



Curriculum-Based Measurement: A Manual for Teachers

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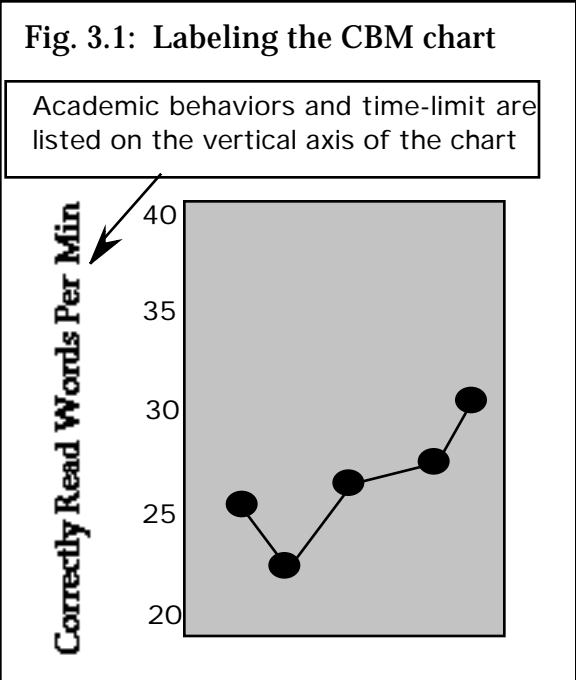
3 | Charting & Interpreting CBM Data

Introduction

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.

Setting up the CBM chart

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 see 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

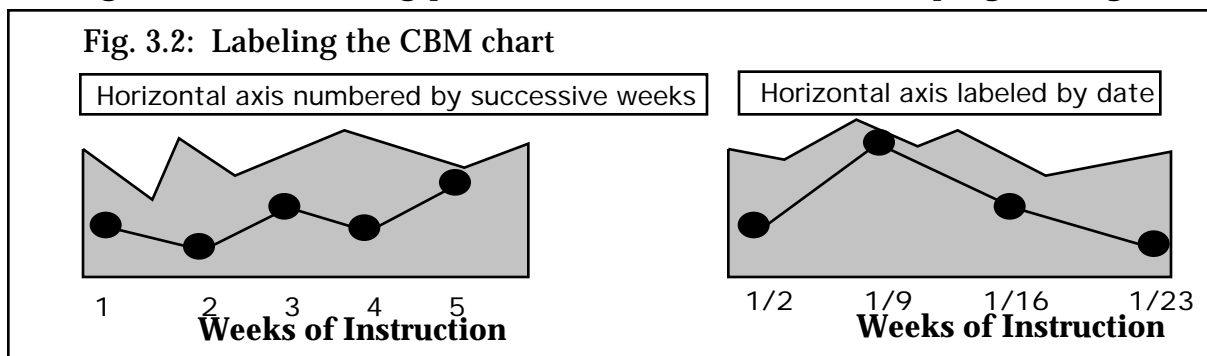


must decide what type(s) of academic behaviors are being measured. In addition to behaviors, the instructor will want to include the time-limit of the CBM probe used to collect the data. For example, a chart may measure 'correctly read words per minute' since that represents both the type of behavior 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

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

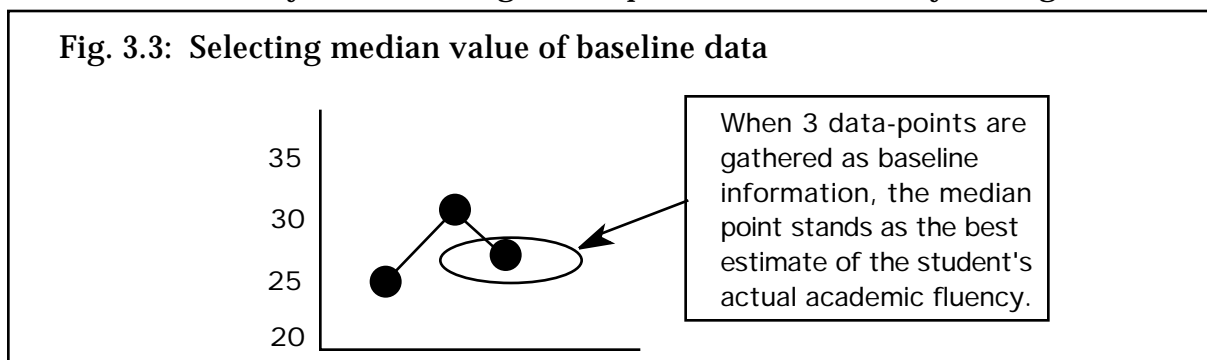
Next, the instructor chooses the number of instructional weeks over which CBM data will be graphed. For regular-education students, the instructor may vary the length of the monitoring-period to match their educational program (e.g., 10



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



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 each week 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

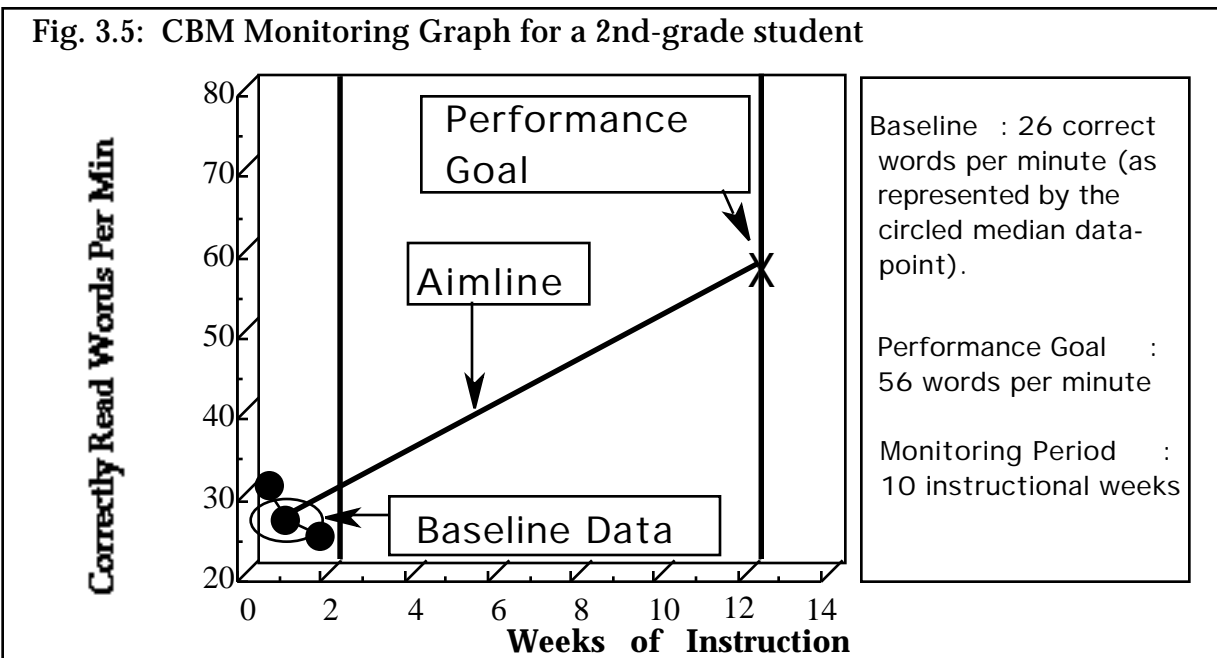
Performance goal = 56 words per minute by the end of 10 instructional weeks

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.

Charting an aimline

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.



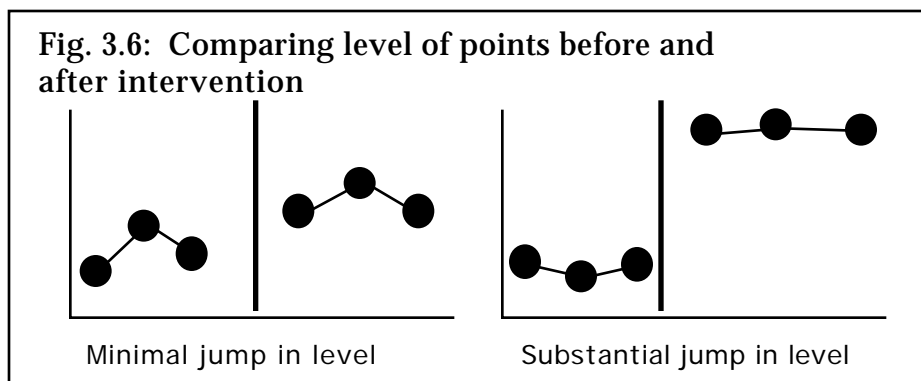
The sample CBM reading chart above displays baseline data, performance goal and aimline for a 2nd-grade student.

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

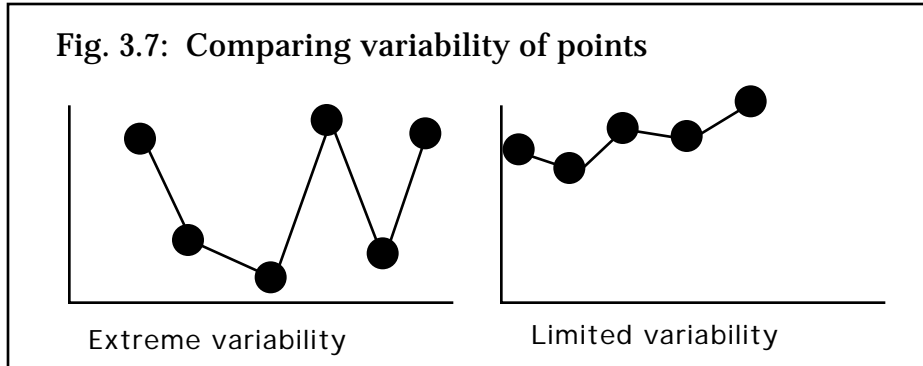
The teacher looks at the average "level" at which data-points are clustered on the graph both before and after a program change has been put into place. If the



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

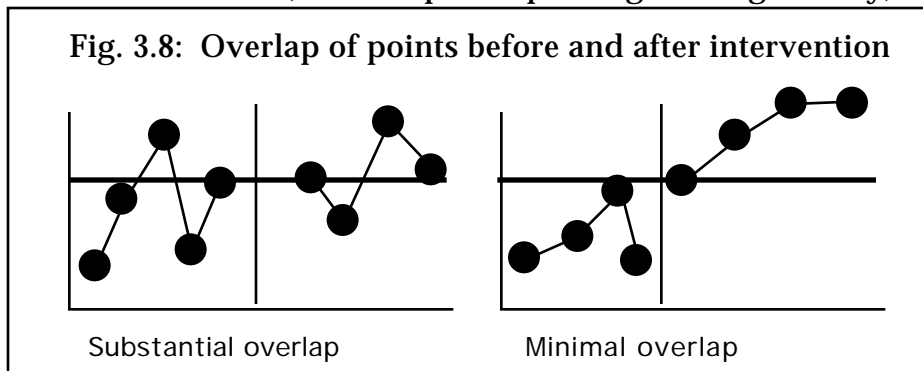
Instructors would prefer that a program change bring about a stable, steady improvement in the student's academic behaviors. This pattern of consistent progress is evident when data-points on the graph are relatively tightly



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



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.

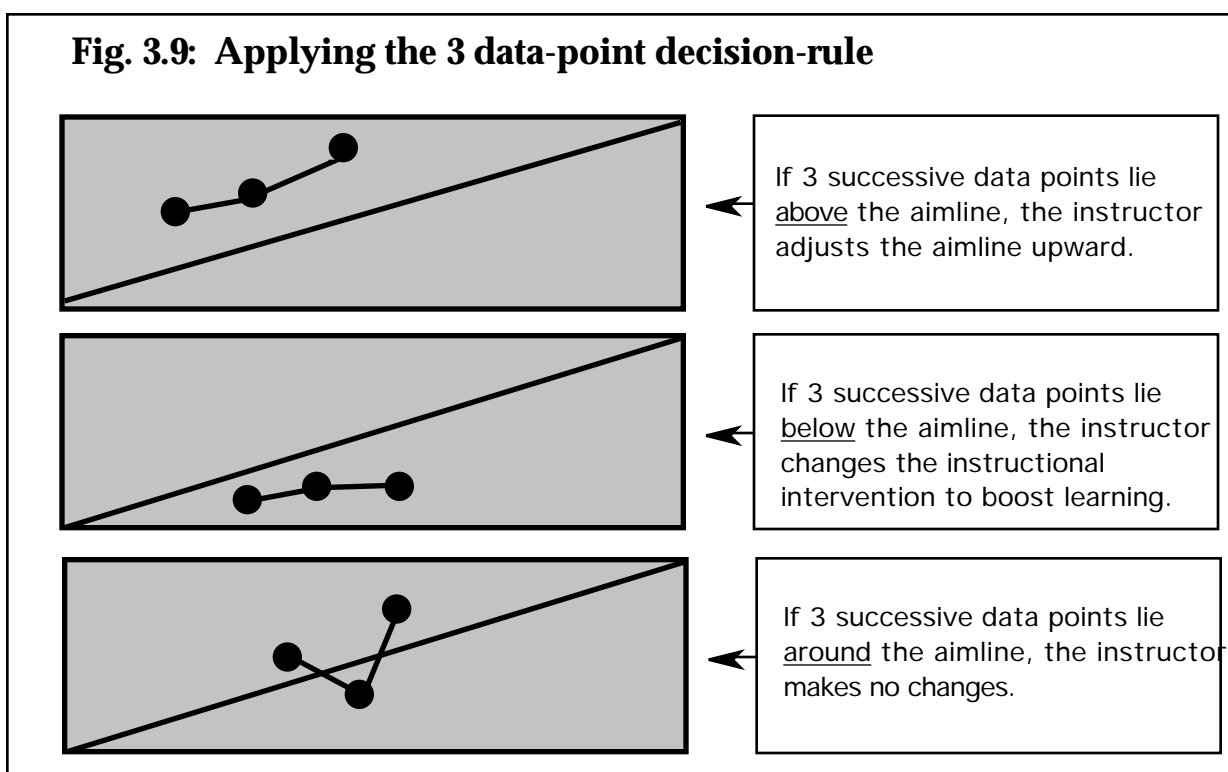
Evaluating data: Formal procedures

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.



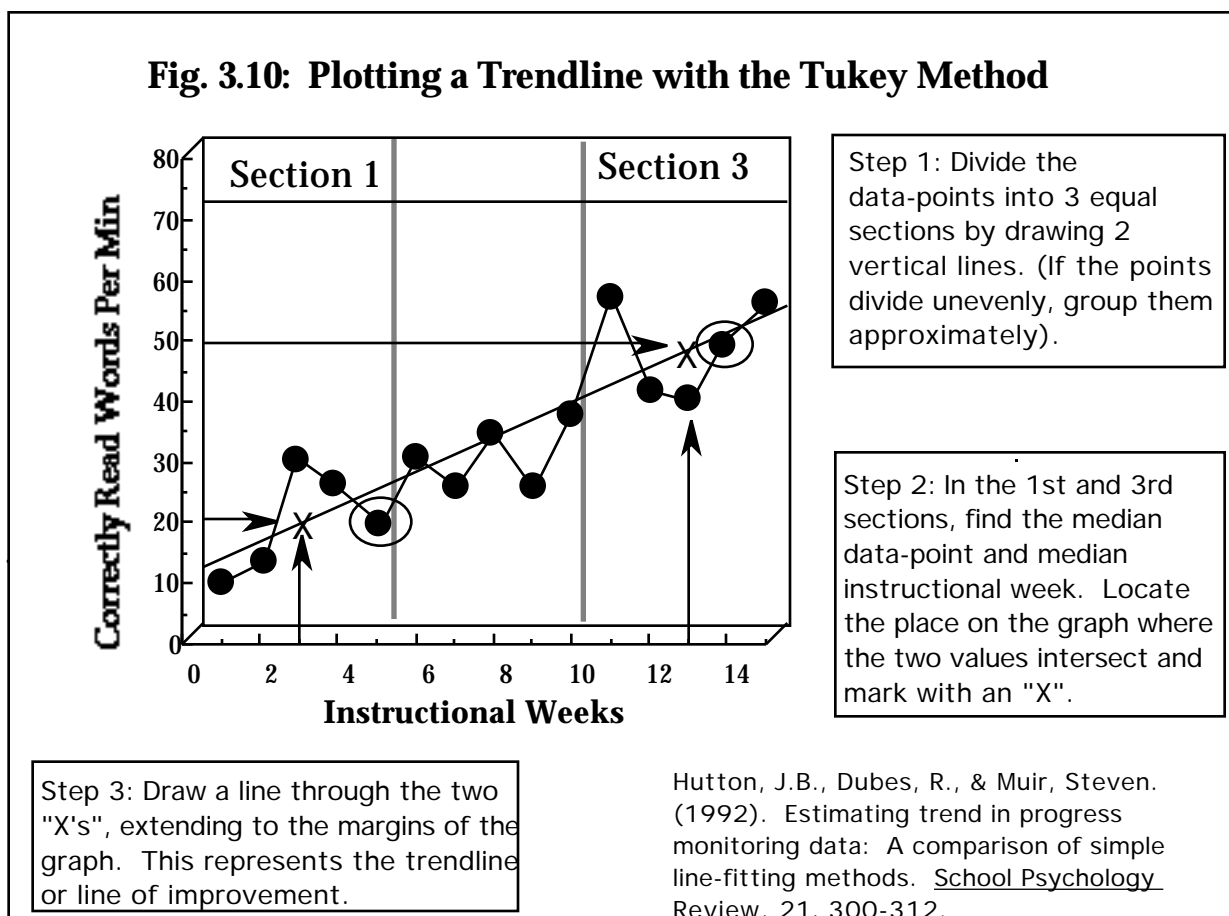
Plotting a trendline using the Tukey method

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 first and third 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.



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.

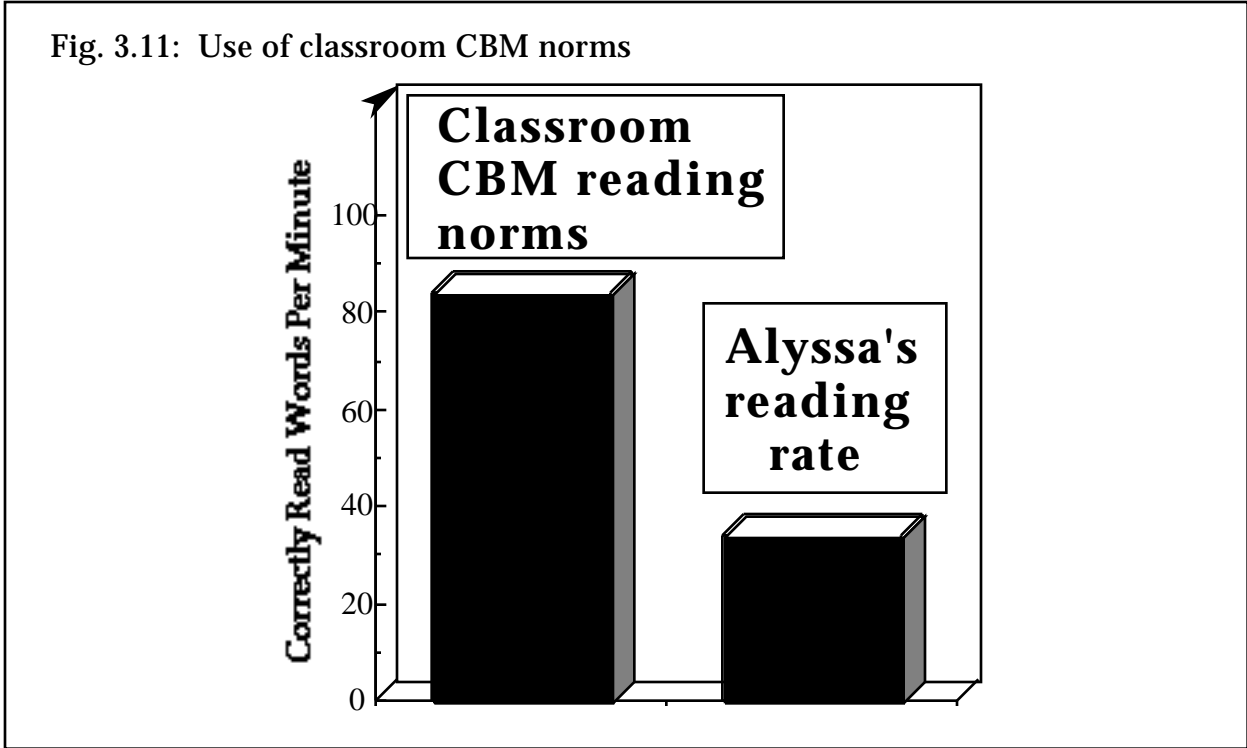
Interpreting CBM data: The case of Alyssa

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.



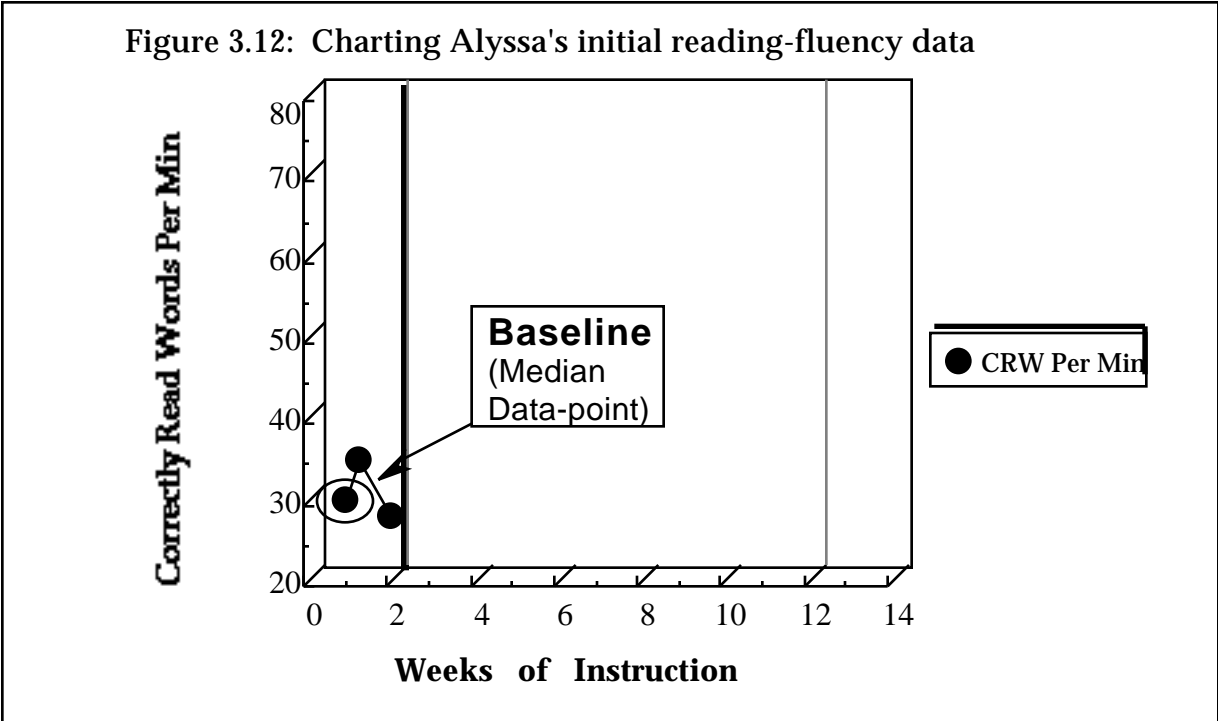
Before she can determine how delayed Alyssa's reading skills are in comparison to those of classmates, Alyssa's teacher decides that she first needs to obtain a grade-appropriate standard of reading fluency. So the teacher gathers CBM norms in reading in her classroom. She finds that, on the average, 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. This 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



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.

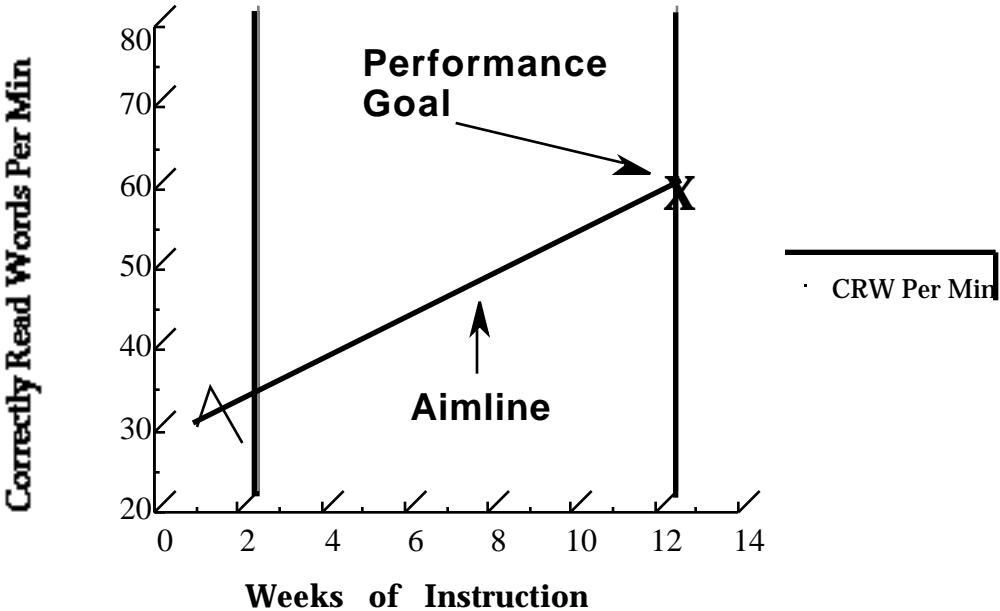
Step 4: Setting a performance goal

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.

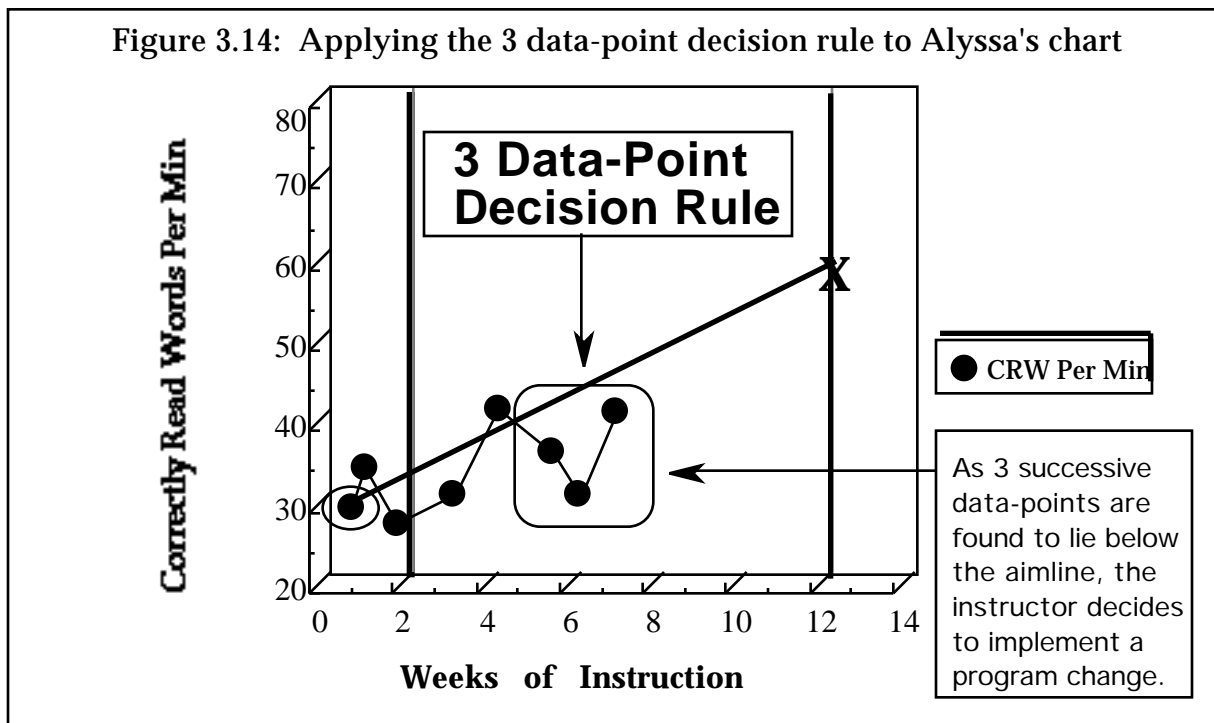
Step 6: Tracking academic growth through CBM

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.

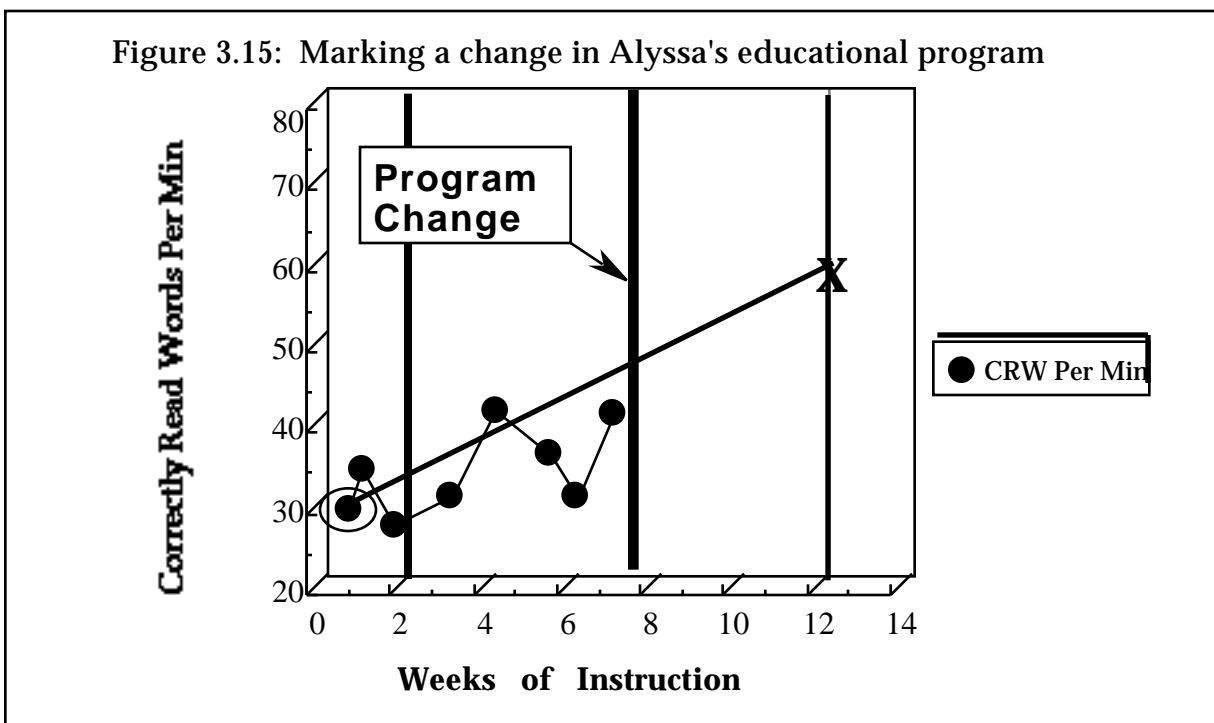
Step 7: Interpreting charted data

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.



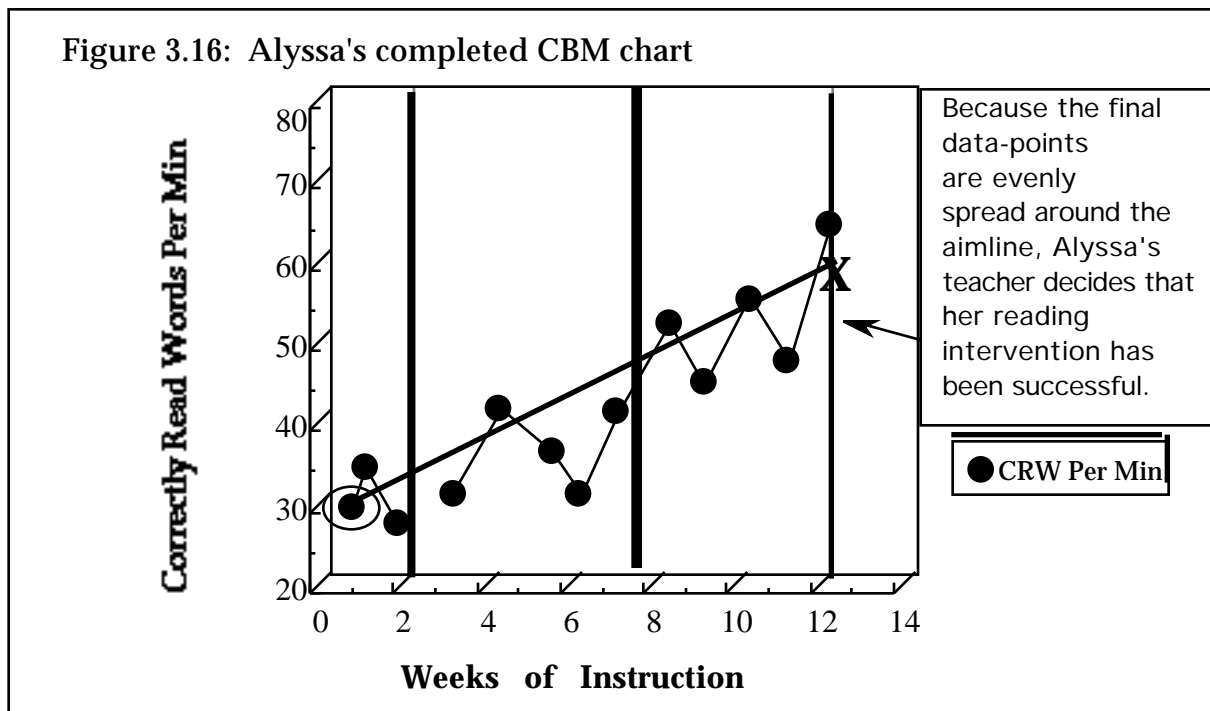
On Alyssa's chart, her teacher places a heavy line to mark the program change that she has put into place. The marking of program changes on a CBM chart makes it



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 after 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



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.

Summary

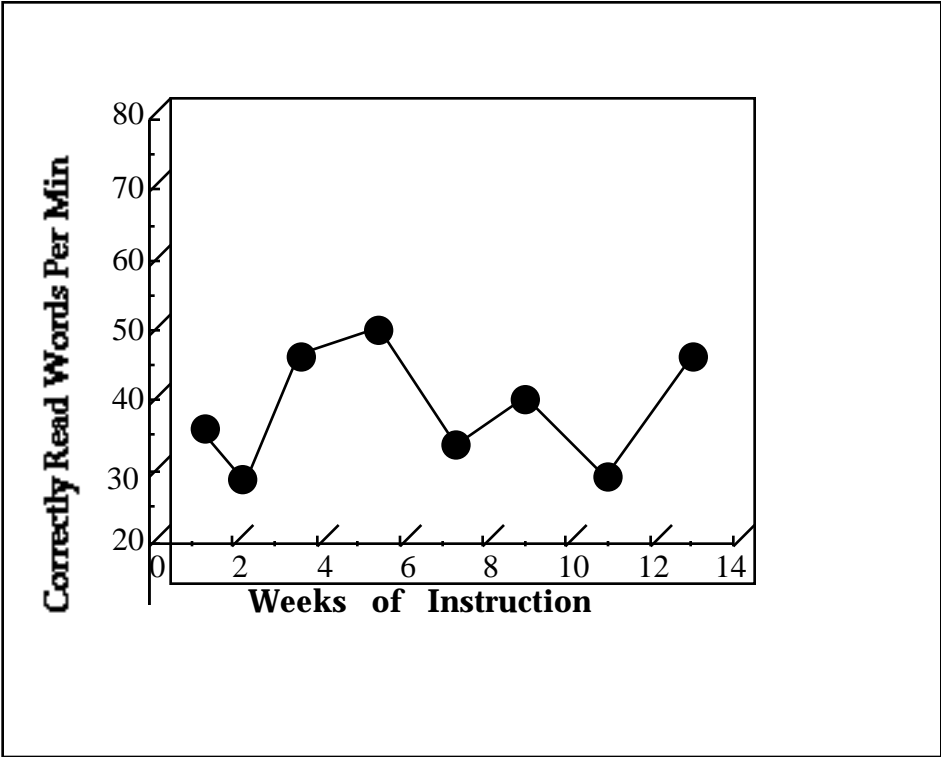
CBM data gathered over time can be charted to provide a visual record of the child's relative rate of progress. In preparing a graph for progress-monitoring, the vertical axis is labeled according to the academic behavior to be measured and the time limit for the probe. The horizontal axis is labeled 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,

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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.



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