat in my........23
spare time.  .........................09
                      Letter total = 154
```

for letter-total . As with word-total, though, the letter-total formula gives only a general idea of writing fluency without examining a student's mastery of writing conventions. When scored according to total letters written, our writing sample is found to contain 154 letters.

3. Correctly Spelled Words--The examiner counts up only those words in the writing sample that are spelled correctly. Words are considered separately, not within the context of a sentence. When scoring a word according to this approach, a

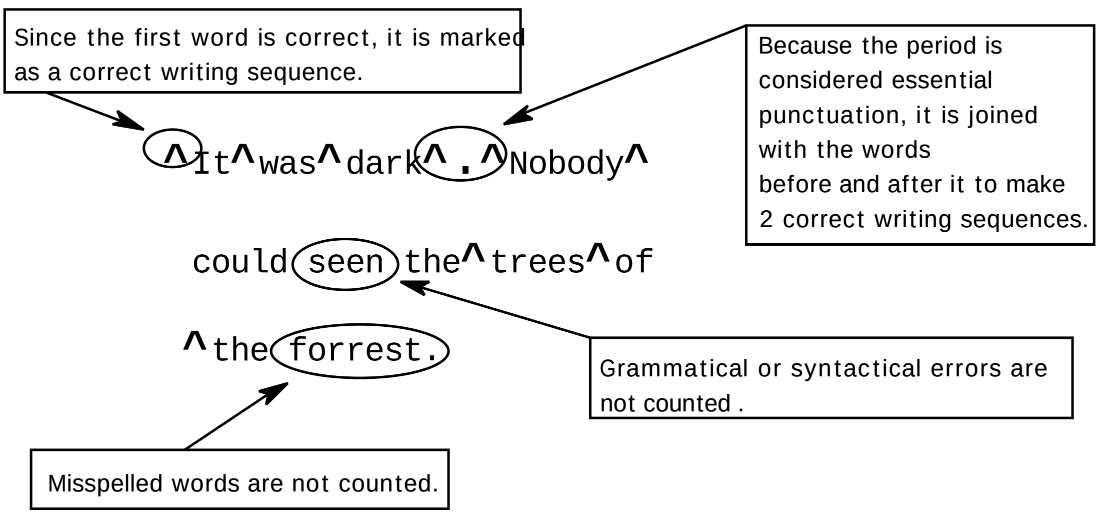
Fig. 2.12: CBM Writing sample scored for correctly spelled words

```
I woud drink water from the ocean.....06
and I woud eat the fruit off of.......07
the trees.  Then I woud bilit a.......05
house out of trees, and I woud........06
gather firewood to stay warm.  I......06
woud try and fix my boat in my........07
spare time.  .........................02
            Correctly Spelled Words = 39
```

good rule of thumb is to determine whether--in isolation--the word represents a correctly spelled term in English. If it does, the word is included in the tally. Assessing the number of correctly spelled words has the advantage of being quick. Also, by examining the accuracy of the student's spelling, this approach monitors to some degree a student's mastery of written language. Our writing sample is found to contain 39 correctly spelled words.

4. Correct Writing Sequences--When scoring correct writing sequences, the examiner goes beyond the confines of the isolated word to consider units of writing and their relation to one another. Using this approach, the examiner starts at the beginning of the writing sample and looks at each successive pair of writing units (writing sequence). Words are considered separate writing units, as are essential marks of punctuation. To receive credit, writing sequences must be correctly spelled and be grammatically correct. The words in each writing sequence must also make sense within the context of the sentence. In effect, the student's writing is judged according to the standards of informal standard American English. A caret (^) is used to mark the presence of a correct writing sequence.

Fig. 2.13: An illustration of selected scoring rules for correct writing sequences.



The following scoring rules will aid the instructor in determining correct writing sequences:

- Correctly spelled words make up a correct writing sequence (reversed letters are acceptable, so long as they do not lead to a misspelling):

Example

^Is^that^a^red^car^?

➢ Necessary marks of punctuation (excluding commas) are included in correct writing sequences:

> Example
> ^Is^that^a^red^car^?

➢ Syntactically correct words make up a correct writing sequence:

> Example
> ^Is^that^a^red^car^?
>
> ^Is^that^a^car red?

➢ Semantically correct words make up a correct writing sequence:

> Example
> ^Is^that^a^red^car^?
>
> ^Is^that^a read car^?

➢ If correct, the initial word of a writing sample is counted as a correct writing sequence:

> Example
> ^Is^that^a^red^car^?

➢ Titles are included in the correct writing sequence count:

> Example
> ^The^Terrible^Day

➢ With the exception of dates, numbers written in numeral form are <u>not</u> included in the correct writing sequence count:

> Example
> ^The 14 soldiers^waited^in^the^cold^.
> ^The^crash^occurred^in^1976^.

Not surprisingly, evaluating a writing probe according to correct writing sequences is the most time-consuming of the scoring methods presented here. It is also the scoring approach, however, that yields the most comprehensive information about a student's writing competencies. While further research is

Fig. 2.14: CBM Writing sample scored for <u>correct writing sequence</u> (Each correct writing sequence is marked with a caret (^)):

```
^I woud drink^water^from^the^ocean...05

^and^I woud eat^the^fruit^off^of.... 06

^the^trees^. ^Then^I woud bilit a....05

^house^out^of^trees,^and^I woud .....06

gather^firewood^to^stay^warm^.^I.... 06

woud try^and^fix^my^boat^in^my  .....06

^spare^time^. ........................03
                  Correct Word Sequences =  37
```

needed to clarify the point, it also seems plausible that the correct writing sequence method is most sensitive to short-term student improvements in writing. Presumably, advances in writing skills in virtually any area (e.g., spelling, punctuation) could quickly register as higher writing sequence scores. Our writing sample is found to contain 37 correct writing sequences

Spelling

<u>Description</u>

Although they can be administered individually, CBM spelling probes are typically given to groups of students. The examiner reads aloud a list of 12 to 17 spelling words, reading successive words after a predetermined number of seconds. Students attempt to spell the words on their answer sheets in the time allotted.

<u>Creating a measurement pool for spelling probes</u>

There are a number of sources from which the instructor may build a measurement pool of spelling words. A number of commercial spelling programs are available (e.g., Scott Foresman) for use in classrooms. Some districts also have created their own spelling curriculums, containing wordlists appropriate to each grade level. Teachers who use a basal reading series may choose to adopt a third alternative: using the new vocabulary introduced in the grade reading text as the source of spelling words. Regardless of what source instructors choose for their spelling words, the process of building a measurement pool is the same. The teacher compiles a single list of all the spelling words to be taught during the instructional year and uses this master list to create individual CBM spelling probes.

Preparing CBM spelling probes

From the list of spelling words that make up the measurement pool , the instructor chooses words at random when compiling individual CBM spelling probes. For grades 1-3, a CBM probe will be comprised of 12 spelling words, with a new word being announced to students each 10 seconds. A spelling probe for grades 4-8 will include 17 words, with a new word announced to students each 7 seconds.

One approach which is helpful in creating truly random CBM spelling lists is for the teacher to randomly select words from a master spelling list, using the random-number table and procedure presented in Appendix A. Choosing numbers in the order that they appear in the table, the instructor counts down the master spelling list. The teacher selects words that correspond with each successive number. The process is repeated, with the instructor advancing through the master list until sufficient words have been chosen for a complete spelling probe.

Materials needed for giving CBM spelling probes

- o Student answer sheet with numbered lines for writing words
- o Instructor wordlist with numbered spelling words
- o Stopwatch
- o Pencils for students

Administration of CBM spelling probes

The examiner distributes answer sheets to all the students in the group. (Note: These probes may also be administered individually). If the students are in grades 1-3, the lined answer sheet should be numbered from 1 to 12. For student is grades 4-8, the answer sheet should be numbered 1 to 17.

The examiner says to the students:

> *I am going to read some words to you. I want you to spell the words on the sheet in front of you. Write the first word on the first line, the second word on the second line, and so on. I'll give you (7 or 10) seconds to spell each word. When I say the next word, write it down, even if you haven't finished the last one. You will receive credit for each correct letter written. Are there any questions?* (Pause) *Let's begin.*

> The examiner says the first word and starts the stopwatch. Each word is repeated twice. Homonyms are used in a sentence to clarify their meaning (e.g., "Lead. The pipe was made of lead.

Lead.")

A new word is announced each (7 or 10) seconds for a total time of 2 minutes. After every third word for younger children and every fifth word for older children, the teacher says the number of the word. (e.g., "Number 5. Basket. Basket.") The examiner or assistants check students while they are writing to ensure that they are writing on the correct line.

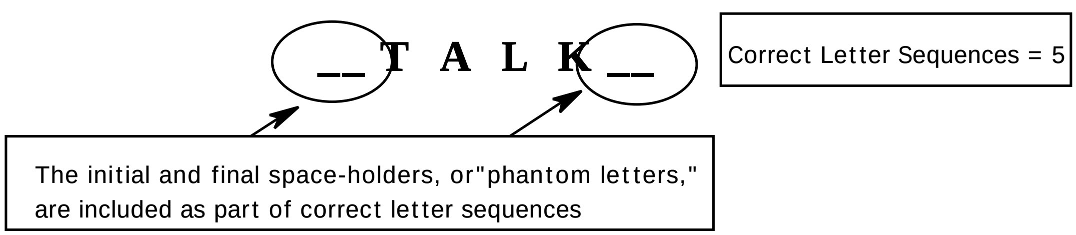
After 2 minutes, the examiner says, *Stop. Put your pencils down.*

Scoring

The scoring of CBM spelling probes is similar to that of other CBM measures in that it is designed to give credit to the student for even partial competencies. Instead of giving credit for words only when all letters are correct, CBM views spelling words as being made up of smaller units called letter-sequences. Correct letter-sequences are pairs of letters in a word that are placed in the proper sequence. Therefore, if a student is able to put at least some letters in the proper sequence, that child will be given partial credit for a word. The CBM method of scoring words is also quite sensitive to short-term student gains in spelling skills.

To compute the number of correct letter sequences in a spelling word, the instructor first assumes that there is a space-holder, or "phantom letter," at the beginning and end of each word. For each pair of letters that appear in correct sequence, the teacher places a caret (^) above that letter-pair. The initial and final "phantom letters" are also counted in letter sequences. The word '**talk**' is scored in Figure 2.15 for all possible correct letter sequences:

Fig. 2.15: An illustration of scoring for correct letter sequences.



As a shortcut when computing possible number of correct letter sequences in a word, the teacher can simply count up the number of letters that make up the word and add 1 to that number. The resulting figure will represent the total letter sequences in the word. For example, '**talk**' has 4 letters. By adding 1 to that amount, we see that it contains 5 letter-sequences.

The following scoring rules will aid the instructor in determining the number of correct letter sequences (CLS) of spelling words:

➢ Omitted letters will affect the letter-sequence count:

Example		
Correct:	`_^t^r^a^i^n^_`	CLS = 6
Incorrect:	`_^t^r^a n^_`	CLS =4

➢ Inserted letters will not be included in the letter-sequence count:

Example		
Correct:	`_^d^r^e^s^s^_`	CLS = 6
Incorrect:	`_^d^r^e a s^s^_`	CLS =5

➢ In words with double letters, if one of those double letters has been omitted, only the first letter written is included as a correct letter sequence:

Example		
Correct:	`_^t^a^p^p^i^n^g^_`	CLS = 8
Incorrect:	`_^t^a^p i^n^g^_`	CLS =6

➢ Initial letters of proper nouns must be capitalized to be included in the letter-sequence count:

Example		
Correct:	`_^M^o^n^d^a^y^_`	CLS =7
Incorrect:	`_ m o^n^d^a^y^_`	CLS =5

➢ In words with internal punctuation (e.g., apostrophes, hyphens), those punctuation marks are separately counted as letters when calculating the letter-sequence count:

Example		
Correct:	`_^c^a^n^'^t^_`	CLS =6
Incorrect:	`_^c^a^n t^_`	CLS =4

➤ Reversed letters are counted when calculating correct letter-sequences unless those reversals appear as another letter:

Example

Correct: _^y^e^l^l^o^w^_ CLS =7

Incorrect: _ q r^e^t^t^y^_ CLS =5

Summary

Well-researched and standardized CBM procedures have been established for reading, mathematics, writing, and spelling. Regardless of the subject area to be assessed, CBM requires that the instructor first establish a measurement pool of potential items (e.g., reading passages, spelling words) from which to create randomly selected CBM probes. Reading probes are scored according to words correctly read aloud per minute. Three separate reading passages are given and the median, or middle, score is selected as the value that best represents the student's "true" rate of fluency in the reading material. Math probes consist of single- and multiple-skill worksheets and have a two-minute time limit. Credit is allowed for each correctly written digit that appears below the line. Writing probes are completed in a three-minute period and offer several scoring options: compositions can be scored according to total words written, number of letters written, number of correctly spelled words, and number of correct writing sequences. Spelling probes are administered in a two-minute span, although the number of words given in that time varies according to grade. Spelling words are scored according to number of correct letter-sequences.

3 Charting & Interpreting CBM Data

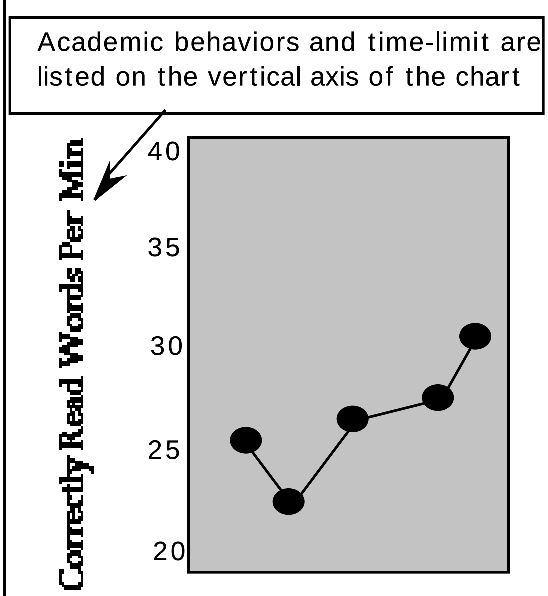
<u>Introduction</u>

Because CBM converts student academic behaviors into numbers (e.g., number of words read correctly per minute), teachers can easily chart the resulting data over time to create a series of data-points that represent a targeted student's rate of academic progress. In this chapter, instructors will learn how to set up CBM-monitoring charts, how to establish academic performance-goals for a student, and how to use CBM data gathered on an ongoing basis to determine the effectiveness of a child's educational program.

<u>Setting up the CBM chart</u>

Before CBM scores can be readily interpreted, they first need to be converted into a visual display. By graphing fluency scores over time as data-points on a graph, the instructor can actually <u>see</u> rates of progress rather than trying to discern trends from tables of abstract numbers. The first step in charting CBM data requires that the teacher set up a progress-monitoring graph. There are several points to be determined before the chart can be created. At the outset, the teacher must decide what type(s) of academic behaviors are being measured. In addition to behaviors, the instructor will want to include the time-limit of the CBM probe used to collect the data. For example, a chart may measure '<u>correctly read words per minute</u>' since that represents both the type of behavior to be measured and the time-limit of the CBM reading probe. Labels listing academic behaviors and time limits are placed on the vertical axis of the graph. Numbers are also listed on the vertical axis, representing a range of frequency of academic behaviors observed. If teachers are using an all-purpose graph for children with a wide range of skills, they may want to include a correspondingly wide range of numbers on the vertical axis. For example, a teacher who has students in her 2nd-grade classroom reading between 20 words and 130 words per minute in grade-appropriate material might want to number the graph to accommodate both the slowest and fastest readers. On the other hand, graphs

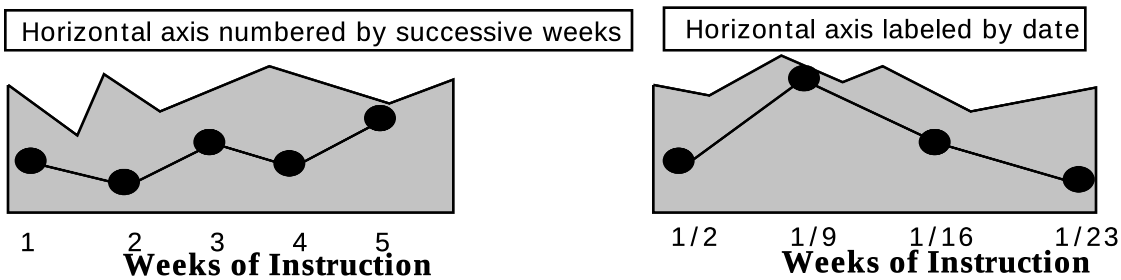
Fig. 3.1: Labeling the CBM chart



can also be prepared for individual children and be numbered with their more limited performance ranges in mind.

Next, the instructor chooses the number of instructional weeks over which CBM data will be graphed. For regular-education students, the instructor may vary the length of the monitoring-period to match their educational program (e.g., 10

Fig. 3.2: Labeling the CBM chart

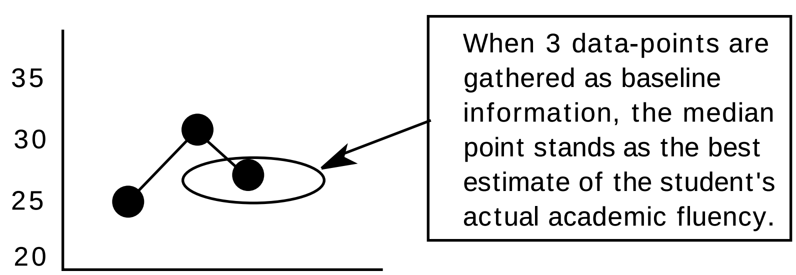


weeks, 25 weeks). Teachers of special-education children may choose to maintain a graph through the school year until annual reviews. The horizontal axis of the graph is labeled "Weeks of Instruction" and may list successive weeks by number (e.g., "1, 2, 3. . ."), by date or using both labels.

Charting baseline data

After the graph has been prepared, the teacher can chart initial data of the student's performance on a selected type of CBM probe. To obtain this initial, or baseline, data, the instructor administers CBM in a targeted subject area and scores it according to the guidelines found in chapter 2 of this manual. The resulting score can then be entered onto the chart. It should be remembered, though, that a child's performance on an isolated CBM probe stands only as an estimate of that student's "true" level of ability. While a single data-point is sufficient to yield a general

Fig. 3.3: Selecting median value of baseline data



approximation of the student's ability, the teacher can have greater confidence in the estimate if at least 3 CBM probes are given over the space of a week or so to collect baseline information. Having charted 3 data-points, the instructor can then choose the middle, or median, score as a good approximation of the child's actual level of academic fluency, as seen in Figure 3.3.

Setting a performance goal

Next, the teacher will set a long-term CBM performance goal for the student.

A performance goal is the rate of increase in skills-fluency that the child is expected to achieve by the end of a monitoring period. It represents a teacher's estimate of the gains in basic skills that a child will achieve over a predetermined number of weeks. Computing a long-term performance goal can be done easily by using a simple formula. First, the teacher obtains CBM baseline data about a student's fluency in a targeted academic area and charts this information. Then, the teacher decides how quickly the student's fluency-rate should increase <u>each week</u> in a successful learning program. The teacher also determines how many weeks the student will be monitored using a certain type of CBM probe. To calculate the long-term rate of skills increase, the instructor multiplies the expected rate of improvement per week by the number of weeks that the student will be monitored. The resulting figure is added to the baseline to give the instructor a performance goal.

Table 3.1

Calculating a CBM Performance Goal

1. Estimated increase in fluency per week X Number of instructional weeks = ______
2. Add product from step 1 to student baseline data (using the median data-point)

Sample Calculation for CBM Reading

1. Estimated increase of 3 words per week in reading fluency X 10 weeks = 30 words
2. Add product of step 1 (30 words) to baseline of 26 words

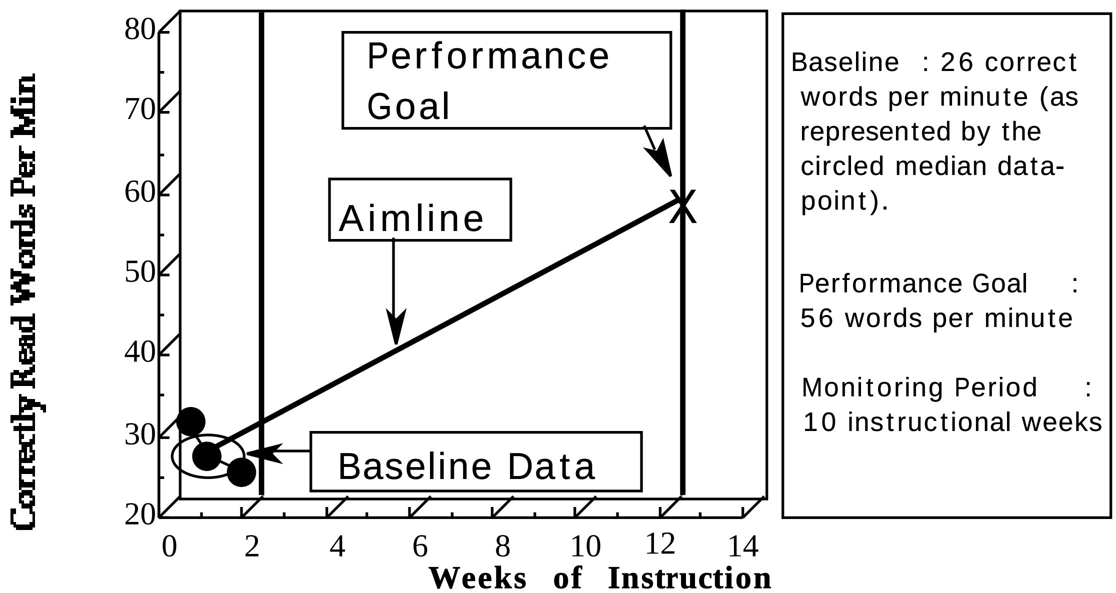
Performance goal = 56 words per minute by the end of 10 instructional weeks

To illustrate the process, let's calculate a sample performance goal in CBM reading. As shown in Table 3.1, a student is found to be reading aloud passages from a 2nd-grade reader at a baseline rate of 26 words per minute. The teacher estimates that the child should be able to increase reading fluency by approximately 3 words per instructional week. In addition, the instructor has chosen to monitor the student over 10 instructional weeks. The teacher multiplies 3 words per week (of increased fluency) by the 10 instructional weeks to arrive at an estimate of 30 words increase in reading fluency at the end of the monitoring period. The 30-word increase is then added to the 26 words from the baseline to arrive at a performance goal of 56 correctly read words per minute by the end of the 10th week of monitoring.

<u>Charting an aimline</u>

When the teacher has calculated a student's performance goal, that goal will be placed on the CBM chart. The teacher marks the performance goal with an 'X' on the last instructional week during which the student will be monitored (on the far right side of the chart). A line is then drawn connecting the student's baseline performance to his or her performance goal. This line is called the "aimline." It stands as a visual reminder of how quickly the student is expected to increase academic skills.

Fig. 3.5: CBM Monitoring Graph for a 2nd-grade student



The sample CBM reading chart above displays baseline data, performance goal and aimline for a 2nd-grade student.

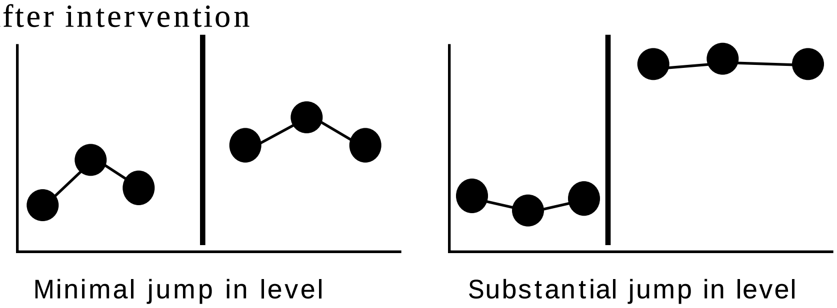
Evaluating data: Informal guidelines

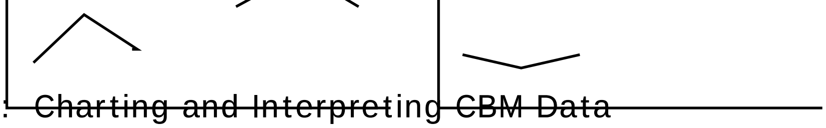
When sufficient data-points have been added to a progress-monitoring chart, the instructor is ready to interpret the charted information. Much of the meaning of the data-points on a chart can be determined by simply glancing at the way that those points are distributed on the graph. Several informal indicators are presented below for drawing conclusions from graphed data about the effectiveness of an instructional intervention (program change).

Degree of change in "level" of data-points

The teacher looks at the average "level" at which data-points are clustered on the graph both before and after a program change has been put into place. If the

Fig. 3.6: Comparing level of points before and after intervention



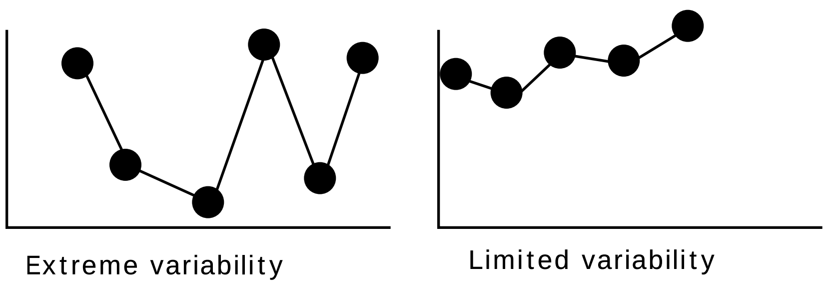


intervention is immediately successful, there may be a marked change in the level of points after the intervention. Typically, educators are looking for increases in level after a program change, but there are situations (for example, when charting a student's rate of reading errors) in which a decrease in level may be desired.

Variability of data-points

Instructors would prefer that a program change bring about a stable, steady improvement in the student's academic behaviors. This pattern of consistent progress is evident when data-points on the graph are relatively tightly

Fig. 3.7: Comparing variability of points

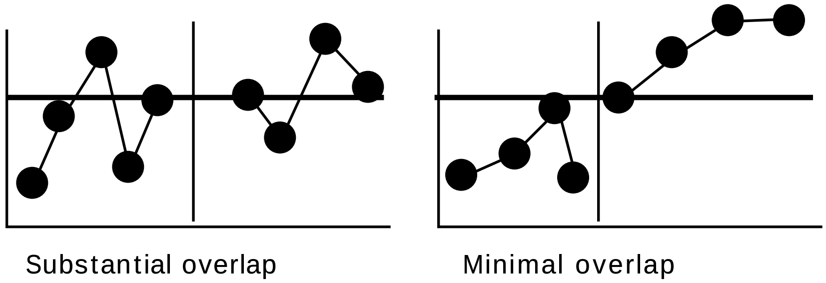


clustered and display only a limited amount of variability. In contrast, data with a high degree of variability would demonstrate inconsistency, a sign that the student's performance could not be easily predicted on any given day.

Overlap of data-points

It can be assumed that, if a program change has had a decisive impact on a child's academic behaviors (for example, improving reading fluency), there should

Fig. 3.8: Overlap of points before and after intervention



be minimal overlap between data-points collected before and those obtained after the intervention has gone into effect. Certainly, some overlap is to be expected, particularly in the early stages of a program-change. That overlap should decrease or disappear, though, as the child develops increased fluency in academic skill.

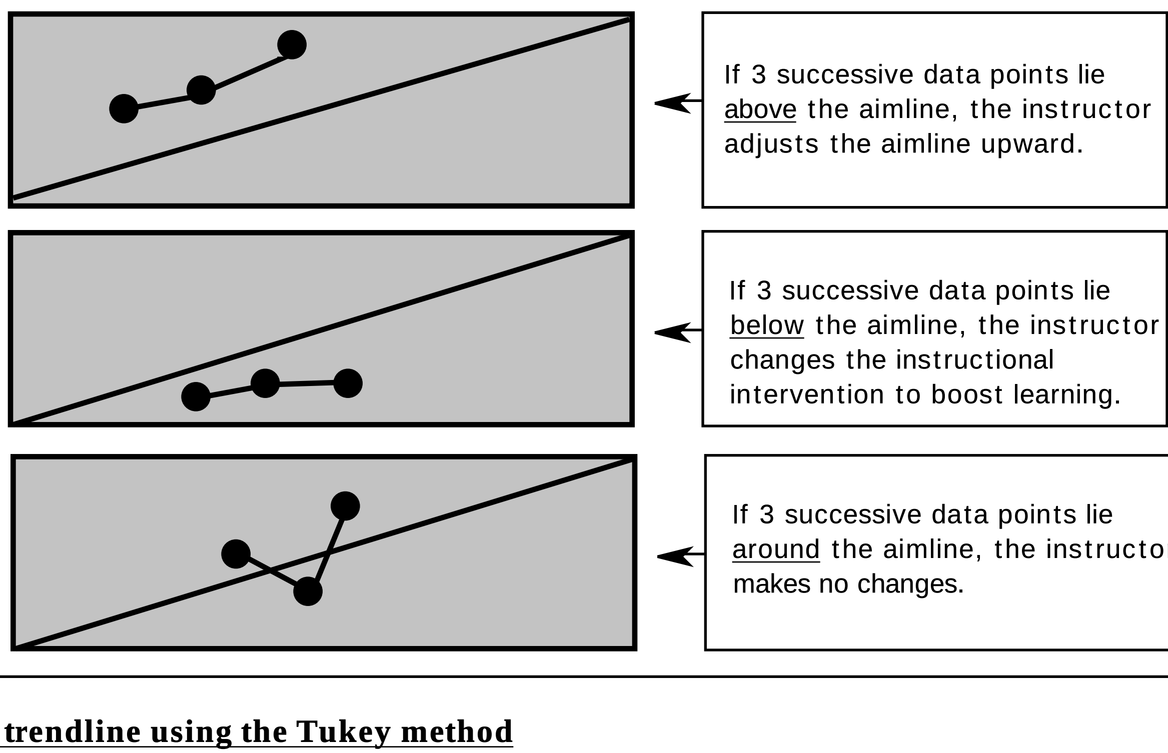
<u>Evaluating data: Formal procedures</u>

While informal methods of evaluating data can be useful, the instructor will greatly enhance the power of CBM by consistently applying decision-rules to charted data. Decision-rules are firm guidelines for interpreting the "pattern" of data-points on a graph. By using decision-rules on a regular basis with CBM data, the teacher will constantly be checking the student's progress to be sure that the child is increasing skill-levels at the expected rate. Research has shown that instructors who simply chart CBM information find that their students do moderately better in targeted academic areas. However, those teachers who systematically use decision-rules to interpret charted CBM data and guide them in instructional decision-making achieve marked improvements in student learning-rates.

3 data-point decision-rule

As a means of interpreting CBM information, the 3 data-point decision-rule is the simplest to use, an important consideration when teachers are working with hand-charted data. Using the 3 data-point rule, the teacher reviews the charted CBM data on a regular basis (see Figure 3.9). If the 3 most recent data-points are found to lie below the aimline at any time, the instructional intervention is altered to encourage an increased rate of learning. If 3 successive data-points are found to lie above the aimline, the aimline is adjusted upward to reflect the more ambitious learning rate. If the 3 most recent data-points are found to be clustered both above and below the aimline, the teacher can assume that the student is progressing at an optimal rate, and no changes in the instructional program are called for.

Fig. 3.9: Applying the 3 data-point decision-rule



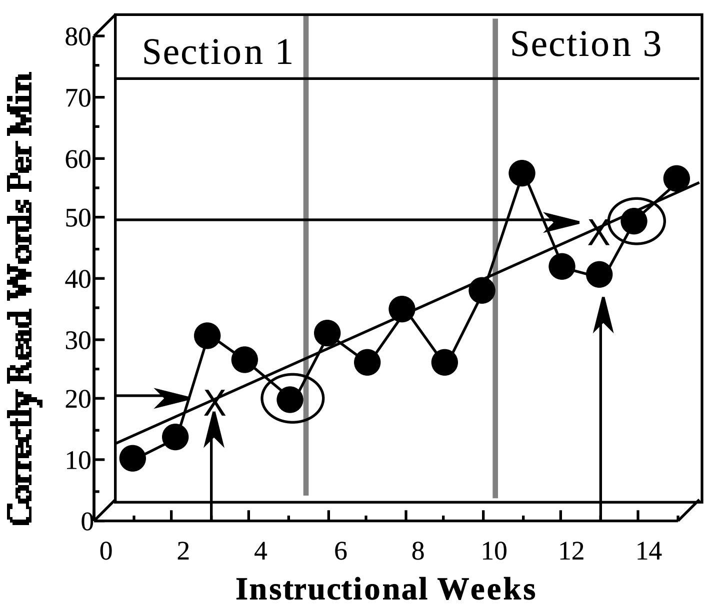
Plotting a trendline using the Tukey method

The 3 data-point rule provides only a very short-range estimate of a child's progress in CBM. Some instructors elect instead to gather a larger number of data-points before applying a decision-rule. When at least 7-8 data-points have been collected, the teacher may use the Tukey method (named after the statistician who invented the procedure) to plot a trendline, or line of improvement, that shows the approximate rate of progress that a student is achieving. The instructor may then compare the trendline to the aimline to make decisions about the effectiveness of an instructional intervention.

To plot the trendline using the Tukey method, the teacher first counts up the data-points on the graph and draws two vertical lines that divide the data-points evenly into 3 groupings. (If the number of data-points does not exactly divide into 3 parts, the groupings should be approximately equal. For example, if the chart contains 11 data-points, they can be divided into groups of 4, 3, and 4 data-points.)

Next, the instructor concentrates on the <u>first</u> and <u>third</u> sections of the graph, ignoring the middle section. In each of the two selected sections, the teacher finds the median point on the X (horizontal) and Y (vertical) axes and marks an "X" on the graph at the place where those points intersect. To locate the median time (e.g., instructional week) on the horizontal axis of a section, the teacher looks at the span of weeks in which data was collected. For example, if data-points appear for weeks 1-5 in the first section, the teacher considers the middle, or median, point to be 3.0. To locate the median number of observed behaviors on the vertical axis, the instructor examines the data-points in the graph-section, selecting the median or middle, value from among the range of points.

Fig. 3.10: Plotting a Trendline with the Tukey Method



Step 1: Divide the data-points into 3 equal sections by drawing 2 vertical lines. (If the points divide unevenly, group them approximately).

Step 2: In the 1st and 3rd sections, find the median data-point and median instructional week. Locate the place on the graph where the two values intersect and mark with an "X".

Step 3: Draw a line through the two "X's", extending to the margins of the graph. This represents the trendline or line of improvement.

Hutton, J.B., Dubes, R., & Muir, Steven. (1992). Estimating trend in progress monitoring data: A comparison of simple line-fitting methods. <u>School Psychology Review</u>, 21, 300-312.

When the instructor has found and marked the point of intersect of median X and Y values in both the first and third sections, a line is then drawn through the two points, extending from the left to the right margins of the graph. By drawing a line through the 2 X's plotted on the graph, the teacher creates a trendline that provides a reasonably accurate visual summary of CBM progress. If the trendline falls below the aimline, a change of program is indicated. If the trendline is above the aimline, the aimline should be adjusted upward to reflect an accelerated learning rate. If the trendline matches the aimline, no changes are recommended.

Interpreting CBM data: The case of Alyssa

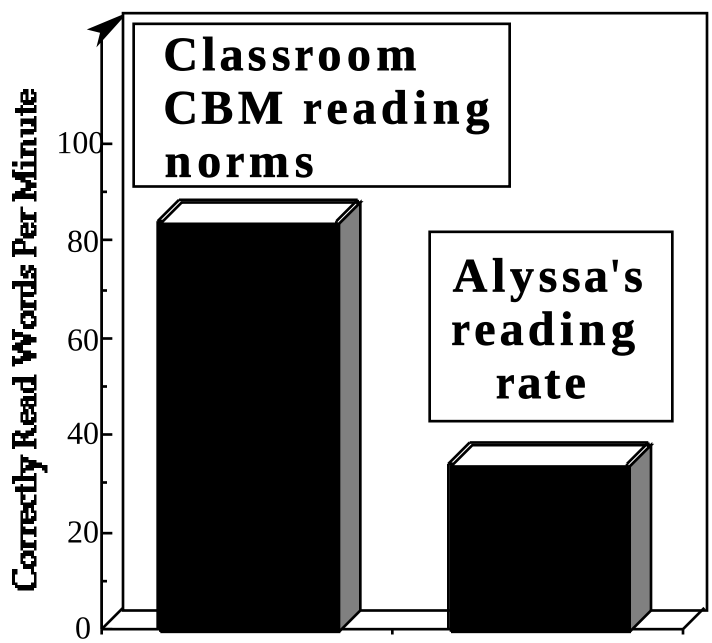
Let's use a sample case to illustrate how CBM can assist a teacher in determining how effective an instructional intervention is for a specific child. Although this case is fictional, it closely resembles actual case histories of local students whose skills were tracked throughout the school year using CBM.

A teacher in a 2nd-grade classroom has decided to use CBM to monitor the academic progress of Alyssa, a student having difficulties with reading. Alyssa is 8 years old and is repeating the 2nd grade. As she begins the present school year, Alyssa is placed in the lower of two 2nd-grade basal readers used in her classroom.

Step 1: Identifying the problem

The first step for the instructor who wishes to use CBM to monitor the academic progress of a child-at-risk is to identify the presence of a learning problem. In our example, Alyssa's teacher notes that Alyssa seems to read much more slowly than many children in her classroom. Based on this informal but important observation, her teacher decides that Alyssa has enough difficulty reading grade-appropriate texts to warrant her investigating the student's problems with reading more closely.

Fig. 3.11: Use of classroom CBM norms



Before she can determine how delayed Alyssa's reading skills are in comparison to those of classmates, Alyssa's teacher decides that she first needs to obtain a grade-appropriate standard of reading fluency. So the teacher gathers CBM norms in reading in her classroom. She finds that, on the average, children in her room are able to read 84 correct words aloud per minute in the early 2nd-grade basal reader. In contrast, Alyssa is able to read only 34 words per minute. From this comparison (Figure 3.11), it is obvious that Alyssa has a significant delay in reading skills when compared to classmates.

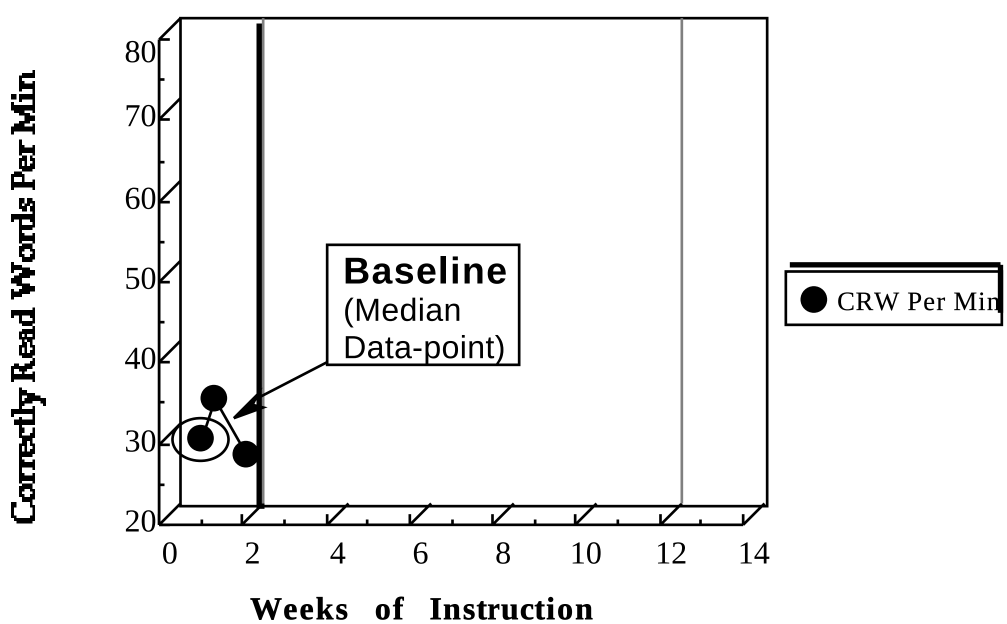
Step 2: Creating a CBM monitoring procedure

The next step for her teacher is to set up an individual program to monitor Alyssa's reading progress through CBM. In Alyssa's case, her instructor decides to monitor the student's reading fluency using CBM probes taken from goal-level reading material. Instructors who measure CBM reading fluency in basal texts often create CBM probes from a text above the one in which the child is presently placed. The ensures that the student's results are not influenced by prior exposure to the text. Also, research indicates that children reading in goal-level material will still show appropriate reading growth if their reading program is effective. Therefore, throughout the monitoring period, Alyssa will read passages weekly chosen at random from the more advanced of the two 2nd-grade basal readers. Furthermore, her reading rate will be charted to determine if Alyssa is actually increasing her reading fluency at an adequate rate.

Step 3: Charting initial data

First, however, initial, or baseline, information about Alyssa's reading rate must be gathered in the more advanced 2nd-grade basal text in which she will be

Figure 3.12: Charting Alyssa's initial reading-fluency data



monitored. Her teacher administers three separate CBM reading probes to Alyssa over the course of a week and chooses the median performance of 29 correctly read words per minute as the most accurate estimate of her reading fluency in the later-2nd-grade reader. This information is placed on a chart as a baseline data-point (Figure 3.12) to show Alyssa's reading fluency before the intervention has been put into place.

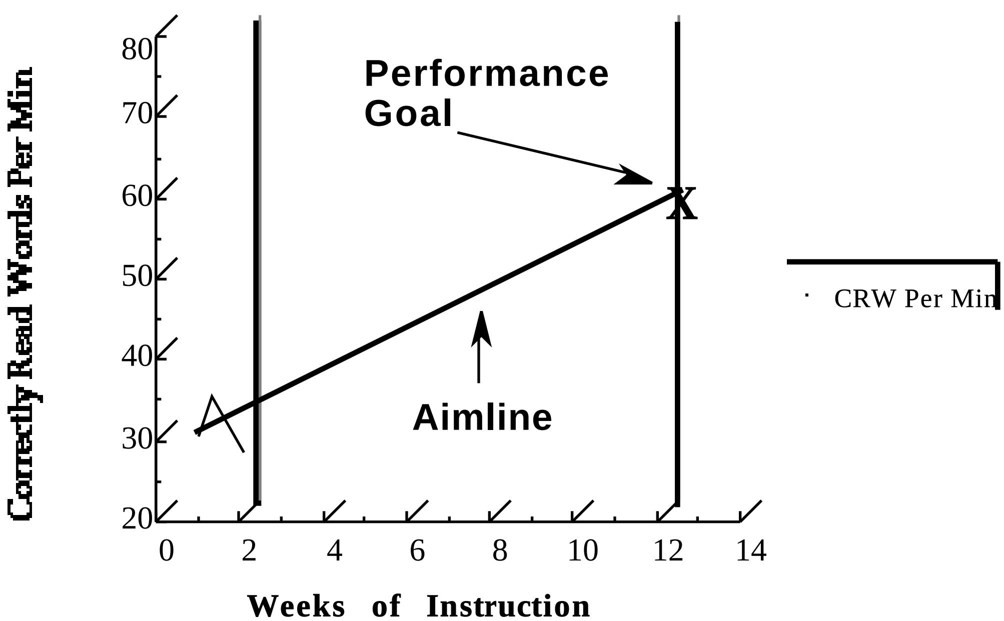
Step 4: Setting a performance goal

Now, Alyssa's teacher is ready to set a CBM performance goal for her student. The instructor has already found that Alyssa is able to read 29 correct words per minute in the later-2nd-grade reader. The next question to be answered is how quickly the student's reading rate should increase each week in a successful learning program. Her teacher uses her own instructional knowledge to estimate that Alyssa has the ability to increase reading fluency by about 2-1/2 words per week. She also decides that CBM reading probes are to be given over the span of 10 weeks of instruction.

To compute Alyssa's performance goal, the teacher simply multiplies the expected weekly rate of increase in fluency on the CBM reading measure by the number of weeks that the student's reading progress will be monitored.

After multiplying the 2-1/2 words increase per week by the 10 weeks of proposed instruction, the instructor calculates that at the end of the monitoring period, Alyssa should be reading 25 additional words per minute. To compute the final reading fluency goal, Alyssa's teacher simply adds the 25 additional words per minute to the 29 words-per-minute baseline figure to arrive at a 10-week reading goal of 54 words per minute. This proposed goal is marked with an "X" at the 10th instructional week on the CBM chart shown in Figure 3.13..

Figure 3.13: Setting Alyssa's reading-fluency performance goal



Her teacher then draws a line connecting Alyssa's baseline performance to her learning goal. This line is called the "aimline." Because the aimline stands as a visual reminder of how quickly this individual student is expected to increase academic skills over time, it allows the teacher continually to compare the student's projected and actual rates of instructional progress as measured through CBM

Step 5: Creating and implementing an instructional intervention

Alyssa's teacher next creates an instructional intervention. She decides to take advantage of a tutoring program that her school has established in which adult volunteers are matched with selected students who require extra help in reading. An adult reading tutor is assigned to work with Alyssa individually in the classroom for two 30-minute periods per week. The tutor regularly previews new vocabulary words with Alyssa that will be appearing in her reading book. Also, because it is often effective in increasing reading fluency, listening passage preview is selected as an additional intervention for Alyssa. During each tutoring session, the tutor will read aloud from a section of Alyssa's basal reader while the student silently reads along. Then Alyssa will read the same section of text aloud, with the tutor correcting her reading as needed.

Step 6: Tracking academic growth through CBM

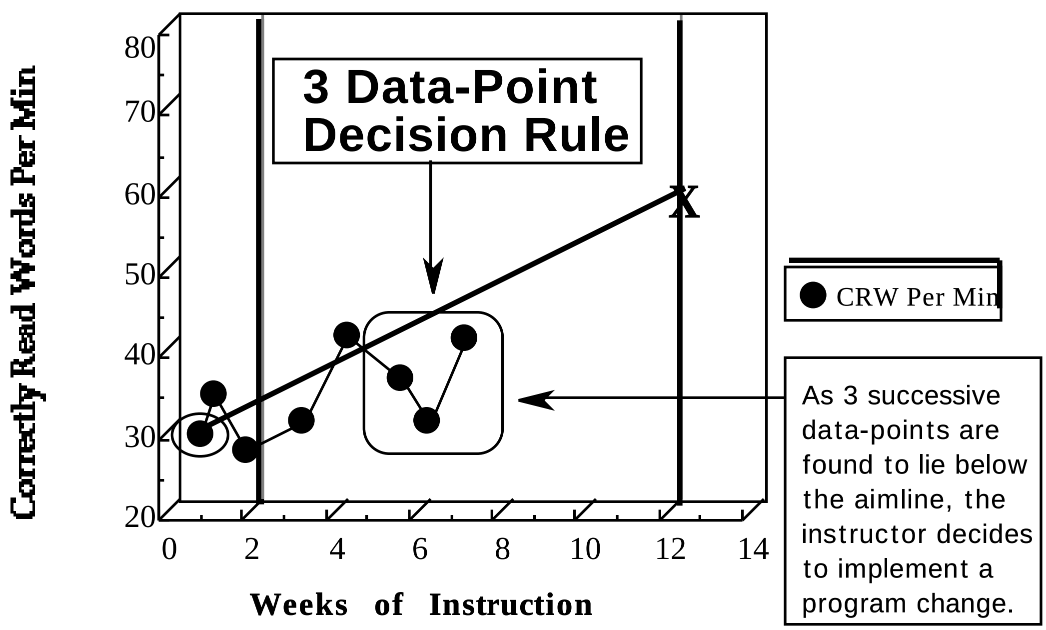
Meanwhile, at regular intervals during the intervention, Alyssa's teacher readministers CBM reading probes and continues to chart the results. Typically, instructors track student skills through CBM once or twice weekly. Within a few short weeks, the instructor will have graphed enough data-points to draw conclusions about the child's rate of learning progress.

Step 7: Interpreting charted data

As the CBM data is charted, it must be interpreted. While there are a number of decision-rules that Alyssa's instructor could use to determine the effectiveness of the student's reading program, she decides to apply the 3 data-point decision-rule, which is quite simple to use with hand-charted data. (This rule is reviewed on page 3-6.) With 5 data-points charted, Alyssa teacher compares her actual rate of increase with her aimline. Her teacher discovers that Alyssa is advancing somewhat more slowly than she had expected, as can be seen by the 3 data-points in a row that are found to be below the aimline in Figure 3.14. It is apparent that her present instructional intervention is not as effective as Alyssa's teacher had hoped.

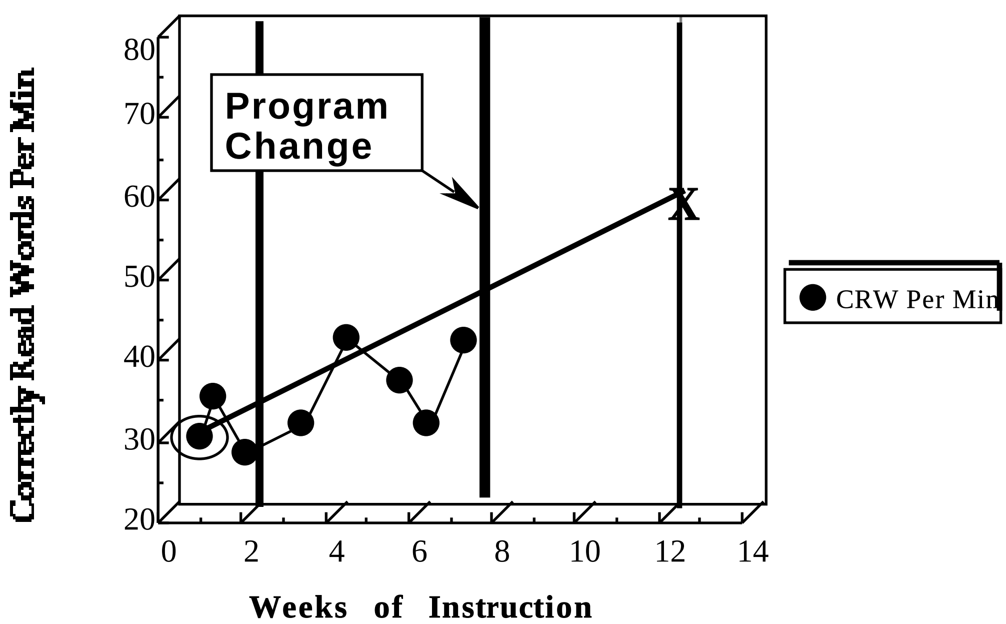
Having reviewed Alyssa's CBM chart, her instructor decides to alter the student's reading program in an effort to help her to increase her reading fluency more quickly. Among other changes, her teacher asks Alyssa's tutor to spend part of their tutoring time creating books. Alyssa writes out the text of the book with some help from the tutor and draws pictures to illustrate it. Both her teacher and tutor observe that Alyssa appears very motivated by the book-writing activity.

Figure 3.14: Applying the 3 data-point decision rule to Alyssa's chart



On Alyssa's chart, her teacher places a heavy line to mark the program change that she has put into place. The marking of program changes on a CBM chart makes it

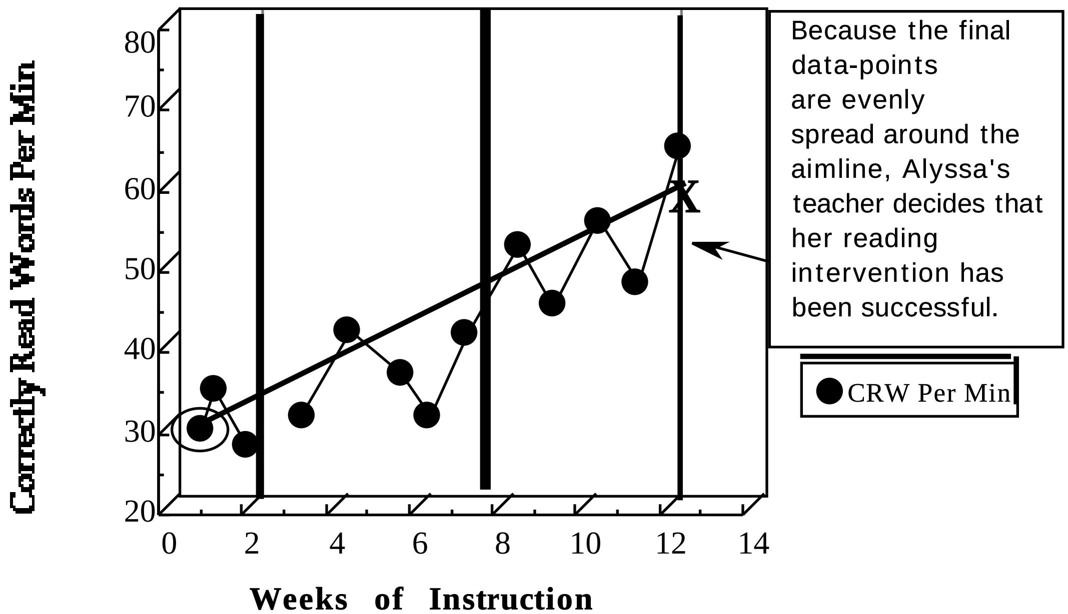
Figure 3.15: Marking a change in Alyssa's educational program



easier for instructors to compare the effectiveness of various instructional interventions that are tried with a particular student.

Her instructor continues to administer weekly CBM reading probes to Alyssa, charting the data regularly and comparing Alyssa's expected and actual rates of progress in reading fluency. Periodically applying the 3 data-point decision rule, Alyssa's teacher sees that the data-points recorded on the chart <u>after</u> the program change fall consistently both above and below the aimline. The more favorable distribution of the data-points indicates that Alyssa is now steadily making progress in building reading fluency. Therefore, her teacher decides that no further program

Figure 3.16: Alyssa's completed CBM chart



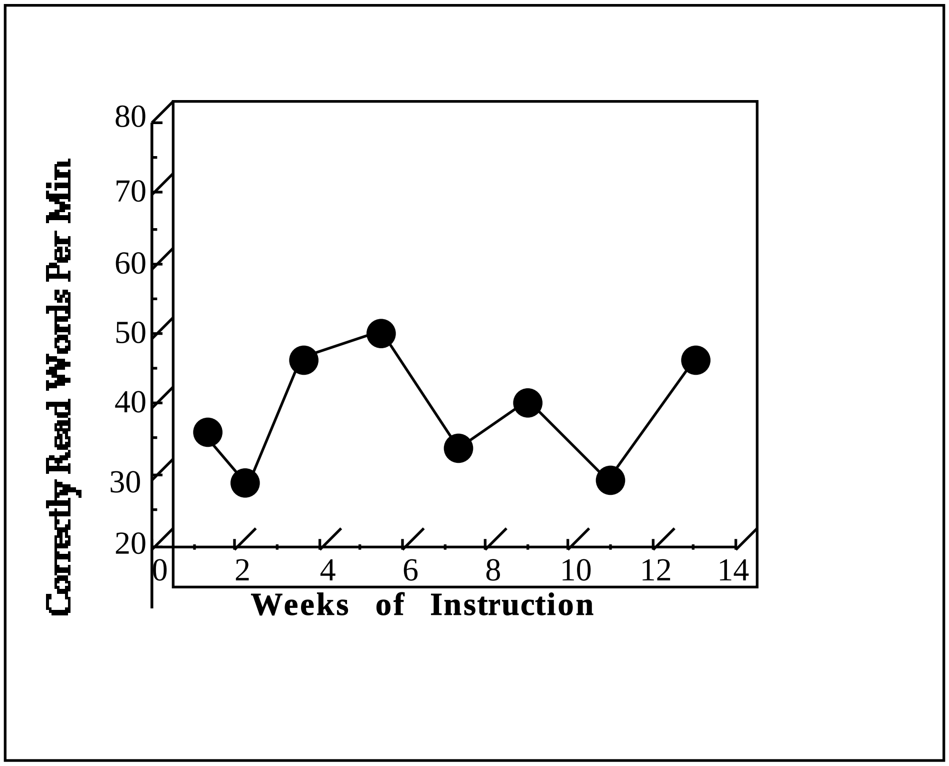
changes are necessary. Throughout the rest of the monitoring period, Alyssa continues to increase her reading fluency at the expected rate; her present instructional intervention is therefore judged to be a success.

<u>Summary</u>

CBM data gathered over time can be charted to provide a visual record of the child's relative rate of progress. In preparing a graph for progress-monitoring, the vertical axis is labeled according to the academic behavior to be measured and the time limit for the probe. The horizontal axis is labeled according to the number of instructional weeks during which monitoring will take place. Ideally, at least three initial CBM data-points are graphed, with the median point taken to represent the student's baseline performance before an instructional intervention is begun. The instructor calculates a performance goal for the student and plots an aimline connecting the child's present rate of fluency to the performance goal. As the instructional intervention is put into place and early data-points are charted, the teacher can informally evaluate the data, for example looking at the change in level or degree of variability, and overlap of the data-points. When enough data-points have been charted, formal decision-rules are used to evaluate progress. By using the 3 data-point rule or by plotting a trendline according to the Tukey method, instructors can judge whether the child is achieving the expected rate of growth in academic skills.

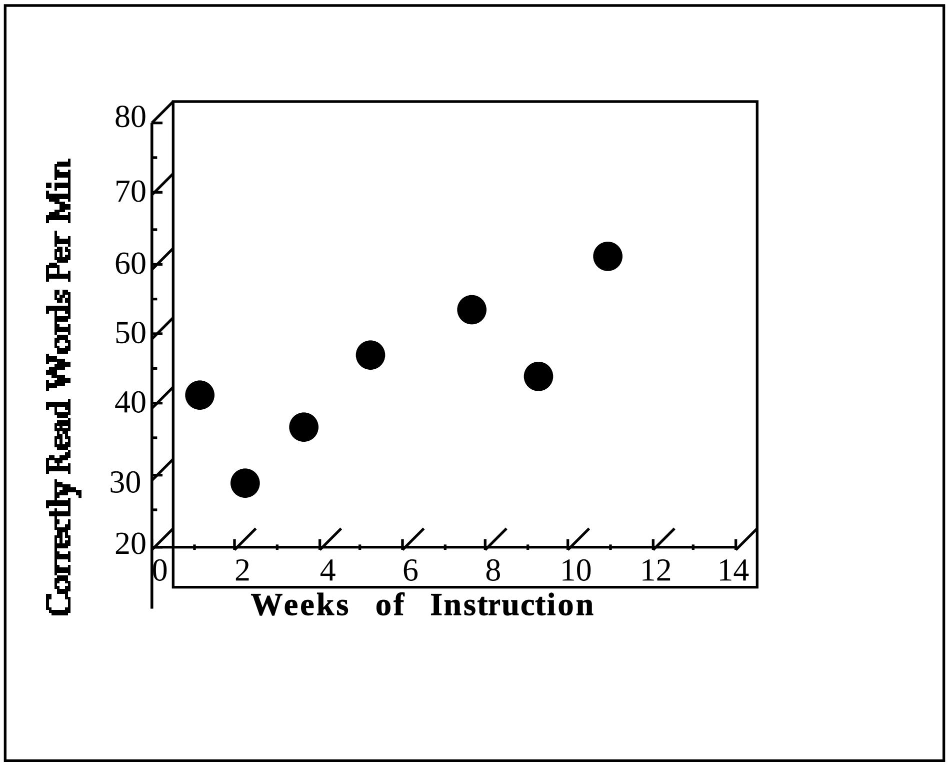
Just for Practice . . .

Compute a trendline for the chart using the Tukey method.



Just for Practice . . .

Compute a trendline for the chart using the Tukey method.



4 Research, Classroom & School-wide CBM Norms

Introduction

An essential component of CBM is the setting of performance-goals for individual children. However, instructors using CBM in their classrooms may initially be uncertain about how to select such goals for their targeted students. How can the teacher judge whether a particular child's fluency in reading, for example, is advanced, average, or delayed in comparison to the reading skills of classmates? In this chapter, we will review several methods that teachers can use to determine typical levels of performance in basic skill-areas. Instructors may choose to rely upon (1) research norms, (2) classroom norms, or (3) school-wide norms when determining average skill levels for children in a designated grade. While each approach has both advantages and limitations, all of the methods of norming supply the instructor with a useful estimate of grade-appropriate levels of proficiency in basic skills. By using any one of these estimates as a "yard-stick" against which to compare the skills of a targeted student, the teacher can decide with some confidence whether that child has a learning problem requiring special attention and, if so, what educational progress the student must make to move up into the average range of academic skills.

Research Norms

Several researchers have completed studies that have yielded estimates of students' expected fluency in reading, mathematics, and written expression across grade levels. An advantage of these norms is their convenience. Teachers can apply them immediately, without having to gather additional normative data of their own. One drawback of these published norms, though, is that they rely on a research sample of students whose skills may or may not resemble those of a particular classroom. Also, the CBM materials used by researchers to measure students' academic skills would not be identical to those prepared by individual teachers using CBM. Even with these limitations, however, these research norms can supply a teacher with conservative estimates of academic fluency which they can use to screen the academic skills of selected children. By comparing the performance of a targeted student to research norms, the instructor can determine whether that student has acquired at least the minimal proficiency in grade-appropriate curriculum materials to function successfully.

Reading

The tables below provide estimates of oral reading fluency at various grade levels. In the manner of informal reading inventories, the charts distinguish among frustration, instructional, and mastery rates of proficiency in reading. The student operating at the frustration level in a reading book tends to decode words quite slowly and may commit a large number of errors, even with considerable teacher support. As a result, that child can be expected to have difficulty both comprehending the text and keeping up with fellow readers in the classroom. When a child is reading instructional-level material, the student is able to decode relatively quickly with only minimal help from the instructor and makes few errors. Students placed in texts that they have clearly mastered are able to read independently at a fluent rate and to adequately comprehend passages without assistance from others.

Table 4.1: CBM research norms for reading fluency

GRADES 1 THROUGH 3

LEVEL	MEDIAN WORDS CORRECT PER MINUTE	MEDIAN ERRORS PER MINUTE
FRUSTRATION	29	8 or more
INSTRUCTIONAL	30-49	3-7
MASTERY	50 or more	2 or fewer

GRADES 4 AND UP

LEVEL	MEDIAN WORDS CORRECT PER MINUTE	MEDIAN ERRORS PER MINUTE
FRUSTRATION	49	8 or more
INSTRUCTIONAL	50-99	3-7
MASTERY	100 or more	2 or fewer

Research norms from Deno, S.L., & Mirkin, P.K. (1977). Data-based program modification: A manual. Reston, VA: Council for Exceptional Children.

In order to make use of these research norms in reading, the teacher first randomly selects 3 basal reading passages from a basal reader suitable to a student's grade placement and administers a CBM reading probe (as outlined in Chapter 2 of this manual). To determine the student's level of reading fluency, the instructor compares the median number of words read correctly by the child, as well as the median error rate, to the research-norm values on the chart. For example, a student who was found to be reading a median of 26 words per minute with 9 errors in a 2nd-grade reading book would best be characterized as working at the frustration level in that particular text. In general, these research norms supply a teacher with useful estimates of reading fluency. However, they should be applied cautiously to 1st-grade students, because beginning readers as a group typically display widely varying rates of acquisition of reading skills.

Completing a survey-level assessment in reading using research norms

Teachers who assess reading fluency using CBM may wish to know not only how well a child may be reading in texts appropriate to an individual classroom, but also at what grade-level the child reads most comfortably. Using the research norms in reading, the instructor can carry out a survey-level CBM reading assessment. With this approach, the teacher gives the child passages from texts of various grades, beginning with reading material from the student's present classroom curriculum. Median oral reading rates are obtained at each grade level. These median reading rates are then compared to the research norms to determine the child's instructional reading level.

If the child demonstrates mastery or instructional reading proficiency on the initial CBM reading probe, the instructor gives probes from successively more advanced grades until the frustration level is reached. If the student operates at the frustration level on grade-appropriate material, however, the teacher then drops back and gives reading probes from successively lower grade levels until the child reaches the mastery level. In most cases, then, the survey-level assessment will show the instructor the grade-level materials in which the child reads with mastery, as well as the range of texts in which the student can operate instructionally and the point in the basal series in which the child encounters frustration in reading.

For example, let's assume that a 4th-grade teacher completed a survey-level reading assessment for Allen, a boy in her classroom who was having difficulty keeping up with his reading group. The results show that Allen was able to

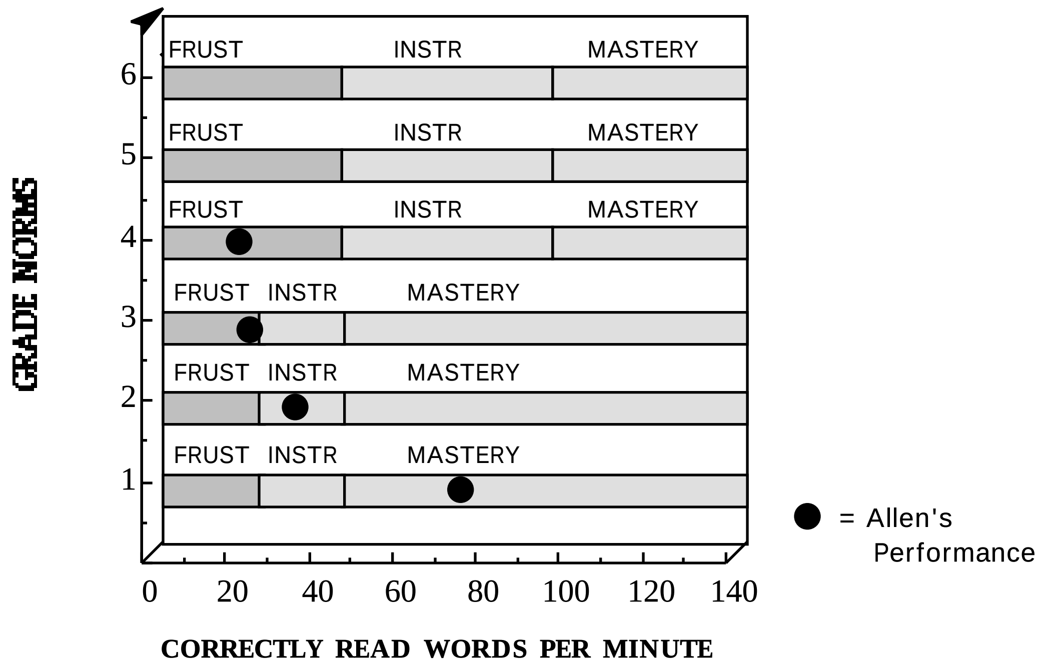
Table 4.2: CBM Survey-level Reading Assessment for Allen H.

Basal Text	Correctly Read Words Per Minute	Errors Per Minute
1st-grade	78	3
2nd-grade	36	6
3rd-grade	26	11
4th-grade	24	8

read at the mastery level in the 1st-grade text and at the instructional level in the 2nd-grade reader. However, his performance in the 3rd- and 4th-grade books suggests that, because he is reading below the cut-off point for basic fluency as outlined in the research norms, Allen is working at the frustration level in both texts. In Figure 4.1, the frustration, instructional, and mastery levels of the research norms are represented as regions on a graph. Allen's performance at each grade-level is represented by a dot. It can be surmised from this survey-level assessment that Allen's most appropriate placement is in 2nd-grade reading material. His teacher may respond to the information by moving Allen into more basic reading texts in which he can more readily build reading fluency.

Particularly at the lower grades, basal reading series often assign more than one reading text per grade level. Of course, teachers may decide to administer CBM

Fig. 4.1: CBM survey-level reading assessment--Research norms



reading probes from each basal when carrying out a survey-level assessment. However, to streamline the process somewhat, the instructor may instead give passages from a representative basal at each grade level. For example, in the

Fig. 4.2: Selecting representative basal texts for a survey-level reading assessment

Silver Burdett & Ginn Reading Series

1st-Grade Texts
- Basal 1: First Pre-Primer
- Basal 2: Second Pre-Primer
- Basal 3: Third Pre-Primer
- Basal 4: Primer
- Basal 5: 1st-Grade Reader

2nd-Grade Texts
- Basal 6
- Basal 7

3rd-Grade Texts
- Basal 8
- Basal 9

Silver Burdett & Ginn basal reading series, there are 9 basals that span grades 1-3. Because teachers might find it overly time-consuming to administer CBM probes from each basal when completing a survey-level assessment, they may choose a single text as the standard for each grade. In the illustration above, the circled texts are those that the instructor decided were most representative of each grade level.

Note that, when two basals were available at a grade level (e.g., 2nd grade), the instructor chose the lower, or less advanced, basal. As a general rule, it is usually best to choose the easier material at a given grade-level in instances when the teacher must select between less and more difficult academic objectives for CBM probes. By settling on the more basic objectives, the instructor can then be even more sure that the student who fails to achieve basic fluency in CBM probes is truly lacking in important educational skills.

Mathematics

As with reading fluency, research norms for math (computational) fluency are presented as three levels of performance: frustration, instructional, and mastery.

Table 4.3: CBM research norms for math (computational) fluency

GRADES 1 THROUGH 3

LEVEL	DIGITS CORRECT PER MINUTE	DIGITS INCORRECT PER MINUTE
FRUSTRATION	0-9	8 or more
INSTRUCTIONAL	10-19	3-7
MASTERY	20 or more	2 or fewer

GRADES 4 AND UP

LEVEL	DIGITS CORRECT PER MINUTE	DIGITS INCORRECT PER MINUTE
FRUSTRATION	0-19	8 or more
INSTRUCTIONAL	20-39	3-7
MASTERY	40 or more	2 or fewer

Research norms from Deno, S.L., & Mirkin, P.K. (1977). Data-based program modification: A manual. Reston, VA: Council for Exceptional Children.

To make use of the mathematics research norms, the teacher gives the student either a single- or multiple-skills worksheet containing math facts. (The math CBM probe is administered according to the directions in Chapter 2 of this manual.) The teacher then compares the number of correct digits and errors on the student's math sheet with the norms in the table on the previous page to determine the child's relative proficiency in the selected computational objective(s).

Completing a survey-level assessment in mathematics using research norms

Teachers can gain a general idea of a student's functioning in computational objectives across grade-levels by completing a survey-level assessment in mathematics. As the first step in such an assessment, the instructor examines the computational goals outlined in the school district math curriculum. (Teachers can also turn to pages 2-25 through 2-27 of this manual for a comprehensive list of computational objectives matched to the appropriate grades.) The instructor selects one or two representative objectives from several grade levels, prepares worksheets based upon these objectives, and administers them to the student. The resulting scores are then compared to the research norms to determine the child's relative mastery of math skills across grade-levels.

To illustrate the method of giving a survey-level assessment in math, we return again to our example of Allen. His 4th-grade teacher decides to conduct a survey-level assessment in math skills, selecting the following computational goals at several grade-levels:

Table 4.4: Selecting computational goals for a survey-level mathematics assessment

Grade 2
- ✔ Add a two-digit number to a two-digit number--no regrouping

Grade 3
- ✔ Subtract a one-digit number from a two-digit number with regrouping.

Grade 4
- ✔ Multiply a two-digit number by a one-digit number with no regrouping.

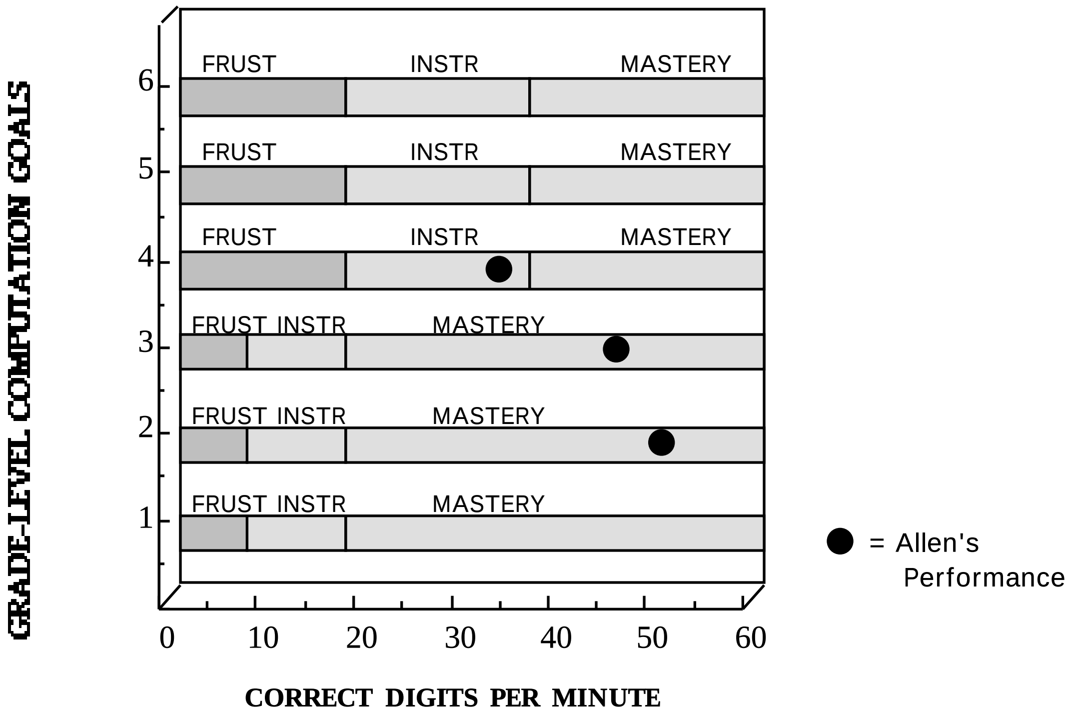
His teacher then creates several separate math worksheets, each containing problems from one of the chosen computational goals. The worksheets are given to Allen to complete under standardized CBM conditions. The results are then

Table 4.5: CBM Survey-level Mathematics Assessment for Allen H.

Grade-Level Math Skill	Correct Digits Per Minute	Incorrect Digits Per Minute
2nd-grade	52	3
3rd-grade	47	1
4th-grade	34	2

compared to the research norms. The chart on the following page presents the research norms as regions on a graph. Allen's performance at various grade-levels is plotted relative to the norms for each grade. It is immediately apparent from this survey-level assessment that Allen has little difficulty with computational skills.

Fig. 4.3: CBM survey-level mathematics assessment--Research norms



He demonstrates mastery of typical 2nd- and 3rd-grade math objectives and is working comfortably within the instructional level in 4th-grade math curriculum material.

Written expression

The norms for written expression presented here list average numbers of words written in 3 minutes for grades 1-6. The examiner administers a CBM writing probe, scores it for the number of words that appear in the composition, and compares the individual student's results to the research norms. Unlike the norms presented for reading and math computation, these writing norms do not include ranges of frustration or mastery. Also, although there are four separate methods presented in chapter 2 of this manual for scoring CBM writing probes, these norms are intended only for the simplest and quickest of those scoring approaches: total words written.

Table 4.6: CBM research norms for written expression

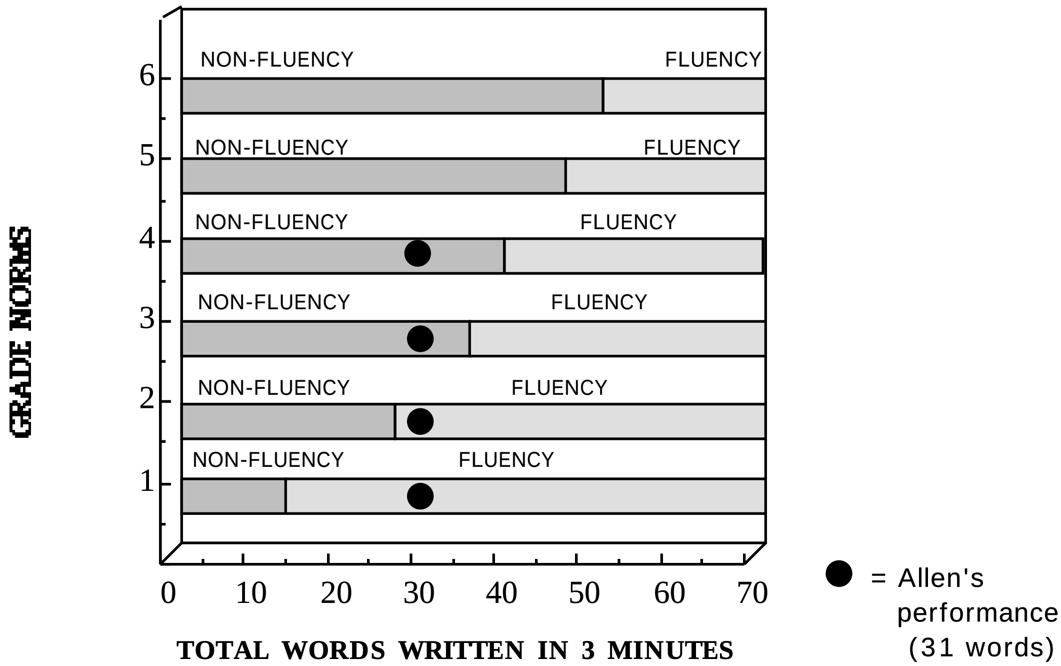
GRADE	WORDS WRITTEN IN 3 MINUTES
1	15
2	28
3	37
4	41
5	49
6	53

Research norms from Mirkin,P.K., Deno, S.L., Fuchs, L., Wesson, C., Tindal, G., Marston, D., and Kuehnle, K. (1981) Procedures to develop and monitor progress on IEP goals. Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities.

Completing a survey-level assessment in written expression using research norms

Undertaking a survey-level assessment in writing is considerably faster than in other academic areas. The teacher simply scores the child's single writing probe and compares the number of words correctly spelled to the various grade levels to find the highest grade at which the targeted student's score falls within the fluent range. We will assume, for instance, that Allen's teacher gave him a writing probe as a routine part of her CBM assessment. She found that he was able to write 31 correctly spelled words during the timed session. The instructor then charted his single writing score across grade levels, noting the highest grade in which Allen's scores still lay within a range signifying fluency in writing. She found that, according to the research norms, Allen wrote at a rate that would be considered fluent for a 2nd-grade student but fell below the fluency range for the 3rd and 4th grades. While this is only preliminary information, the teacher may conclude that

Fig. 4.4: CBM survey-level writing assessment--Research norms



Allen would benefit from greater emphasis on writing skills to increase his proficiency in written language.

Classroom Norms

When teachers compile classroom CBM norms, they can gain direct estimates of average abilities in basic-skill areas for those children presently under their instruction. Classroom norms offer obvious advantages over research norms. First, the average level of academic ability often varies considerably among classrooms at a given grade-level, even when one compares rooms within the same school building. Each classroom comprises a unique learning environment, having its own range of educational resources and student skill Thus, an instructor can benefit from knowing how proficient typical children from his or her classroom are in basic academic competencies.

Once the teacher has an idea of the "average" student level of performance in reading, writing, spelling, and math objectives for a particular classroom, that instructor can then administer similar probes to children who show learning delays, to determine how far they might lie from the classroom average. In other words, classroom norms can help teachers both to better identify those students who may have limited proficiency in academic areas and to better define the degree of academic delays. Also, classroom norms can be used by the instructor to set performance goals for individual students who are to be monitored over time using

CBM probes. These performance goals would be placed on a graph, representing the teacher's expectation of how quickly the student's fluency in academic skills should grow over a set number of instructional weeks. (For a more complete account of CBM performance goals and their use in tracking student academic progress, see chapter 3 of this manual.)

Creating a measurement net

As the first step in norming a classroom, the examiner must decide what basic-skill areas to assess. CBM probes in the selected subject areas comprise the measurement net. As the name implies, a measurement net is an array of CBM assessment materials chosen by the instructor to "capture" important data about average student competencies in academic areas. The teacher determines both the number of skill-areas and the individual curriculum objectives that will be assessed.

Before putting together a measurement net for norming a classroom, instructors should carefully review chapter 2 of this manual, which outlines the selection of curriculum performance objectives, preparation of CBM probe materials in various academic areas, and administration of those probes under standardized conditions. Teachers, of course, must be fully aware of the range of curricular goals for students at their grade level.

Once the measurement net has been assembled for a particular classroom norming, it will ideally contain a mix of CBM probes to assess typical student performance in (1) curriculum goals that are presumed to have been mastered and (2) curriculum material that is presently being taught. Sometimes instructors question whether a particular educational objective might be too "easy" to include in the classroom norming. In most cases, it is a good idea to include a few such basic learning goals, if only to ensure that children have mastered these fundamental skills. For example, a 4th-grade teacher who wants to assess his classroom using several math computation objectives might include a worksheet featuring 2-digit addition with regrouping to check that the average child in the room has achieved fluency in this skill.

The 2nd-grade measurement net shown below contains goals selected from the 1st-grade curriculum, as well as objectives suitable for the 2nd grade. The teacher decided that she wanted to include the 1st-grade probes as a check to ensure that her classroom was fluent in lower-level academic skills.

Our sample measurement net illustrates a central point regarding the instructor's role in gathering classroom norms: The teacher has considerable latitude in determining the nature and extent of the norming process in his or her own classroom. There is no "right" or "wrong" approach to classroom norming. Any type of CBM probe that an instructor feels will give information useful in future instructional planning or program monitoring can be included in the classroom norming. For instance, the 2nd-grade teacher in the example chose to evaluate student fluency in reading, math, spelling, and writing. However, she may have decided instead to evaluate only reading and math, omitting the other areas. She also selected a single math objective from the 1st-grade curriculum but could

Table 4.7: Sample measurement net for 2nd-grade classroom norming

Reading:

Three 150-word passages chosen at random from Basal 5 (*A New Day*) of the Silver Burdett & Ginn reading series (1st-grade curriculum objective).

Three 150-word passages chosen at random from Basal 6 (*Garden Gates*) of the Silver Burdett & Ginn reading series. (2nd-grade reader)

Mathematics:

(1) single-skill math worksheet. Addition (1-digit terms) with sums $\leq$ 10 (1st-grade curriculum objective).

(1) single-skill math worksheet. Addition (2-digit terms) without regrouping. 100 problems.
(1) single-skill math worksheet. Subtraction (2-digit terms) without regrouping. 100 problems.

Spelling:
12 spelling words selected at random from a comprehensive list of new vocabulary introduced in Basal 6 (early 2nd-grade reader) of the Silver Burdett & Ginn reading series.

Writing:
Appropriate story-starter.

instead have picked 3 objectives from that curriculum if she had wished for more extensive information about classroom performance in supposedly mastered material. (Note: For ease of administration, it is recommended that instructors gather the various CBM materials to be used in the norming into test booklets.)

<u>Choosing students for classroom norming</u>

When selecting children for the classroom CBM norms, the teacher defines the <u>sampling pool</u>, that is, the larger group of students in the classroom from which a smaller group is to be selected to participate in the norming process. Only students who are not presently classified as learning handicapped and who receive no special-education services are included in the sampling pool. special-education students are excluded from classroom CBM norms because the purpose of those norms is to determine the typical skill-levels of those children in the classroom who receive no additional (special-education) support. In other words, classroom norms are intended to give the instructor an estimate of the average academic skill-levels a child should possess to make adequate educational progress without extra support services. Children with diagnoses of learning disability, emotional disturbance, speech impairment, and other special-education classifications would not be included in the sampling pool. However, students would be placed in the sampling pool if they have no special-education diagnosis but receive Chapter I remedial reading or math services.

Methods of selecting students

There are three methods that teachers can use for selecting students to take part in classroom norms:

1. Random selection from the sampling pool--The teacher first prepares a comprehensive class list, containing student names and also information about any children identified as having special-education diagnoses. The instructor crosses off the names of those students receiving special-education services. Next, the teacher chooses students at random from those remaining on the class list until a sufficient number have been selected for the norming. In classrooms with 20 to 40 children, a sample size ranging between 5 and 10 students will be sufficient to allow for a useful estimate of academic skills. A strength of the random-sampling approach is not only that it will yield a median classroom estimate of proficiency in designated academic areas, but also that the sampling procedure will give the teacher a sense of the range of skills among children in the room. For more specific guidance in selecting a random sample, the reader is referred to Appendix A of this manual.

2. Use of a middle reading group--As a quick sampling method, the instructor can simply use the students from the middle reading group from the classroom as the CBM norming sample. A strength of this sampling approach is that the students selected can already be assumed to have reading skills falling within the average range for the class. A drawback, though, is that the children assessed will not display an overall range of academic fluency representative of the entire class. As with other selection procedures, students who receive special-education services of any kind are excluded from the norming group. Also, the sample size should be between 5 and 10 children for a classroom of 20-40 students. If the middle reading group is large (e.g., 9 students) and the teacher wishes to choose a smaller number of children from that group for the CBM norming, those students should be selected at random from the larger reading group.

3. Mixed administration: Splitting the assessment between the entire class and a randomly selected subgroup--Some instructors adopt a mixed strategy when completing classroom CBM norms. The entire class is given CBM writing, mathematics, and spelling probes, which are well suited to group administration. A subset of that class (approximately 5-10 students) is randomly selected and individually administered CBM reading probes. This mixed approach to sampling a

classroom has at least 2 points to recommend it. Because assessment in math, spelling, and writing takes only a short period of time to give to a whole classroom, the teacher can quickly measure the relative skill levels of all students in the room. Also, sampling the entire class in certain subject areas allows the instructor to have confidence that the data collected during those sections of the CBM norming are a very accurate estimate of the classroom's true range of abilities. A disadvantage of the mixed administration method is that the larger number of probes resulting from using the entire class as the norming group will require increased instructor time to score.

When using this method of classroom norming, the instructor can include children with special-education diagnoses in the group administration for convenience, although scores from those students would not ordinarily be included in the scoring and norming process. The smaller group of children chosen for the reading assessment would be picked at random from the measurement pool of typical students in the room.

Interpreting CBM classroom data: Computing median and range of performance

To interpret the scores from a classroom norming, teachers need to determine both the median student performance and the range of scores that are obtained. The median score, of course, represents the best estimate of the average level of classroom fluency in the targeted educational skill. The range between the lowest and highest scores, on the other hand, gives the instructor some idea of how great the variations of skill-levels are among typical children in the classroom. Although several student sampling methods can be used for classroom norming, the CBM data resulting from any of these methods are treated in the same manner. After scoring the probes in each subject area, the teachers places the scores in rank order. If there are an odd number of scores (e.g., 7), the teacher selects the middle score as representing the median performance. If there are an even number of scores (e.g., 8), the instructor locates the 2 middle scores, adds them together and divides by 2 to arrive at the median value.

In the example below, the results of a CBM norming in reading are presented for children selected at random from a 2nd-grade classroom. The teacher chose to sample a smaller sub-group of the class for the individual reading assessments:

Fig. 4.5: Choosing the median value from odd number of scores

45 52 70 89 104

←——————————————→

Classroom Median = 70 Correctly Read Words

Because an odd number of children were sampled, the middle score of 70 correctly read words per minute is circled as the median value. This number represents the most accurate estimate of the average fluency rate in reading for the classroom. The scores range from 45 to 104 words per minute, suggesting the degree of variation in reading fluency that exists among typical students in the room.

In the same classroom, the teacher administered writing probes to the entire group of 18 typical children:

Fig. 4.6: Choosing the median value from even number of scores

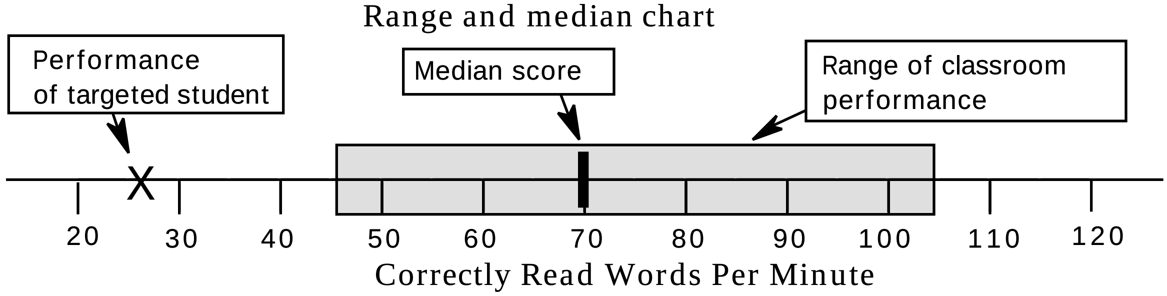
4 9 12 13 14 14 14 15 15 17 17 17 18 19 21 21 22 22

Since an even number of students completed the writing exercise, the instructor first arranged the scores in rank order, then circled the two middle scores of 15 and 17 correctly spelled words. Next, she added the circled scores and divided by 2 to arrive at the median figure of 16 correctly spelled words in 3 minutes as an indicator of average writing fluency for that particular classroom. Again, the spread of scores (which vary from 4 to 22 words) allows the teacher to gain a general idea of the range of student writing abilities among typical children in the class.

<u>Using CBM classroom norms for problem identification and instructional planning</u>

Teachers can apply the information derived from CBM classroom norms in a variety of ways. Many instructors use these norms to aid in identifying individual learning problems. For example, if a particular student is having difficulty with a targeted academic skill, the instructor may give the child a series of CBM probes and compare that student's performance to classroom averages. To more clearly see a comparison between the skill-levels of an individual child and the classroom average, a teacher can prepare a chart that depicts both the CBM median and range of performance of the classroom in a single academic skill. The targeted student's performance is then plotted on the same chart. For example, the 2nd-grade instructor who completed CBM norms for her classroom created a chart showing the results of the reading assessment. She marked the median score with a heavy line and represented the range of performance as a shaded region of the graph. Because the teacher was concerned about the apparently delayed reading skills of

Fig. 4.7: 2nd-grade classroom CBM norms in reading -- October 1991
Correctly read words per minute
Range and median chart



one of her students, she then gave that child a CBM probe in reading. By placing his median score on the same chart with the classroom scores, the instructor was able to see clearly how far the child fell below the average reading level for the room. Since the child's reading rate was found to lie below that of even the lowest-performing typical student sampled, his teacher realized that he would probably require extra intervention to boost his proficiency in reading. Similar charts could be prepared for any academic areas in which classroom CBM norms have been collected.

Additional considerations

During classroom CBM norms, the instructor should be sure that the room is reasonably quiet and free of distractions. If the whole class is participating in any of the CBM probes, it is also a good idea to have another adult in the room to help with distributing and collecting materials and so forth.

Classroom CBM norms can be gathered whenever the instructor feels the need for the information. However, a more regular sampling plan offers the advantage of documenting increasing classroom proficiency in basic skill-areas as the school year progresses. Possible sampling plans might call for classroom normings in September, January, and May, or in October, February, and June.

Combining research and classroom norms

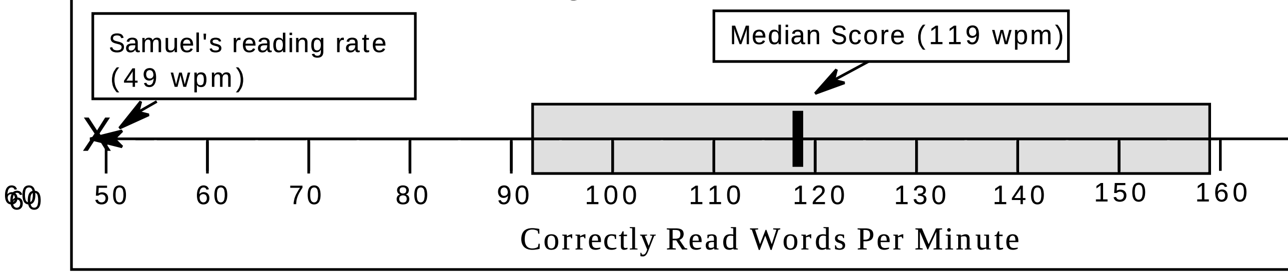
Research and classroom norms have features that complement each other. While classroom norms allow the instructor to see just how delayed a student may be in comparison to the class average for a selected academic area, research norms are also useful because they let the teacher determine a student's placement relative to other grade levels. An example using reading scores will illustrate how both types of norms can be effectively combined in a single assessment.

Marsha and Karen teach in a classroom that is structured according to an unusual inclusionary model. Children from two regular-education grades (11 from the 5th-grade and 12 from the 6th grade) are combined with 14 children with handicapping conditions who would traditionally have been placed in self-contained classrooms. Their adoption of this model grew out of the conviction of the teachers that special-education students learn best (1) when given appropriate learning support and (2) when allowed to mix with typical students in both academic and social contexts. However, it was something of a challenge for Karen and Marsha to provide optimal educational programming for all the children, because the educational skills in the classroom ranged from readiness (early 1st-grade) to 8th grade.

To help them more accurately determine what the spread of skills was in their room, the instructors decided to gather classroom CBM norms. They chose to collect norms separately for the 5th- and 6th-grade groups and also to complete individual assessments for each of the children with handicapping conditions. The measurement net that they put together included passages from grade-appropriate reading books, spelling and writing probes, and several math probes.

When it was time to assess average reading skills among the 5th-grade students, the teachers first compiled a list of those children who received no special-education services. From the list of 11 students, they selected 5 and administered them passages from the 5th-grade reading book. After ranking the reading scores of each student in ascending order, they found that the median reading rate for the 5th

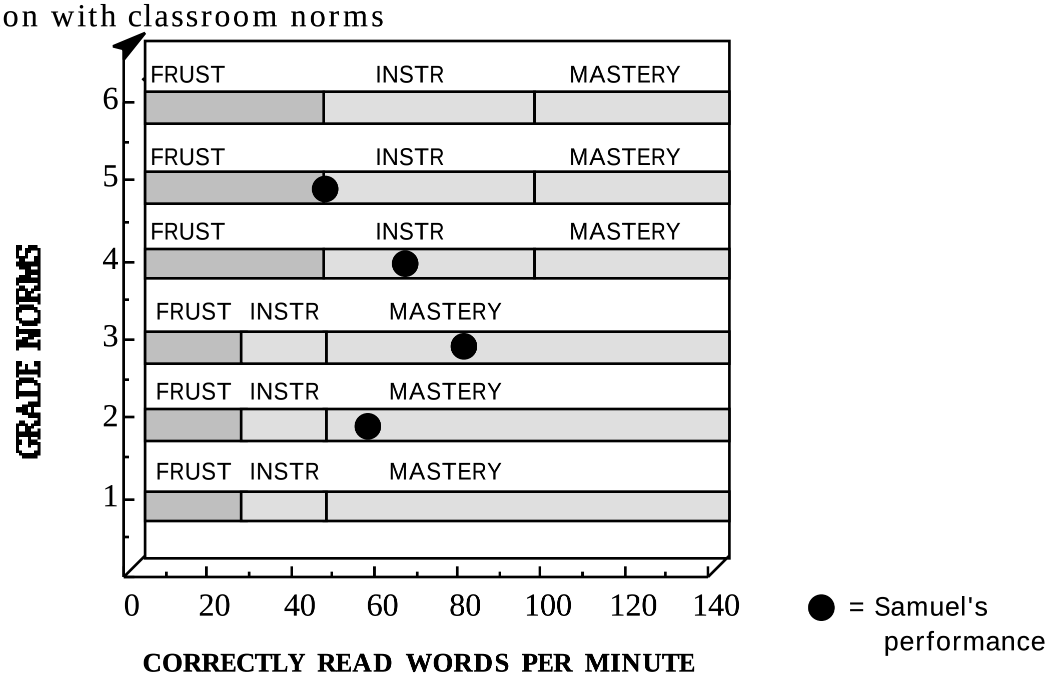
Fig. 4.8: 5th-grade Classroom CBM norms in reading -- April 1992
Correctly read words per minute
Range and median chart



grade group in their classroom was 119 correctly read words per minute with an average of 1 error. They also completed a survey-level reading assessment of Samuel, a student with an identified learning handicap. In 5th-grade reading material, Samuel was able to read 49 correct words per minute with an average of 5 errors per passage. Because he was found to read at less than half the rate of classmates, it was apparent that Samuel had difficulties in reading in comparison to other children in his class.

His teachers next compared Samuel's reading rates in material from earlier grades to research norms. According to these norms, he was able to read with

Fig. 4.9: Example of using research norms to extend information in conjunction with classroom norms



mastery from 2nd- and 3rd-grade material and to read within the instructional range on 4th-grade passages. On text taken from the 5th-grade reader, Samuel performed at the borderline between instructional and frustration levels. Using the norms as a guide, his instructors could assume that Samuel's present decoding skills indicated that a 4th-grade reader would be his most suitable placement in the basal series. This example also emphasizes the contrast in estimates of fluency between research and classroom norms. For example, while research norms suggest that a reading rate of 49 correctly read words per minute represents the threshold of basic fluency for most children, Samuel's classmates were able to read an average of 119 words per minute, more than double that rate. It is probable that, in some classrooms, even children who have achieved basic fluency will seem to have impaired skills--if only because they work at so much slower a rate than classmates.

Schoolwide Norms

Although classroom CBM norms give good information about the average level of academic skills in a selected room, teachers and other school professionals may also want to know the typical levels of educational proficiency across an entire grade in a school building. These school-wide norms are valuable because they can serve as a common point of comparison for children in the same grade who come from different classrooms. If all teachers at a certain grade level are interested in group CBM norms, they will also find that gathering those norms school-wide represents a more efficient use of time than compiling equivalent norms in a number of separate classrooms.

The steps involved in preparing for, gathering, and displaying the results of school-wide CBM norms are presented only briefly here. For a fuller treatment of these steps, the reader is referred to Dr. Mark Shinn's (1989) book, Curriculum-based measurement: Assessing special children (New York: Guilford Press). The book is an excellent introduction to the use of CBM normative data to screen children for possible learning problems, but Chapter 4 is especially useful as a blueprint for setting up a plan for assessing entire grade-levels using CBM procedures. Teachers preparing to gather school-wide CBM norms are also encouraged to consult first with a school psychologist or other support person in their building who has training in the administering and scoring of educational tests. Among other types of assistance, these auxiliary personnel can monitor the school-wide norming to ensure that a random sampling plan is followed when choosing students and that standardized procedures are observed during administration of CBM probes. They can also work with teachers to interpret the resulting information.

Creating a measurement net

As with classroom CBM norms, the collecting of school-wide norms requires initially that teachers put together a measurement net for each grade to be assessed. Instructors have considerable latitude regarding the actual skills that they choose to measure, but by following some basic guidelines, they will be assured of the greatest amount of useful information. First, teachers should consult district curricula, scope-and-sequence charts, and appropriate student texts when generating a list of curriculum goals to be included in the measurement net. It is also a good idea to put together a mix of probes for the targeted grade level that assesses supposedly mastered academic skills, as well as current curriculum objectives. Including both easier and more difficult assessment materials in the measurement net will allow teachers to gain knowledge of student performance in a wide range of skills, a guarantee that they do not overlook any possible gaps in children's mastery of skills. For example, a team of instructors collecting school-wide norms for the 2nd grade in a building may select a simple-addition mathematics worksheet as part of their measurement net. Although simple sums are in fact a 1st-grade curriculum goal, it may be revealed during the scoring of the worksheets that the 2nd-grade students are not very fluent on this basic computational objective. As a result, the teachers could then choose to spend some of their instructional time reviewing addition skills with their classes.

Choosing students for the school-wide norming

Teachers should obtain a list of all the students in the grade. Only those students who presently have no diagnosis of an educational handicapping condition are included in the school-wide norming, so children with special-education classifications are crossed off the grade list. Then students are chosen at random from the list, with care taken that each child has an equal chance of being selected. As a rule, between 15 and 20 percent of the students at each grade-level should be included in the norming, and a minimum of 20 students should be selected.

Conditions for testing

The site chosen for completing the school-wide norms should allow comfortable seating for at least 20 children. As with any setting used for academic assessment, the lighting should be adequate , the area should be reasonably quiet, with limited distractions. At least 2 adults should be present when group probes are administered, one to read instructions and time the probes and the other to distribute materials, monitor student behaviors, and provide other help as needed. For ease of administration, booklets should be prepared in advance, made up of probes to be administered to the group.

Because reading probes are given individually, it is helpful to have additional adults assist in administering these probes. Reading assessments can be given to children at the time that the norm group is assembled, or examiners can arrange at a later time to take students individually from their classrooms for a brief period (about 5 minutes per student) to complete reading probes. The period for collecting school-wide norms at any grade level should not exceed a week (including the collecting of individual reading data). If the data-gathering exceeds this time-limit, it is possible that students assessed near the end of the period will have had an opportunity in the mean time to acquire increased fluency in skills, potentially distortingthe results of the school-wide norming.

Frequency of school-wide norms

Once school-wide CBM norms have been collected, they remain relatively current indicators of school skills for about 3-4 months. After that point, the majority of students have increased their fluency in academic areas to so great a degree that it is necessary to gather new norms. Ideally, school-wide norms in CBM should be updated three times per school year. Some schools have adopted a schedule for norming in September , January, and May of each year, while other buildings or districts complete normings in October, February, and June.

Interpreting CBM school-wide norms

After all CBM probes have been given and scored, the scores for probes in each subject area are placed in rank order and the median value is selected as the best estimate of the grade average in that curriculum objective. Median values are the most important information that school-wide norms yield, but instructors may also be interested in noting the range of scores for each probe.

Because school-wide norms result in so many scores, manual recording and analysis of those scores can be time-consuming. Instead teachers may want to make use of one of the basic statistics packages that are now available. These software programs can simplify the process of ordering and storing the data from school-wide norms; they can also greatly enhance the interpretation of CBM scores. For example, instructors may want to know the range of scores that are typical of the central two-thirds of the students in a grade-level (the so-called "average range"). Using a statistics program, it is a simple matter to compute standard deviations for the scores obtained from each CBM probe. The range defined by one standard deviation above to one standard deviation below the mean score of a CBM probe represents the span of scores to be expected from two out of three children in the grade. Keeping this range in mind, the instructor can better compare a targeted child's performance to the typical performance of other children at his or her grade-level. Statistical programs can also compute box-plots (visual displays of interquartile, or median, values) and other treatments of data that are easily interpreted and very useful for purposes of group comparison.

Gathering school-wide norms: An example

Recently, a school psychologist working at a large urban elementary school in central New York decided to gather school-wide norms using CBM. He had been using CBM extensively in his own educational assessments and wanted to have a set of CBM norms for each grade. With such norms, the building's Pupil Service Team would be able to compare the performance of any student at risk of academic failure to the appropriate skill-level for that student's grade. To begin with, the school psychologist needed to establish a **measurement net** of CBM probes that would be used to assess children in each grade in reading, mathematics, spelling, and written expression. The psychologist reviewed curricula used by the district for each of the academic areas. He also interviewed teachers and his school's instructional specialist for further guidance in assembling a suitable measurement net.

To assess reading fluency, the school psychologist used passages chosen at random from the district basal series. In mathematics, several computational probes were selected for each grade, with at least one of those probes made up of problems that were presumed to have been mastered according to the guidelines of the math curriculum. Spelling probes were made up of wordlists chosen at random from a commercial spelling program (Scott Foresman). Written-expression probes were prepared using grade-appropriate story starters.

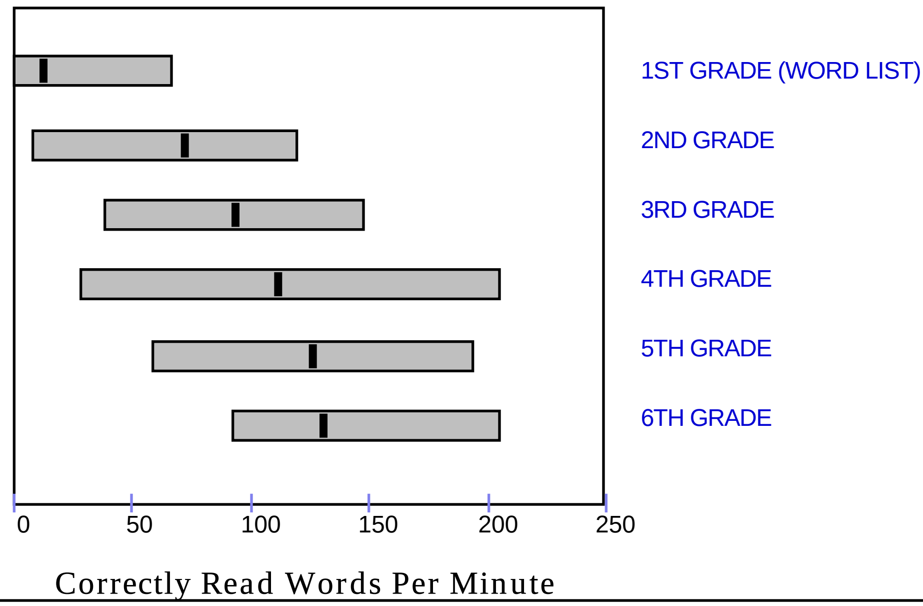
Once the assessment materials had been put togther, the psychologist **randomly selected students** from grades 1-6 to participate in the school norming procedure. He obtained a computer listing of all children attending the school, grouped alphabetically according to grade. First, the names of students receiving special-education services were removed from the list, since the norms were intended to represent average academic skills of children who do not require additional educational support. Then for each grade, the psychologist chose names at random from the list using a random-number table (see Appendix A of this manual for a description of the random-selection procedure). Because he wanted at least 20 children per grade as a representative norming sample, the psychologist selected 25 students from each grade-list, with the 5 additional students included to take into account children from the sample group who might be absent or otherwise unable to participate on the day of the norming. In all, about 120 children were to be assessed in these school norms.

The school cafeteria was set aside as the CBM **testing site**, since this was the only free area of the building that had sufficient room for 20 children to be tested at one time. Several staff members and a parent volunteer with training in the administration of CBM probes assisted in the collecting of the data. Two successive mornings were reserved for completing the building CBM norms. Students chosen from each grade were brought together to the cafeteria, and CBM mathematics, writing, and spelling measures were administered to the group by the data-collection team. Then adult examiners met with children individually to complete the CBM reading probes. Each grade required about 45 minutes to complete all the CBM materials.

Once probes had been given to all grades and **scored**, the psychologist entered the scores into a statistical software package. The use of the software made the task of recording, organizing, and interpreting the data from across grade-levels much easier than trying to complete the same process by hand. (After all, with a minimum of 4 CBM probes given to each child and a total of 120 children participating in the school norming, one could expect at least 480 individual scores that needed to be organized and interpreted!)

The school psychologist decided to summarize each grade-level's norm results by visually representing the median and range of the data. Figure 4.10 displays CBM reading norms for grades 1-6. The median rate of reading fluency at each grade-level is indicated by a heavy vertical line, while the total range of fluency for the grade-sample is shown as a gray bar. The illustration shows clearly that reading fluency increases with each grade level and also that gains in fluency are most dramatic in the earlier grades. The school psychologist and other members of the building's staff found the CBM school norms to be useful in a number of ways. With the norms in place, students found to have difficulty with reading fluency could be given a survey-level assessment. Their reading rate in basals from various grade-levels could be compared to the school norms to determine the mastery, instructional, and frustration levels of the students at risk when compared to the

Fig. 4.10: CBM reading fluency norms
for an elementary school (Grades 1-6)   October 1991



median reading performance of peers. The charted school norms also underscored the fact that, although every grade contains readers with a wide range of ability, the majority of those students are considered to be "normal" readers. In other words, the school norms served as a reminder to the school staff that varying academic skill-levels among children is a normal occurrence that should be expected in any classroom and appropriately programmed for.

Summary

There are several kinds of normative information about CBM skills that instructors can collect and refer to when attempting to understand "average" academic-skill levels at various grades. Research norms are estimates of typical rates of student fluency in CBM reading, writing, and math computation tasks that have been published in education journals. Research norms have the advantage of requiring no additional work in gathering information about local (classroom or grade) norms. A disadvantage is that they offer only a general approximation of basic fluency in various academic skills and do not give an accurate picture of the typical abilities of children in a particular educational setting.

Classroom norms are collected from regular-education students in a single classroom. Teachers must select one of several sampling plans when selecting children for classroom norms: (1) random small-group; (2) middle reading group; or (3) combination of large- and small-group. A measurement net is assembled, consisting of the important curriculum objectives to be assessed. Resulting scores are placed in rank order to determine both the median score and range of scores representing the typical spread of abilities in a classroom. Although classroom norms give an accurate indication of the average skills in a single room, the norms cannot be applied to other rooms with different children.

School-wide norms are the most comprehensive of CBM normative data, representing estimates of fluency in academic skills for entire grade-levels. Like norms gathered in the classroom, school-wide norms require the establishment of a measurement net and a random sampling procedure for choosing typical students for assessment. Median scores and ranges of scores are determined for each CBM probe. Statistical programs are available that can both simplify the data collection process and increase the ability of the instructor to interpret the resulting distribution of scores.

5 Advanced Applications of CBM

Introduction

Once educators who have been trained in curriculum-based measurement begin to use it routinely in their classrooms, they quickly discover additional useful applications of CBM. This chapter will discuss two important aspects of CBM that have the potential to be of immediate help to teachers. First, we will examine the use of CBM data and monitoring procedures to write clear, outcome-based IEP goals. Also included is a review of several commercial software programs which can allow instructors to create monitoring materials more easily and to automate the charting and interpreting of CBM information. Finally, several recent case studies are presented in which teachers used CBM to make important decisions about students' educational programming.

Creating IEP Goals Using CBM

Special-education teachers are faced with additional responsibilities for predicting and documenting student academic growth than are instructors in regular-education classrooms. Federal and state regulations state that those children identified as having educational handicaps are entitled to an individual education program (IEP) tailored to meet their specific learning needs. Teachers of children with special needs formulate yearly IEP goals for these students. IEP goals specify particular educational skills to be taught, and also include criteria for judging mastery of the objectives. But teachers and administrators in special education have voiced frustrations with present approaches to the writing of IEP goals. While many teachers write consistent and clear goals, a review of IEP's shows that goals too often fluctuate between extremes: they are either so vaguely worded as to provide little guidance in day-to-day programming or are overly ambitious, attempting to catalogue individual learning objectives in overwhelming detail.

Several features of CBM make it well-suited as a starting-point for creating salient IEP goals. CBM is tied to specific, explicitly stated academic behaviors (e.g., number of words read correctly per minute) that can be measured with accuracy. Rules of administration are standardized, allowing results of similar probes given over several months to be compared directly. Because CBM emphasizes the setting of fluency goals as a routine part of the monitoring process, special-education teachers can conveniently incorporate these estimates of learning progress into IEP goals.

Deciding between short- and long-term IEP objectives

As instructors contemplate the use of CBM as a starting point in preparing IEP goals, they must first decide whether they will monitor short- or long-term learning objectives. Short-term objectives consist of discrete academic sub-skills that one might expect a student to master within a relatively short period. Short-term CBM goals in reading, for example, may include the successive mastery of the Dolch Pre-Primer and Primer wordlists, while short-term math goals may focus on mastery of addition problems with sums $\leq$ 10 and subtraction problems with 2 single-digit terms. One advantage of short-term learning objectives is that they match the day-to-day curriculum more closely than more generalized objectives. Also, teachers of children with severe learning handicaps may find short-term goals to be quite sensitive to small but significant gains in their students' skills. Teachers monitoring with short-term CBM goals are required, however, to prepare a fresh range of materials whenever their student moves into a new short-term objective. Also, data collected for different short-term CBM objectives cannot be charted on the same graph and compared directly. As a result, a teacher may be able to see short-term gains demonstrated in targeted skills but would not obtain a unified chart that documents rate of academic growth across the school year.

Long-term CBM IEP goals are tied to more general learning objectives. A long-term CBM goal in reading fluency, for instance, might be put into place that requires the student to be monitored using reading passages selected from a basal reader more advanced than the child's present reading level. Similarly, a long-term math goal may seek to boost a student's computational fluency on a mix of grade-appropriate number problems. Progress toward that long-term math goal could be measured on a weekly basis by giving the student mixed-skill computational probes.

A strength of long-term CBM IEP objectives is that they allow the instructor to chart data and plot a visual record of increase in academic fluency over a long period--even through the entire school year, if necessary. Teachers may also find it less time-consuming to prepare materials for long-term CBM goals, because once they invest the initial time to prepare a single collection of probes, instructors can continue to draw from that collection for monitoring materials. In addition, long-term CBM objectives accurately reflect general academic growth (e.g., increase in reading fluency), independent of specific sub-skills being taught in the classroom.

A drawback of long-term CBM goals, however, is that they may result in a "floor effect" for students with very delayed skills. A floor effect simply means that the materials being used to monitor student growth are so difficult for an individual child that he or she is not able to show meaningful academic growth when measured. Imagine, for example, that a student has mastered ten sight-words when first assessed but has not yet developed the ability to phonetically decode words. That child may experience a floor effect if given probes to read taken from a 2nd--grade reader. Stated another way, although she may be making real progress in acquiring sight-words and skills in phonics, the extent of the student's reading progress would most likely be masked by the difficulty of the relatively advanced reading passages in which the student is being measured.

The decision to use short- or long-term CBM objectives when preparing IEP objectives remains with the instructor. Either approach (or even a combination of the two) may be best suited for a particular child. As a rule of thumb, though, long-term CBM objectives appear to be most often used with children in regular-education settings, while both short- and long-term goals are found to be appropriate in special-education classrooms.

A formula for writing CBM IEP goals:

The actual writing of CBM IEP goals is rather simple, particularly for the instructor who has already gone through the systematic process of gathering CBM information on a targeted student in the manner outlined in the first four chapters of this manual. When writing an IEP goal for CBM, the special-education teacher merely condenses into a single sentence the essential points of the CBM monitoring program. There are three elements that are included in the IEP goal: (1) the standardized conditions under which the CBM probe is to be given; (2) the behavior that is to be measured; and (3) the performance criterion that the instructor has set to indicate mastery of the measured academic skill.

1. Conditions. The introductory phrase of the CBM goal sums up the essential, standardized conditions according to which the academic skill will be measured. This phrase will include the amount of time allotted for the student to achieve the fluency goal (most often presented as number of weeks until annual review). There will also be mention of the specific materials from the student's curriculum used to measure academic progress, as well as a summary description of other essential features of the CBM administration.

Several CBM IEP goals written by local teachers appear below. The section of each goal outlining conditions has been set off in bold-face type:

- **In 30 instructional weeks, when given a randomly selected passage from level 10 (Silver Secrets) of the Silver Burdett & Ginn reading series**, the student will read aloud at 90 correct words per minute with no more than 5 errors.

- **In 30 instructional weeks, when given a worksheet of 40 randomly selected problems (addition of a 2-digit number to a 2-digit number with no regrouping)**, the student will write a total of 25 correct digits with 90 percent overall accuracy on problems attempted.

- **In 30 instructional weeks, when given a story starter and 3 minutes in which to write**, the student will write a total of 40 correctly spelled words.

2. Behavior. The behavior presented in the CBM IEP goal is that through which the instructor measures academic fluency in a selected academic area. On probes intended to measure reading fluency, for example, the relevant behavior is reading aloud, while on written expression probes, the behavior of interest is writing.

In the CBM IEP goals below, the section of each goal outlining behaviors has been set off in bold-face type:

- In 30 instructional weeks, when given a randomly selected passage from level 10 (Silver Secrets) of the Silver Burdett & Ginn reading series, **the student will read aloud** at 90 correct words per minute with no more than 5 errors.

- In 30 instructional weeks, when given a worksheet of 40 randomly selected problems (addition of a 2-digit number to a 2-digit number with no regrouping), **the student will write** a total of 25 correct digits with 90 percent overall accuracy on problems attempted.

- In 30 instructional weeks, when given a story starter and 3 minutes in which to write, **the student will write** a total of 40 correctly spelled words.

3. Performance Criterion. The criterion is that part of the goal which represents the standards that the instructor will use in judging the student's attainment of a fluency-goal in a selected academic area. The criterion is expressed as a minimum number of correctly completed academic behaviors (e.g., "40 correctly read words", "30 correct digits"). The instructor may also decide to specify the maximum allowable number of errors as a criterion for mastery (e.g., "with no more than 3 errors"). Or, rather than focusing on errors, the teacher may instead choose to include an accuracy criterion, presented as a percentage of correct answers (e.g., "with 90 percent accuracy").

The section of each goal outlining one or more performance <u>criteria</u> has been set off in bold-face type in the CBM IEP goals below:

- In 30 instructional weeks, when given a randomly selected passage from level 10 (Silver Secrets) of the Silver Burdett & Ginn reading series, the student will read aloud **at 90 correct words per minute with no more than 5 errors**.

- In 30 instructional weeks, when given a worksheet of 40 randomly selected problems (addition of a 2-digit number to a 2-digit number with no regrouping), the student will write **a total of 25 correct digits with 90 percent overall accuracy on problems attempted.**

- In 30 instructional weeks, when given a story starter and 3 minutes in which to write, the student will write **a total of 40 correctly spelled words**.

The procedures set forth in this section for writing CBM IEP goals are intended for use by teachers of children with special needs. However, instructors in regular-education classrooms may want to follow similar guidelines when summarizing monitoring guidelines for specific students. Educators from a variety of educational settings find that they can better visualize their expectations for student progress by framing those expectations in terms of a single "goal-oriented" sentence--one that outlines conditions, behaviors, and criteria for mastery for projected academic outcomes.

CBM-Related Software

Increasingly, teachers have access to computers to assist them in instructional planning, teaching, and program monitoring. As educational software becomes more accessible, instructors find opportunities to match children with appropriately selected computer programs in basic skills and content areas to allow those students time for individual drill and practice. Computers excel at organizing data and transforming it into visual displays such as graphs and charts. Software is also available that quickly creates basic skill worksheets (e.g., math worksheets). Because of its utility, the computer has great potential for reducing the time and work required to implement a successful CBM monitoring program in a classroom or school building. This section will review examples of commercial software that can be of substantial benefit to instructors exploring the uses of CBM. However, the few programs discussed here by no means comprise a comprehensive list of software with CBM applications; readers are encouraged to look through educational catalogs for information about additional useful programs.

Charting data and generating trendlines

Many computer programs are now available that have the ability to chart CBM information, while a number of such programs also have the capacity to plot trendlines and carry out more sophisticated interpretation of the data. One program expressly designed for CBM users is **Sheri**, created by Performance Monitoring Systems. The program, which runs on the Apple II computer family, gives the teacher the option of setting a goal and aimline for an individual student. Once the data have been keyed into the program, Sheri will plot a graph displaying the data and will also plot a trendline (similar to those reviewed in Chapter 3) to summarize the upward or downward "trend" of the data. An updated graph can be printed after each new data-point is entered. The program will even allow the user to plot two separate values on one chart (a useful feature for the teacher who wants to see correctly read words and errors per minute displayed on the same graph).

Among additional features, Sheri has an internal calendar, so that data from CBM probes can be paired with the dates on which they were collected. When a progress-monitoring graph is printed, it has a running calendar along the horizontal (X) axis, allowing the user to quickly determine the duration of the monitored intervention and the approximate dates that individual data-points were collected. Because the program has word-processing capabilities, instructors can enter descriptions of initial instructional interventions and of program changes. Along with graphs, Sheri is also capable of printing compact "reports" that present all recorded instructional interventions and summarize the data of CBM probes in a neat table for easy reference. For the teacher who wishes to use CBM to monitor a relatively large group of students, the Sheri program can be very useful as a tool for organizing and interpreting data.

Those interested in obtaining more information about Sheri can write to:

Performance Monitoring Systems
133 SE 2nd Avenue
PO Box 148, Cambridge, MN 55008.

The phone number for the company is:

(612) 689-2688.

Another solution for automating much of the charting and analysis of data can be found in spreadsheet software. These programs are widely available and often have the capacity to generate line-graphs and even trendlines. There are also an increasing number of easy-to-use statistical packages that can plot both line-graphs and trendlines. It is worth exploring whether any suitable software is available within your school district or building to assist you in managing your CBM information.

Automated testing and scoring

A software package has recently become available that goes a considerable way toward automating the entire CBM process. **Monitoring Basic Skills Progress**, or **MBSP**, is a collection of three programs that use the Apple II computer to monitor student performance in reading, mathematics, and spelling. In the reading program, the student sits down at the computer and inserts both a student disk and a "Stories" disk. The program automatically administers a timed cloze passage from the "Stories" disk matched to the student's reading ability. The cloze passage uses a multiple-choice format, with passages randomly selected by the computer from a measurement pool of items included as part of the software.

At the end of each timed administration, the computer scores the student's performance. A teacher can review student data at any time throughout the school year, calling up a chart which displays the student's cumulative plotted data. Instructors may set a goal and aimline for each child. The software also generates a trendline summarizing student progress when sufficient data-points have been charted. Another feature of MBSP is that it applies decision rules to the collected data, giving teachers prompts in the form of messages on the screen. The program may advise them, for example, to raise the goal line for a successful reader or to change the instructional intervention for a child who is performing below expectations. The math and spelling software differ somewhat from the reading in administration procedures, but all MBSP programs have the same charting and data interpretation features.

With the MBSP math program, a routine assessment begins with the student completing a paper-and-pencil worksheet while being timed by the computer. Worksheets contain a mix of computation problems suitable for the student's grade or instructional level. When the child's testing time expires, the student keys all answers into the computer, which then scores the worksheet and automatically charts the resulting CBM data. Worksheets covering all elementary grades are included in a book that comes with the program.

The MBSP spelling software requires that a "reader" (e.g., instructor, classroom assistant, peer tutor) read off spelling words to a targeted child while that student types the words into the computer. The computer times the operation, giving the student a limited number of seconds to type each word. When the timed test is finished, the computer scores the probe for correct letter-sequences and charts the results. Lists containing spelling words for various grade-levels accompany the program.

Teachers who would like more information about the MBSP programs can write to:

Pro-Ed
8700 Shoal Creek Boulevard
Austin TX 78758-9965

The phone number for Pro-Ed is:

(512) 451-3246.

Creating CBM probe materials in math, reading, and spelling

Since making up probes is typically the most time-consuming part of CBM, teachers can benefit from programs that generate materials for academic progress-monitoring. Several examples of software are presented here for use in making up math, reading (word list), and spelling probes.

An excellent program for creating mathematics worksheets on the Apple II computer family is the **Mastering Math Worksheet Generator**, or **MMWG**. It allows the teacher to select computational objectives in addition, subtraction, multiplication, and division. Once objectives have been chosen, the instructor can request single-skill or multiple-skill worksheets corresponding to those objectives. MMWG will create any desired number of unique worksheets based on a teacher's specifications and will also print answer keys. A sister program to MMWG, which creates worksheets for more advanced computation (e.g., addition of fractions), is called Conquering Math Worksheet Generator. Both programs were designed by the Minnesota Educational Computing Corporation (MECC), an organization that produces educational software for schools. A large number of school districts across the nation have licensing agreements that permit them to copy MECC software on site. If your school district participates in the Direct License program, you can obtain the software through them. If you wish instead to order products directly from MECC, you can write to:

MECC
3490 Lexington Avenue North
St. Paul, MN 55126

The MECC information phone number is:

(612) 481-3500

Twin programs produced by Performance Monitoring Systems give instructors the ability to produce math, reading (word list), and spelling probes with an Apple II computer. The **Continuous Assessment Program--Mathematics** is similar to the MECC software described above. It will create single-skill worksheets in all basic computation areas and also offers considerable flexibility in choosing particular types of problems. The **Continuous Assessment Program--Reading & Spelling** requires that the instructor type master-lists of reading vocabulary or spelling words into the computer. Using the items from each master-list as a measurement pool, the software will then generate random lists that can be used as CBM spelling probes or as word lists for the measurement of reading fluency. The CAP programs can be obtained at the Performance Monitoring Systems address given above.

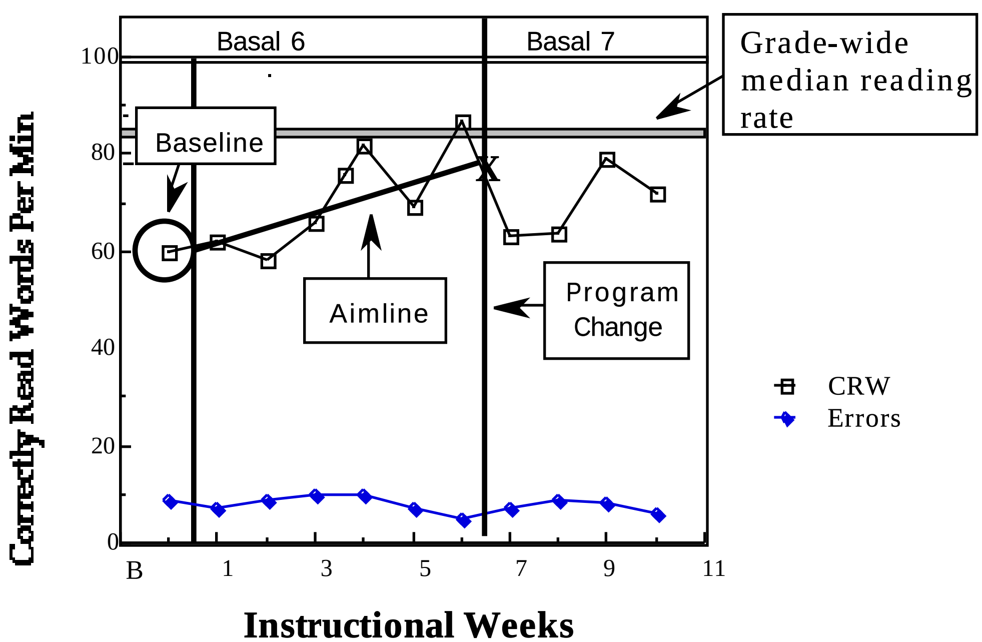
CBM Case Studies

In the next section, several actual case studies are presented which illustrate how CBM can be used to make decisions about the effectiveness of instructional interventions. The purpose of these examples is to give instructors a living sense of the usefulness of CBM as a tool for monitoring the academic progress of children.

Wayne: A successful reading intervention

Wayne was an 8-year-old boy found to be reading at the 1st-grade level at the start of the year. His teacher placed him in a DISTAR reading group. Wayne also attended reading lab twice per week and was included in a supplementary whole-language group made up of delayed readers in his classroom. Baseline data on Wayne's reading fluency was gathered, using passages taken from the early 2nd-grade reader (basal 6) of the Silver Burdett & Ginn reading series. That reading book was selected as goal-level material in which Wayne would be monitored.

Fig. 5.1:   Charted CBM reading data for Wayne R. : Successful intervention



Results revealed that, at the outset of his reading program, Wayne was able to read 60 correct words per minute in basal 6 with 10 errors. Grade-wide CBM norms were also collected; it was discovered that Wayne's grade-mates were able to read an average of 85 correct words per minute in the same text, with a average of 4 errors.

His teacher decided that Wayne should be able to increase his reading fluency by about 3 words per instructional week. His instructor also expressed a willingness to advance him into the next basal at the point that Wayne's reading performance matched that of peers. The accompanying graph displays Wayne's reading progress over approximately 10 weeks. He made steady progress throughout his instructional program. That progress can be surmised by the relatively even distribution of data-points around the aimline in the section of the graph in Figure 5.1 labeled "Basal 6." Wayne's progress was so strong, in fact, that by week 6 he was able to exceed the grade-wide reading rate (represented at the top of the graph as a horizontal gray line) and to decrease his number of errors.

Because of his strong reading growth, Wayne's teacher promoted him into the next reading book. She monitored him for four more weeks. Since these additional data-points seemed to indicate that Wayne was able to function instructionally within that more advanced basal text, his teacher was satisfied with his reading performance and discontinued CBM monitoring.

Ellen: Lack of expected progress despite a change of program

Not all students monitored through CBM show uniform rates of progress. Because of differences in their ability and school experience, children display considerable variation in rates of academic growth. This next example documents a less-than-favorable learning outcome. The case is presented in some depth, because it highlights the value of CBM in helping educators to identify those students with such severe delays in acquisition of academic skills that those delays can be said to constitute a learning handicap.

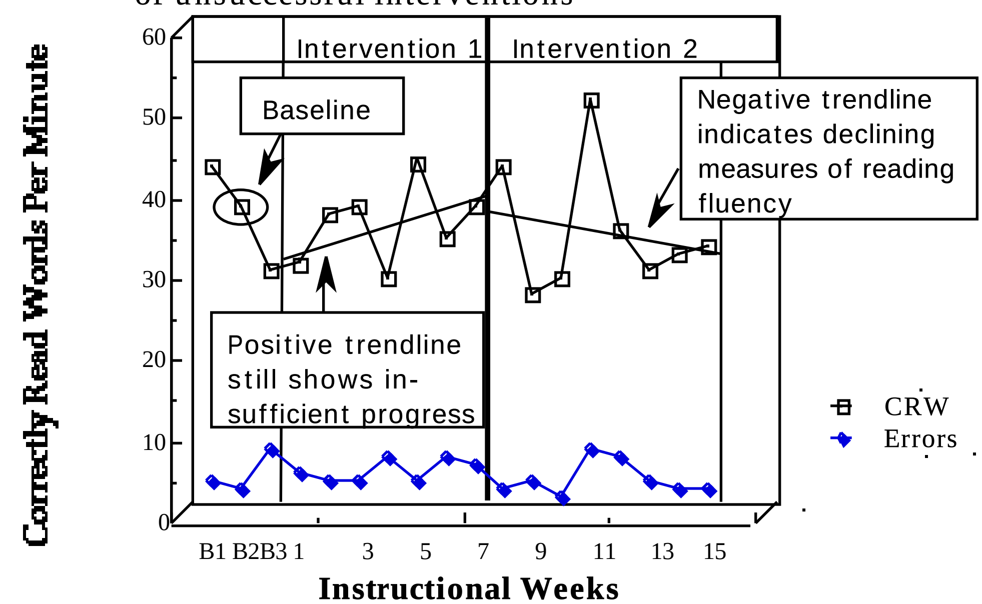
Ellen was just beginning the 2nd grade, having been retained in the 1st grade the previous year because of limited reading skills. A survey-level CBM reading assessment indicated that Ellen read most comfortably at the later 1st-grade level. Along with the child's lagging reading skills, her teacher was concerned at signs that Ellen became anxious when asked to read aloud, appeared to be self-conscious about her limited reading skills, and would seem to make elaborate efforts to hide those more limited reading abilities from classmates (e.g., picking up a book beyond her abilities and pretending to read it in full view of the class). Her teacher decided to place Ellen in the early 2nd-grade reader, despite the fact that this placement was somewhat more advanced than was indicated by the child's level of reading fluency. The instructor reasoned that, since Ellen had already spent the past two years in the 1st-grade reading books, she would be very discouraged upon being placed in the same basic texts for a third year. The teacher also thought that Ellen might feel singled out and "different" if she could not read in the same book as classmates.

However, other resources were put into place to strengthen her reading skills and to support Ellen in this advanced reading placement. She attended reading lab twice per week. Ellen was also assigned a reading tutor, an adult volunteer who met with her individually for three 30-minute periods per week. Tutorial instruction consisted of activities intended to give Ellen drill-and-practice opportunities in reading. In particular, the tutor reviewed with Ellen stories that would soon be covered in her reading group. It was hoped that by practicing stories in advance, Ellen would be able to read aloud with greater competence in her group.

In order to gauge her progress in reading fluency, Ellen was monitored on a weekly basis, using passages from the early 2nd-grade reader (basal 6) of the Silver Burdett & Ginn reading series. This was the same book in which she was placed for instruction. The decision was made to monitor Ellen in instructional material because it would give the teacher regular feedback about how the student was coping with the demands of her present reading program. The tutor had been trained in administration of CBM and agreed to administer reading probes to Ellen. It was decided that Ellen's estimated rate of progress in reading fluency should be set at 3 additional words per week, an ambitious but not unachievable goal for a regular-education student with additional reading assistance. (The aimline has been omitted from the accompanying chart.)

From the outset, Ellen's reading performance showed a high degree of fluctuation. For example, even her baseline data-points ranged from 32 to 45 words per minute, suggesting a pattern of unpredictability in her reading rate from week to week. After the first seven weeks of data representing Ellen's reading progress had been graphed, a trendline was generated using computer software (see the section of the grap in Figure 5.2 labeled "Intervention 1"). The trendline showed an average increase in reading fluency of about a word per week, a substantially slower rate of progress than her teacher had hoped for. There was also considerable overlap between the baseline data-points and those collected during the first weeks of intervention. Although the charted progress was somewhat disappointing, both Ellen's teacher and parents were able to report that she had shown an improved

Fig. 5.2: CBM reading data for Ellen B. : Monitoring of unsuccessful interventions



attitude toward reading since the beginning of the intervention, including greater participation in the reading group and an increased readiness to attempt to read simple texts independently at home.

In an attempt to accelerate Ellen's reading fluency, changes were instituted in her reading program. Ellen's tutor continued to preview stories with her from the reading book, but also recorded and reviewed error words with Ellen at each meeting. The reading lab instructor devoted a larger amount of time each session to a review of phonics skills. In the classroom, Ellen's instructor tried to get her involved in informal but rewarding reading activities, such as writing stories and reading to younger children in a neighboring classroom. When eight additional data-points had been graphed, however, the resulting trendline displayed a decreasing trend (see the section of the graph labeled "Intervention 2" in Figure 5.2). At the very least, Ellen had made no apparent gains since the implementing of the program change and--in fact--appeared to have actually lost ground when compared to her earlier reading progress. Ellen's individual data-points also continued to show substantial variation over time.

After examining the 15 weeks of CBM monitoring data, her teacher decided to consult with the school's Pupil Service Team about Ellen's documented lack of progress in reading fluency. They discussed the possibility that Ellen might have a learning handicap which prevented her from making reading gains typical for children her age. A learning evaluation was completed. Formal test data supported the teacher's conclusion that Ellen was severely delayed in reading ability. The student was diagnosed as having a learning disability in reading and assigned resource assistance for an hour per day. The CBM data supplied by her teacher had provided very useful information about the extent of Ellen's learning handicap. Her failure to make adequate progress in reading was carefully documented, providing educators with important evidence that Ellen would most likely require additional remedial services to become a fluent reader in grade-appropriate material.

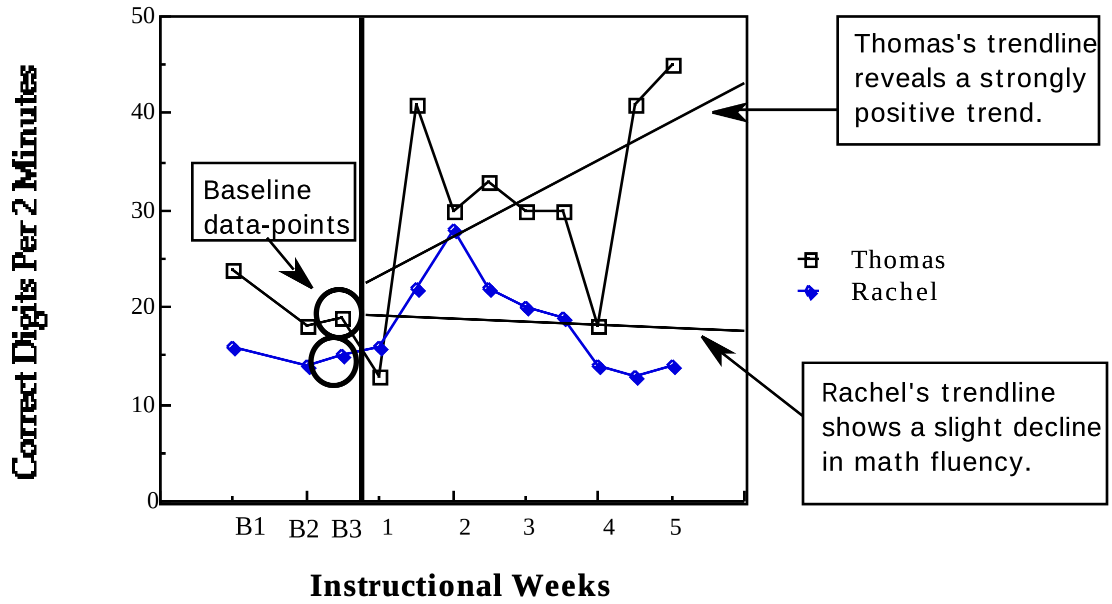
Rachel and Thomas: Mixed outcomes

A major reason that CBM holds such potential for instructors is that it gives timely feedback about the effectiveness of specific interventions for increasing student fluency in basic academic skills. After all, even the most experienced teacher cannot predict with certainty beforehand that a particular intervention is well-suited for an individual student. Since every intervention is based on a hypothesis (i.e., that a certain teaching approach will be effective with a targeted child), the hypothesis can be tested through the gathering, charting, and interpreting of CBM data. It may be helpful to review a case in which CBM was used to monitor the performance of two children who were receiving identical mathematics instruction. In this example, the resulting CBM data plainly distinguished between a student who benefited from the intervention and one that failed to make significant progress.

Rachel and Thomas were part of an 8-student math group composed of the lowest-skilled students from two classrooms. The group met daily for 30 minutes. The teacher structured her instruction around a DISTAR mathematics program.

Consequently, each lesson included frequent repetition of concepts, and opportunities for students to repeat important information and to demonstrate understanding. In order to monitor the progress of her students through CBM, the teacher prepared a series of single-skill math probes. She chose to monitor the children using a math objective in which they were currently being instructed--subtraction with 2 double-digit terms and no regrouping. Twice per week the instructor opened the group by having the students complete a math probe. She

Fig. 5.3:   Comparison of CBM math data for two students
(Subtraction with double-digit terms / no regrouping).



also set a fluency goal of 3 additional digits per week, based on her knowledge of the skills of the group members.   (Aimlines have been omitted from the accompanying chart.)

The median baseline data-points (Figure 5.3) show that, when first evaluated, Thomas was writing an average of 4 more correct digits than Rachel in a 2-minute period. However, a review of the charted data after 4-1/2 weeks showed that the gap in computational fluency between the two students had widened greatly. While his trendline demonstrates that Thomas had increased his fluency on those math problems by an average of 18 digits, Rachel's trendline shows a slight decrease in fluency. In only several weeks, CBM was able to give the teacher valuable information about the widely varying impact of her instructional program on students.

Summary

Advanced applications of CBM include the writing of IEP objectives and use of computer software. An alternative method of writing IEP goals can be adopted, using the CBM monitoring procedure as a framework. CBM IEP statements contain references to the conditions under which the program monitoring will take place, the specific academic behavior that will be measured, and the criterion set for successful completion of the objective. Computer software is now on the market that automates the administration and scoring of CBM probes, while programs are also available that automatically chart CBM data and generate trendlines. Teachers can also rely on selected software to prepare probe materials, greatly reducing the time investment needed to implement CBM in the classroom. Several case studies presented in this chapter demonstrate how CBM can be used to make decisions about the effectiveness of instructional interventions in applied settings.

APPENDIX A: The random-number table: A method for choosing truly random samples

Random sampling is a fundamental part of curriculum-based measurement. When teachers select students for classroom or school-wide CBM norms, they must be sure to avoid bias in their choice of children to include in the norming sample. Used in the context of random sampling, bias refers to any specific pattern that a person may follow when choosing elements from a larger group. When bias is present in the selection process, the resulting sample cannot be considered random.

But what is the underlying reason for insisting so strongly on random sampling, particularly when choosing children to be in CBM norm groups? The purpose of such groups is to give the instructor an idea of typical classroom or grade-wide abilities in academic skills. However, if only those students with a certain trait (e.g., "good" reading skills) are considered, the resulting group can no longer be thought of as reflecting the typical, or "average," skills of the larger classroom or grade. Put another way, we will have chosen a biased sample group.

While instructors might be on guard against obvious sources of bias in sampling, caution is also required to prevent hidden bias from creeping into the selection process. Imagine that a teacher decides to avoid bias by "just randomly choosing" names from a student roster to include in a CBM norm group. Although the instructor believes the process to be random, it is more likely that the teacher is actually following a hidden pattern in selecting students. For example, the instructor may unknowingly be choosing more students from the beginning or end of the list than from the middle. Although not intentional, the resulting sample may very well be biased. Now consider the situation of a teacher who looks at a sample of students chosen from a class roster and decides to "adjust" the list to include a more "representative" group of readers for the room. Again, bias has been introduced into the selection process, because the instructor has altered the composition of the CBM norm group to match that teacher's preconceived notions of a typical range of readers.

Since bias can so easily contaminate the selection process and compromise the usefulness of CBM norms, it is recommended that teachers use a random-number table when choosing members of a norming sample or putting together other random groupings. Although it is specifically presented here as a means of choosing random CBM norm groups, the systematic random selection process outlined below can be adopted for creating random samples of any kind (e.g., for choosing passages from a basal reader for CBM probes). The procedure is simple and straightforward:

1. Prepare the master list. The instructor first prepares a list, grouping all the elements from which the sample group will be chosen. If a CBM norm group is to be selected from a regular-education classroom, the teacher removes from the class list any students presently receiving special-education services. Students remaining on the roster make up the initial selection list.

2. <u>Consult the random-number table</u>. The teacher turns to the random number table in this appendix. (The table was generated by a computer statistics program, and the numbers in it were randomly selected and arranged.) Starting at any point in the table, the instructor moves from left to right, reading off the numbers that appear. It is a good idea to start at varying points in the table each time that it is used. If "0" is selected, the instructor moves one digit to the right of the 0 and uses that number instead. If two-digit numbers are required for selection, the teacher simply moves along the table, choosing two numbers at a time and reading them as a single two-digit number (e.g., choosing "2" and "1" in sequence and reading them as "21", or selecting "0" and "4" and reading them as "4").

3. <u>Match random numbers to elements on the master list</u>. For <u>each number</u>, the teacher counts down the equivalent spaces on the master list, choosing the item that corresponds to the random number. The process is then repeated until enough elements have been chosen to make up the sample group. Each time, the instructor uses the most recently selected element in the list as the starting-point for counting off by the next random number.

For example, if a teacher encounters the number 4 in the random-digit table, the instructor would count down the class roster, choosing the fourth student as a member of the norm group. Then, using the most recently chosen student as the new starting point, the teacher would read off the next random number from the table and count down the proper number of spaces to select another student, repeating the process until a sufficient number of names have been selected to make up the sample group.

<u>Example of a random selection of students for a classroom group</u>

A teacher has made arrangements to gather CBM norms for his 4th-grade classroom. When the time comes to choose a sample group, he decides that the CBM norms will be collected from 7 typical students chosen at random. He first examines his class roster and crosses off those children in his room who currently have special-education needs (Figure A-1).

Fig. A-1: Students receiving special-education services are eliminated from the class list

```
4th-grade   Classroom 109   Ms. Norton
```

~~Abbott, Joseph......................Speech Impaired~~
Accardo, Jonathon
~~Bartholomay, Andrea.................Learning Disabled/Reading~~
Bayne, Christopher
Craig, Rodney
D'Arrigo, Daniel
Falge, Dorothy
Fenner, Richard
Hatalak, Susan
Hatch, Jolene
James, Laura
~~Jeffreys, Richard...................Learning Disabled/Math~~
Kyle, Valerie
Purtell, Michael
Quino, William
Randolph, Anna
Ruston, Blaire
~~Sherlock, Tammi.....................Visually Impaired~~

The instructor then consults the random number table in this appendix. He arbitrarily picks the ninth line in the number-table and sees the following string of numbers.

Fig. A-2: Line from random-number table

1 0 4 6 0 5 3 6 1 1 0 0 2 2 7 0 1 1 5 1 9 8 0 3

Seeing that the first number appearing in the series is "1," the teacher counts down one name from the top of the list. (When counting, he skips those names that have been omitted because they receive special-education services.) So beginning his count with "Accardo, Jonathon," the teacher counts down one name, stopping at "Bayne, Christopher." This student (Figure A-3) is selected as the first member of the norming group. The instructor returns to the number table and finds that the

Fig. A-3: Students are randomly chosen, using numbers from the random number-table

4th-grade Classroom 109 Ms. Norton

~~Abbott, Joseph......................Speech Impaired~~
Accardo, Jonathon
~~Bartholomay, Andrea.................Learning Disabled/Reading~~
Bayne, Christopher
Craig, Rodney
D'Arrigo, Daniel
Falge, Dorothy
Fenner, Richard
Hatalak, Susan
Hatch, Jolene
James, Laura
~~Jeffreys, Richard...................Learning Disabled/Math~~
Kyle, Valerie
Purtell, Michael
Quino, William
Randolph, Anna
Ruston, Blaire
~~Sherlock, Tammi.....................Visually Impaired~~

Counting off by numbers taken from the random-number table, the instructor chooses members of the norm group from the list of typical students.

next number is "0." He simply moves one digit to the right, finding the number "4." Once again, he counts down the list, coming to rest at "Fenner, Richard," who is included in the norm group. The process is repeated until the required number of students have been selected.

Random-number Table

7 2 2 7 1 2 8 3 1 6 3 4 5 4 2 4 0 3 7 5 4 1 6 1

1 9 1 8 7 1 2 2 4 6 6 6 7 2 8 8 2 4 3 2 1 3 5 0 1

8 4 3 2 5 4 1 0 9 2 8 3 8 4 0 2 2 7 5 0 2 6 9 6

4 1 6 8 1 8 6 5 7 7 2 1 1 8 0 3 1 4 2 0 3 5 4 0

8 1 5 5 7 9 4 8 7 4 2 8 8 5 4 2 1 6 7 5 6 6 8 4 9

1 2 8 4 3 2 0 8 1 5 5 8 0 1 1 2 1 5 4 9 4 4 4 3

1 2 5 1 0 5 4 4 2 9 3 7 1 7 9 3 0 2 7 2 5 2 9 9

5 1 5 5 0 8 9 5 6 9 0 4 6 3 8 6 9 5 9 5 4 7 6 2 9

1 0 4 6 0 5 3 6 1 1 0 0 2 2 7 0 1 1 5 1 9 8 0 3

6 1 3 3 2 4 6 4 5 1 4 7 3 0 5 0 7 5 7 5 6 3 9 0

1 8 3 6 4 9 7 9 9 8 5 9 1 8 6 2 3 7 8 4 1 0 9 9

3 5 6 3 7 8 1 4 8 2 9 2 5 3 8 3 4 1 9 9 3 9 1 3

8 7 2 7 4 4 4 5 9 2 0 7 0 0 7 8 9 2 1 6 5 7 0 7 6

2 9 0 4 3 8 6 3 3 9 7 5 1 2 1 3 1 9 8 6 2 9 3 3

1 3 6 3 1 7 2 8 7 1 8 4 6 4 3 8 9 3 3 0 9 9 1 4

0 6 5 7 2 5 7 0 2 4 8 7 8 1 6 7 7 7 2 3 4 5 7 4 9

6 9 8 2 7 5 1 7 8 9 0 2 0 8 1 8 0 7 2 8 8 1 9 5 0

9 2 5 8 2 4 1 0 3 2 3 5 7 7 0 8 3 5 3 2 6 9 8 9

3 4 0 4 7 8 9 2 5 4 2 9 1 6 2 6 7 7 9 3 6 9 8 8

9 9 6 9 7 4 0 1 4 0 7 6 8 6 3 7 9 9 8 3 6 7 1 3

9 5 3 6 5 1 4 1 3 6 7 3 3 0 9 6 0 0 5 4 8 4 5 6

4 1 0 7 6 6 8 9 5 7 4 9 6 4 2 8 6 4 2 4 0 9 2 2 9

APPENDIX B: CBM fluency charts based on research norms

The following charts present CBM research norms in reading, mathematics, and writing, as visual displays, representing ranges of student performance. They can be photocopied and used for completing survey-level assessments of individual students as outlined in Chapter 4.

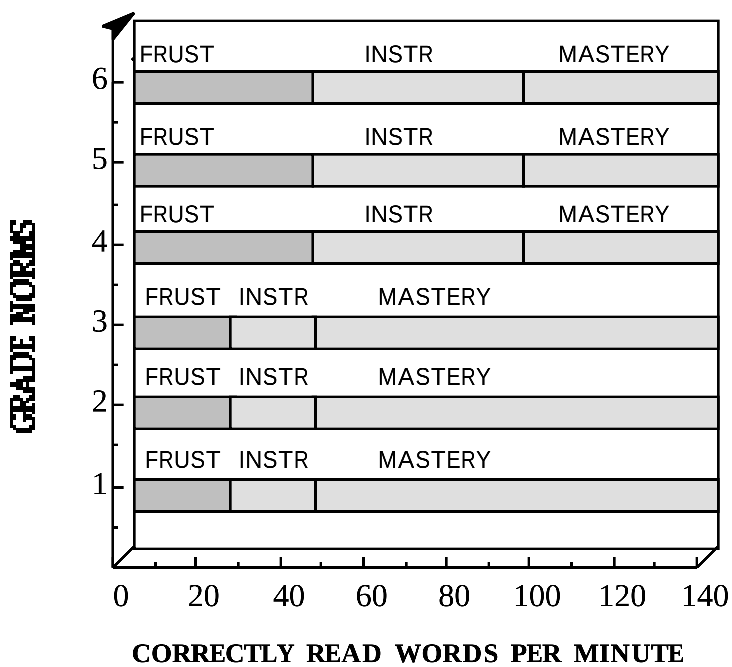
CURRICULUM-BASED MEASUREMENT
RESEARCH NORMS -- READING

Student Name_________________________________

School_____________ **Grade**________ **Room**_____

City Reading Level _____ **Basal Placement:** _____

CBM SURVEY-LEVEL READING ASSESSMENT--RESEARCH NORMS



Research norms from Deno, S.L., & Mirkin, P.K. (1977). Data-based program modification: A manual. Reston, VA: Council for Exceptional Children.

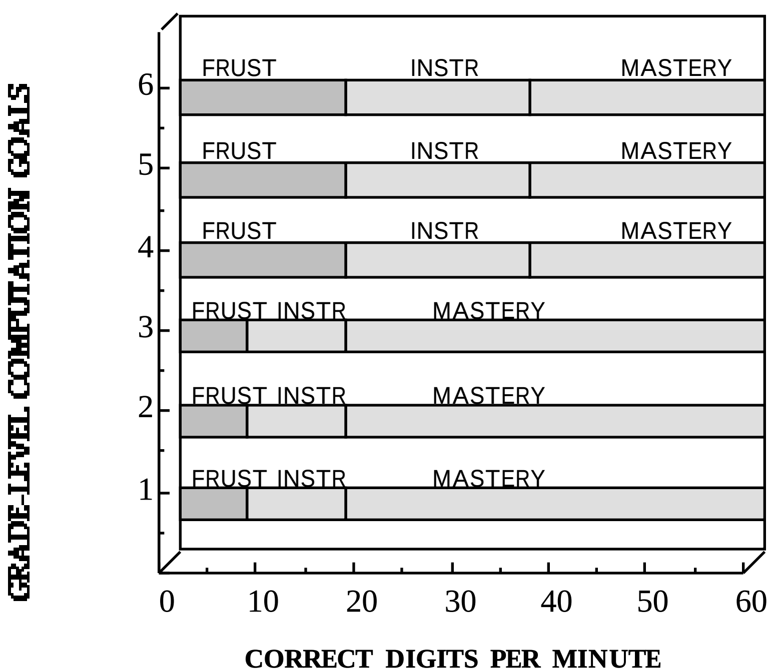
CURRICULUM-BASED MEASUREMENT
RESEARCH NORMS -- MATHEMATICS

Student Name___________________________________

School_____________ Grade_______ Room_____

City Math Level _____

CBM SURVEY-LEVEL MATH ASSESSMENT--RESEARCH NORMS



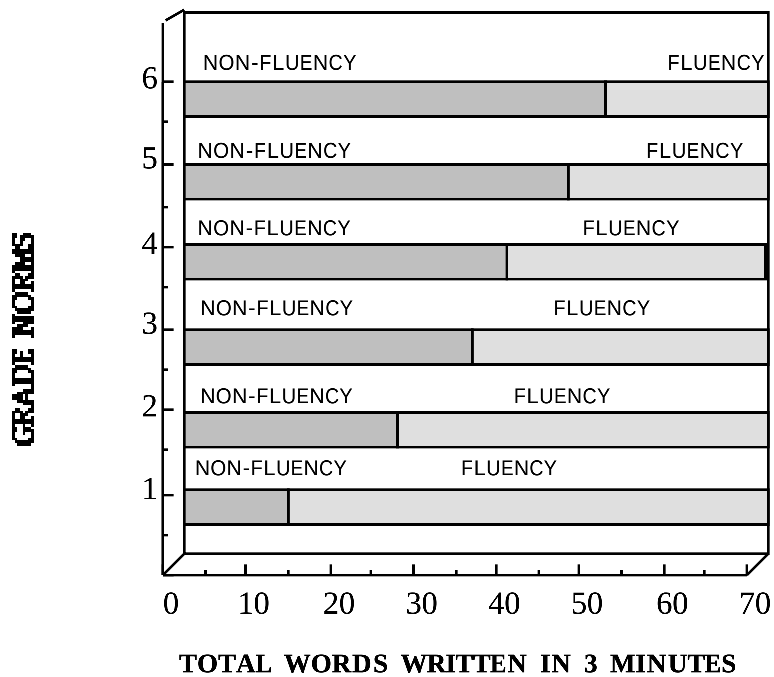
Research norms from Deno, S.L., & Mirkin, P.K. (1977). Data-based program modification: A manual. Reston, VA: Council for Exceptional Children.

CURRICULUM-BASED MEASUREMENT
RESEARCH NORMS -- WRITING

Student Name________________________________

School_____________ **Grade**_______ **Room**_____

CBM SURVEY-LEVEL WRITING ASSESSMENT--RESEARCH NORMS



Research norms from Mirkin,P.K., Deno, S.L., Fuchs, L., Wesson, C., Tindal, G., Marston, D., and Kuehnle, K. (1981) Procedures to develop and monitor progress on IEP goals. Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities.

APPENDIX C: Progress-monitoring charts for CBM

Six blank CBM progress-monitoring charts appear in this appendix. The charts differ both in the maximum number of academic behaviors that can be charted (50, 100, and 200) and the number of instructional weeks over which the monitoring will take place (10 and 20 weeks). Instructors may want to experiment with several charts to find those that best meet their needs.

50/10

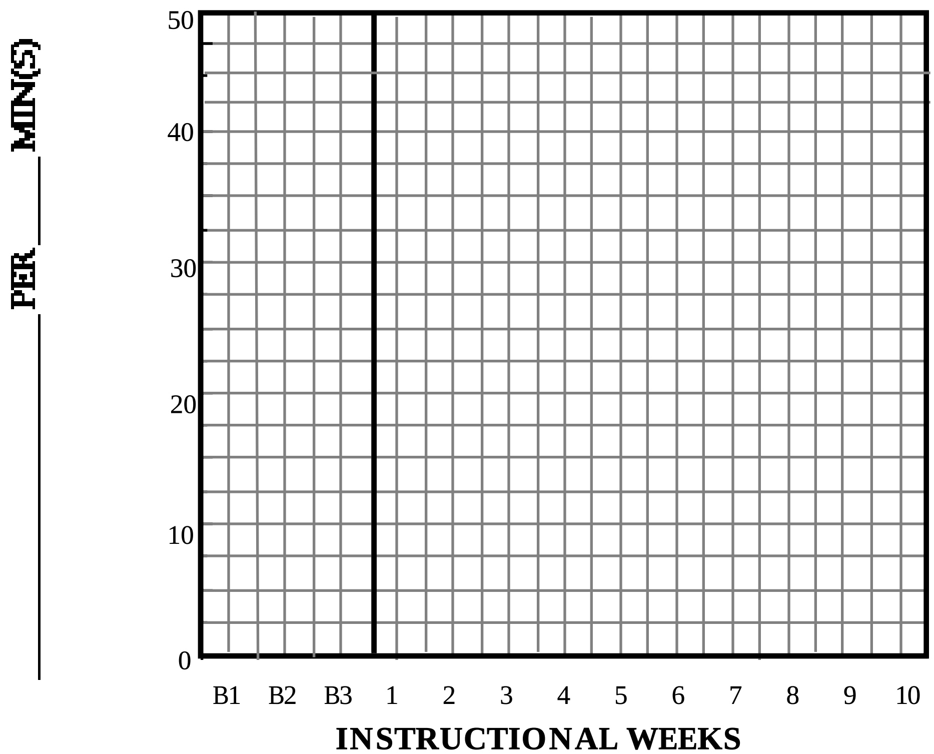
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name________________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

100/10

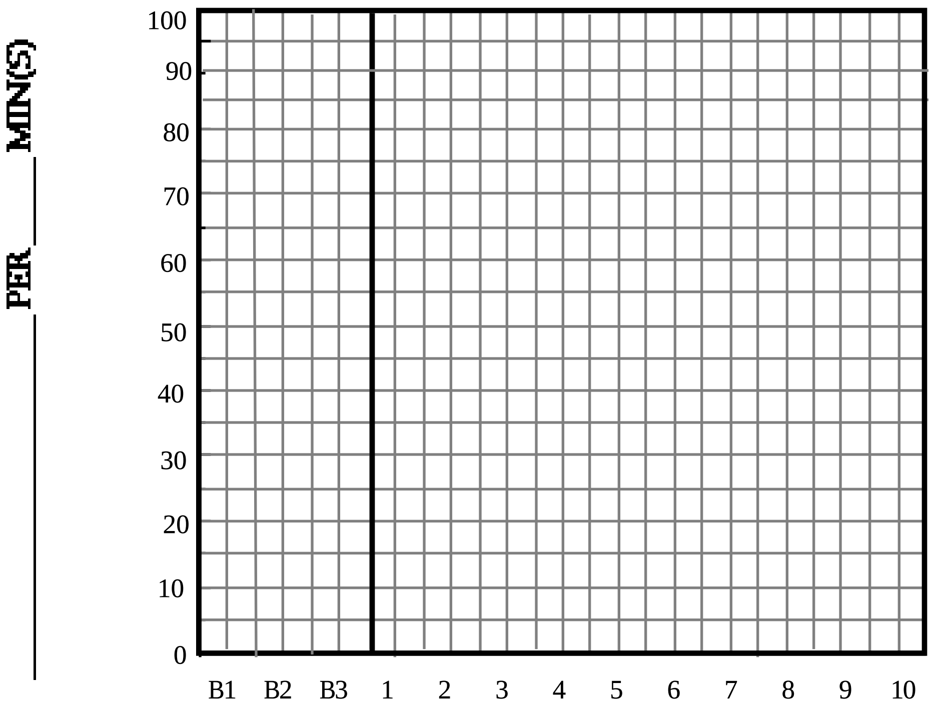
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name________________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



INSTRUCTIONAL WEEKS

Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

200/10

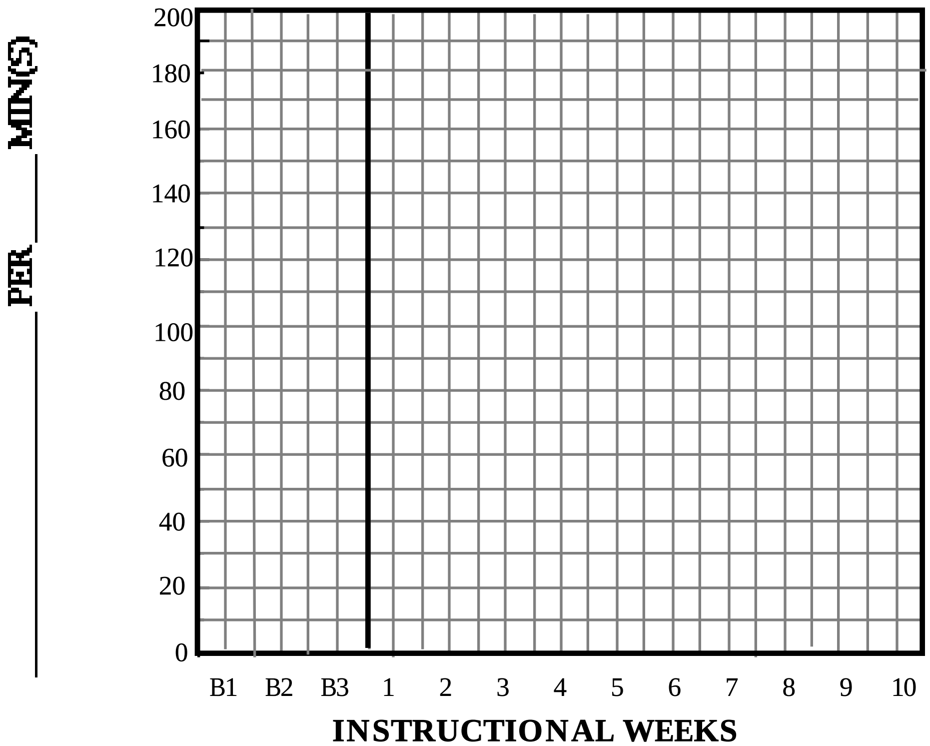
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name________________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

50/20

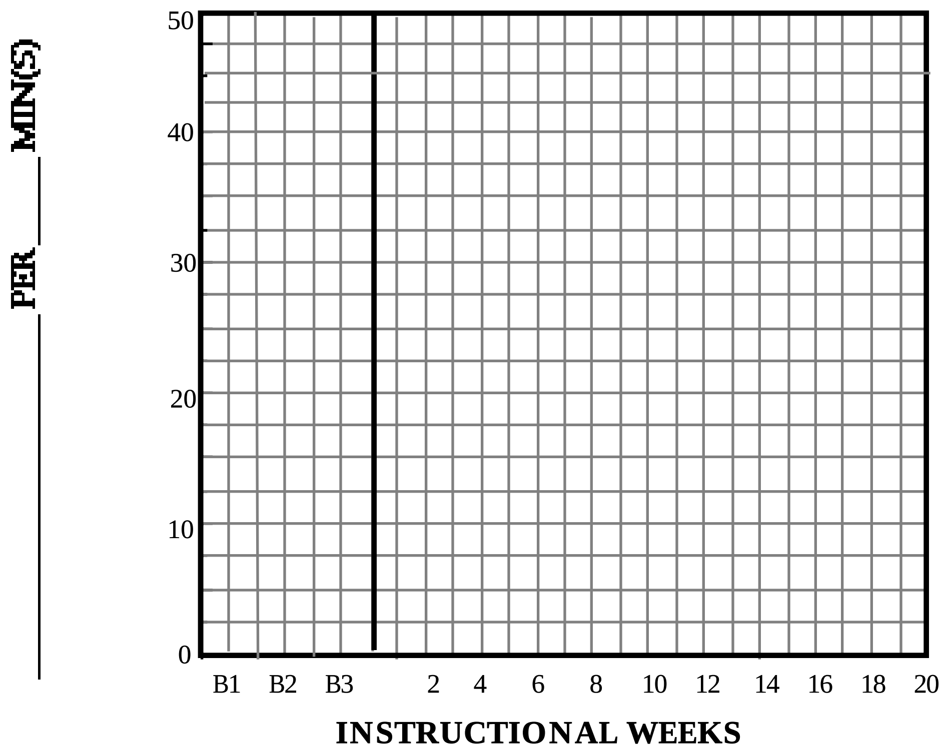
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name________________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

100/20

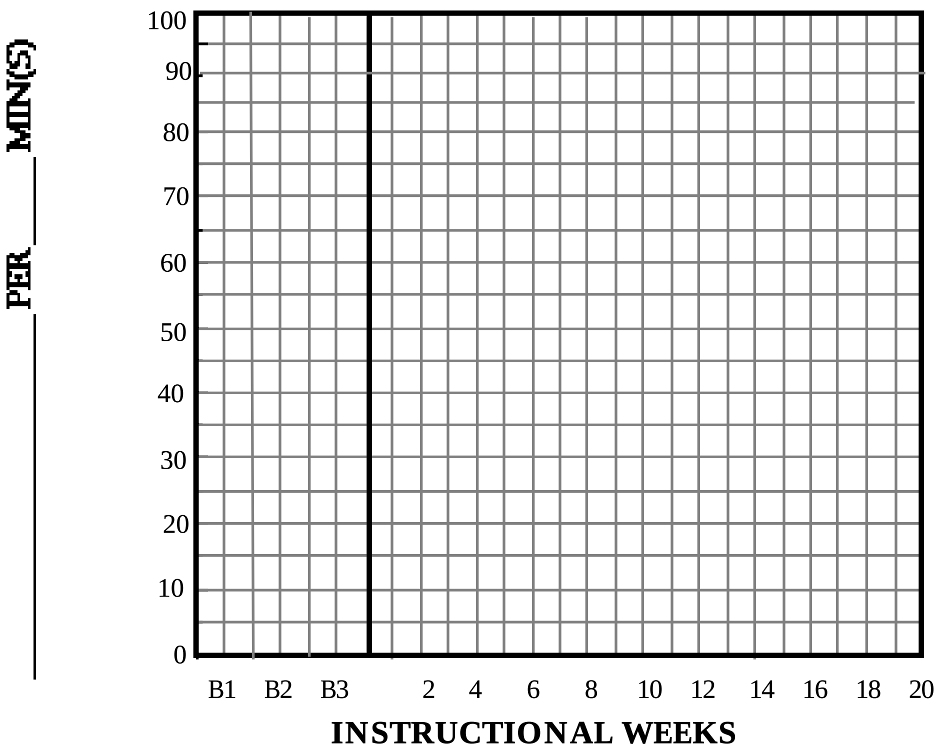
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name_______________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

200/20

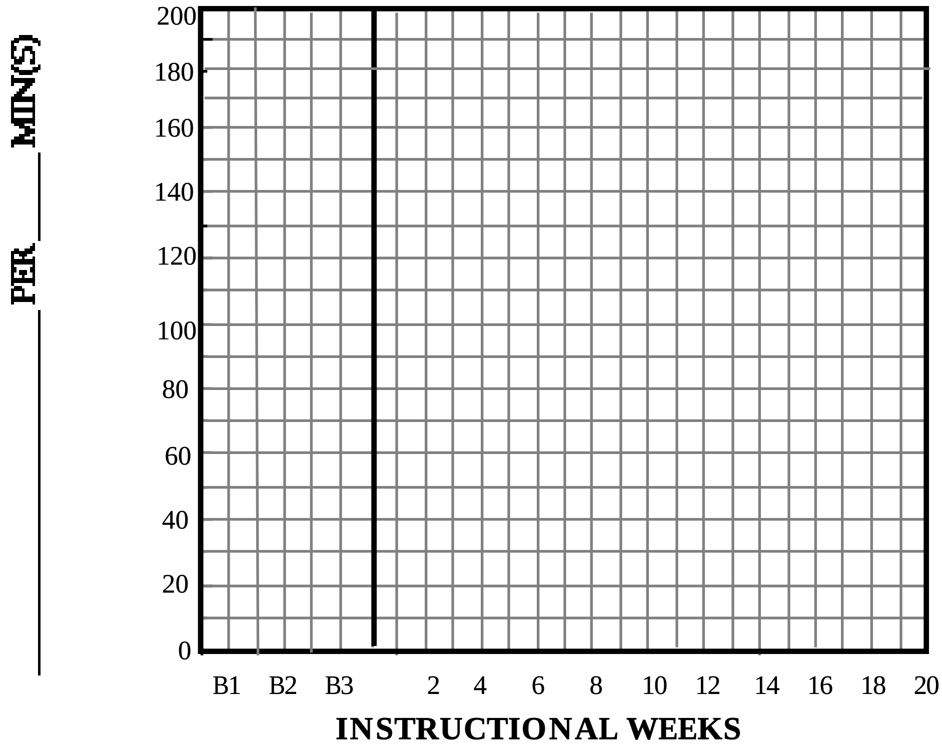
CURRICULUM-BASED MEASUREMENT DATA CHART

Student Name_________________________________

School_____________ **Grade**_______ **Room**_____

City Reading Level _____ **City Math Level:** _____

__ Reading
__Mathematics
__Spelling
__Writing



Data Table: Record CBM data in the table below prior to charting.

Week #	Date	CBM Data	Week #	Date	CBM Data	Week#	Date	CBM Data
B1	/ /			/ /			/ /	
B2	/ /			/ /			/ /	
B3	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	
	/ /			/ /			/ /	

APPENDIX D: List of computational goals

COMPUTATIONAL GOALS OF MATH CURRICULUM (ADAPTED FROM SHAPIRO, 1989)

The computational skills listed below are arranged in ascending order of difficulty. Please identify(1) the skills which you have instructed in the classroom, (2) the skills that the student has mastered, and (3) the skills with which the student is currently having difficulty.

MASTERED : Place a check under the M column indicating the skills which the student has mastered.

INSTRUCTED : Place a check under the I column indicating the skills which you have instructed.

DIFFICULTY : Place a check under the D column indicating the skills with which the student is having difficulty.

M	I	D	
			Grade 1
__	__	__	1. Add two one-digit numbers: sums to 10.
__	__	__	2. Subtract two one-digit numbers: combinations to 10.
			Grade 2
__	__	__	3. Add two one-digit numbers: sums 11 to 19.
__	__	__	4. Add a one-digit number to a two-digit number--no regrouping.
__	__	__	5. Add a two-digit number to a two-digit number--no regrouping.
__	__	__	6. Add a three-digit number to a three-digit number--no regrouping.
__	__	__	7. Subtract a one-digit number from a one- or two-digit number: combinations to 18.
__	__	__	8. Subtract a one-digit number from a two-digit number--no regrouping.
__	__	__	9. Subtract a two-digit number from a two-digit number--no regrouping.
__	__	__	10. Subtract a three-digit number from a three-digit number--no regrouping.
__	__	__	11. Multiplication facts--0's, 1's, 2's.
			Grade 3
__	__	__	12. Add three or more one-digit numbers.
__	__	__	13. Add three or more two-digit numbers--no regrouping.
__	__	__	14. Add three or more three- and four-digit numbers--no regrouping.
__	__	__	15. Add a one-digit number to a two-digit number with regrouping.
__	__	__	16. Add a two-digit number to a two-digit number with regrouping.
__	__	__	17. Add a two-digit number to a three-digit number with regrouping from the units to the tens column only.
__	__	__	18. Add a two-digit number to a three-digit number with regrouping from the tens to the hundreds column only.
__	__	__	19. Add a two-digit number to a three-digit number with regrouping from the units to the tens column and from the tens to the hundreds column.
__	__	__	20. Add a three-digit number to a three-digit number with regrouping from the units to the tens column only.
__	__	__	21. Add a three-digit number to a three-digit number with regrouping from the tens to the hundreds column only.

M	I	D	
__	__	__	22. Add a three-digit number to a three-digit number with regrouping from the units to the tens column and from the tens to the hundreds column.
__	__	__	23. Add a four-digit number to a four-digit number with regrouping in one to three columns.
__	__	__	24. Subtract two four-digit numbers-no regrouping.
__	__	__	25. Subtract a one-digit number from a two-digit number with regrouping.
__	__	__	26. Subtract a two-digit number from a two-digit number with regrouping.
__	__	__	27. Subtract a two-digit number from a three-digit number with regrouping from the units to the tens column only.
__	__	__	28. Subtract a two-digit number from a three-digit number with regrouping from the tens to the hundreds column only.
__	__	__	29. Subtract a two-digit number from a three-digit number with regrouping from the units to the tens column and from the tens to the hundreds column.
__	__	__	30. Subtract a three-digit from a three-digit number with regrouping from the units to the tens column only.
__	__	__	31. Subtract a three-digit number from a three-digit number with regrouping from the tens to the hundreds column only.
__	__	__	32. Subtract a three-digit number from a three-digit number with regrouping from the units to the tens column and from the tens to the hundreds column.
__	__	__	33. Multiplication facts--3 to 9.

Grade 4

M	I	D	
__	__	__	34. Add a five- or six-digit number to a five- or six-digit number with regrouping in any columns.
__	__	__	35. Add three or more two-digit numbers with regrouping.
__	__	__	36. Add three or more three-digit numbers with regrouping with regrouping in any columns.
__	__	__	37. Subtract a five- or six-digit number from a five- or six-digit number with regrouping in any columns.
__	__	__	38. Multiply a two-digit number by a one-digit number with no regrouping.
__	__	__	39. Multiply a three-digit number by a one-digit number with no regrouping.
__	__	__	40. Multiply a two-digit number by a one-digit number with no regrouping.
__	__	__	41. Multiply a three-digit number by a one-digit number with regrouping.
__	__	__	42. Division facts--0 to 9.
__	__	__	43. Divide a two-digit number by a one-digit number with no remainder.
__	__	__	44. Divide a two-digit number by a one-digit number with remainder.
__	__	__	45. Divide a three-digit number by a one digit number with remainder.
__	__	__	46. Divide a four-digit number by a one-digit number with remainder.

M	I	D	Grade 5
__	__	__	47. Multiply a two-digit number by a two-digit number with regrouping.
__	__	__	48. Multiply a three-digit number by a two-digit number with regrouping.
__	__	__	49. Multiply a three-digit number by a three-digit number with regrouping.

List of computational goals taken from Shapiro, Edward S. (1989). Academic skills problems: Direct assessment and intervention. New York: Guilford Press.

APPENDIX E: Record form for CBM reading fluency

The record form in this section may be used by instructors to keep an accurate record of children's reading fluency, number of errors, and accuracy in decoding on CBM reading probes. Consult page 2-8 of this manual for an example of a completed record form.

CBM Reading-Fluency Recording Sheet

Student Name____________________ Grade/Unit________________

Reading Level_____________ Current Basal Placement_______

Basal Number:_______ Date________

	Correctly Read Words	Errors	Percent Accuracy
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______

Basal Number:_______ Date________

	Correctly Read Words	Errors	Percent Accuracy
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______

Basal Number:_______ Date________

	Correctly Read Words	Errors	Percent Accuracy
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______
Story Name:___________________	_________	_____	______

APPENDIX F: Suggestions for further reading

Instructors who are interested in knowing more about curriculum-based measurement and related direct-assessment approaches are encouraged to consult the following books:

Shinn, Mark R. (Ed.) (1989). Curriculum-based measurement: Assessing special children. New York: Guilford Press.

Shapiro, Edward S. (1989). Academic skills problems: Direct assessment and intervention. New York: Guilford Press.

The sampling of articles listed below provides additional general information about CBM and its use in regular and special education classrooms.

Deno, S.L. (1985). Curriculum-based measurement: The emerging alternative. Exceptional Children, 52, 219-232.

Deno, S.L. & Fuchs, Lynn S. (1987). Developing curriculum-based measurement systems for data-based special education problem solving. Focus on Exceptional Children, 19 (8) 1-16.

Fuchs, L.S. & Fuchs, D. (1986). Curriculum-based assessment of progress toward long-term and short-term goals. The Journal of Special Education, 20, 69-82.

Fuchs, D., Fuchs, L., Benowitz, S., & Barringer, K. (1987). Norm-referenced tests: Are they valid for use with handicapped students? Exceptional Children, 54, 263-271.

Fuchs, L. S., Deno, S.L., & Mirkin, P.K. (1984). The effects of frequent curriculum-based measurement and evaluation on pedagogy, student achievement, and student awareness of learning. American Educational Research Journal, 21, 449-460.

Fuchs, L.S. & Deno, S.L. (1991). Paradigmatic distinctions between instructionally relevant measurement models. Exceptional Children, 57, 488-500.

Fuchs, L.S. & Deno, S.L. (1992). Effects of curriculum within curriculum-based measurement. Exceptional Children, 58, 232-243.

Further reading

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