Formative Assessment Overview

Specific Assessment Tools in Literacy and Behavior: Supplemental Resources

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Workshop PowerPoints available at:
http://www.interventioncentral.org/SETRC.php

Excerpt from Wright, J. (1992). *Curriculum-based measurement: A manual for teachers*. Retrieved on September 9, 2008, from http://www.jimwrightonline.com/pdfdocs/cbaManual.pdf

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?

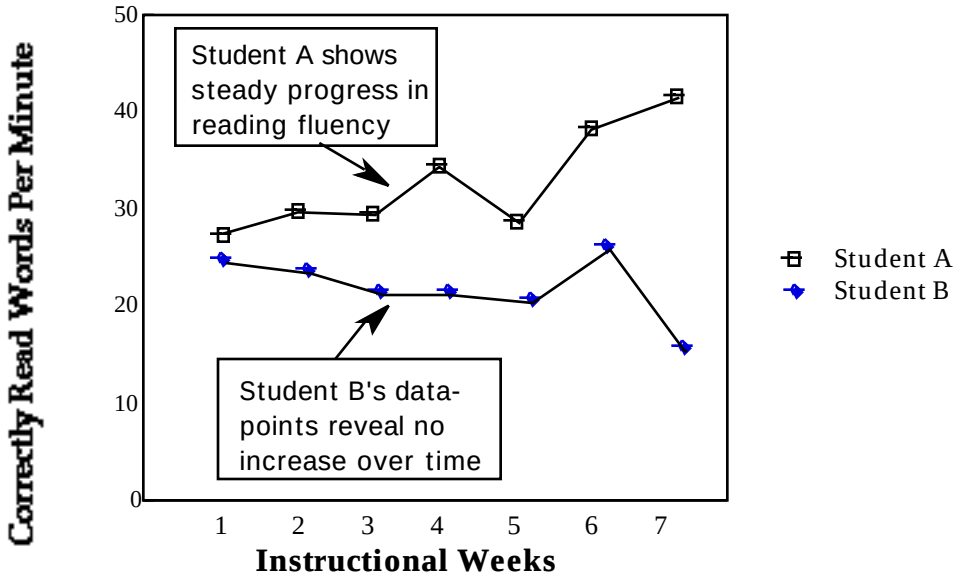
A: Instructors are faced with a central problem: they cannot predict with complete assurance that a particular instructional intervention will be effective with a selected student. The truth is that only through careful observation and data gathering can teachers know if a child's educational program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

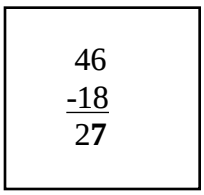
More traditional approaches to scoring computational math problems usually give credit for the total number of correct answers appearing on a worksheet. In contrast to this all-or-nothing marking system, CBM assigns credit to each individual correct digit appearing in the solution to a math fact. By 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:

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

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.



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.

Sample Literacy Probes: Created using tools from 'Curriculum-Based Measurement Warehouse':

http://www.interventioncentral.org/htmdocs/interventions/cbmwarehouse.php

- Oral Reading Fluency
- Word List
- Letter Identification

Curriculum-Based Assessment Reading Probe: Examiner Copy

Title: *Roughing It*

Author: *Mark Twain*

Total Rd Wds:_____|#Errors: ___|Correct.Rd Wds:_____|%Correct.Rd Wds:____

Total Words in Sample: ***195*** Total Sentences in Sample: ***10***
Average Number of Words Per Sentence: ***19.5***
Words Not Matched to Dale Familiar 3000-Word List: ***14***
Percentage of Words Not Matched to Dale Familiar 3000-Word List: ***7.17***
Dale-Chall Readability Index: ***5.73*** *Raw Score;* ***5-6th*** *Grade Level*

After breakfast, at some station whose	6
name I have forgotten, we three climbed	13
up on the seat behind the driver, and let	22
the conductor have our bed for a nap. And	31
by and by, when the sun made me drowsy, I	41
lay down on my face on top of the coach,	51
grasping the *slender* iron railing, and	57
slept for an hour or more. That will give	66
one an *appreciable* idea of those	72
matchless roads. *Instinct* will make a	78
sleeping man *grip* a fast hold of the	86
railing when the stage *jolts,* but when it	94

only swings and *sways,* no *grip* is	101
necessary. Overland drivers and	105
conductors used to sit in their places	112
and sleep thirty or forty minutes at a	120
time, on good roads, while spinning along	127
at the rate of eight or ten miles an	136
hour. I saw them do it, often. There was	145
no danger about it; a sleeping man will	153
seize the irons in time when the coach	161
jolts. These men were hard worked, and it	169
was not possible for them to stay awake	177
all the time. By and by we passed through	186
Marysville, and over the Big Blue and	193
Little Sandy.	195

Dale-Chall Readability Formula for This Passage =
(**0.0496 *** *19.5* **Avg. Number of Words Per Sentence) +**
(0.1579 * *7.17* **Percent of Words in Sample Not Found on Dale Familiar Word List)**
+
3.6365 = *5.73* **Raw Score** = ***5-6th*** *Grade Level*

Click for Student Worksheet

Curriculum-Based Assessment Wordlist: Student Copy

Student: Date: _____

Class: Correct Items:_____

_____ Total Items Attempted:_____

with	at	wish	big
how	much	yes	not
does	round	up	they
brown	been	myself	wash
new	its	pretty	walk
all	too	once	so
put	hurt	very	and
far	old	said	where
pick	three	want	off
then	those	both	to
you	but	she	no
from	fast	please	was

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Curriculum-Based Assessment Wordlist: Student Copy

Student: Date: _____

Class: Correct Items:_____ Total Items _____ Attempted:_____

a	R	O	e
Z	Y	U	c
y	b	A	F
V	G	W	N
H	E	K	r
u	q	l	d
x	t	z	o
M	P	T	f
w	m	k	Q
J	C	g	l
i	n	S	X
p	s	v	j

www.interventioncentral.org

Daily Behavior Report Cards (2006). Retrieved on September 4, 2008, from http://www.interventioncentral.org/htmdocs/interventions/behavior/behrptcd.php

Daily Behavior Report Cards: A Convenient Behavior Monitoring Tool

Daily Behavior Report Cards (DBRCs) are behavior rating forms that teachers use to evaluate the student's global behaviors on a daily basis or even more frequently. An advantage of DBRCs is that these rating forms are quick and convenient for the teacher to complete. This section contains daily and weekly versions of a generic DBRC, as well as a progress-monitoring chart to record cumulative DBRC ratings.

Increasing the Reliability of DBRCs. DBRCs rely heavily on teacher judgment and therefore can present a somewhat subjective view of the student's behavior. When a teacher's ratings on DBRCs are based on subjective opinions, there is a danger that the teacher will apply inconsistent standards each day when rating student behaviors. This inconsistency in assessment can limit the usefulness of report card data. One suggestion that teachers can follow to make it more likely that their report card ratings are consistent and objective over time is to come up with specific guidelines for rating each behavioral goal. For example, one item in the sample DBRC included in this section states that *"The student spoke respectfully and complied with adult requests without argument or complaint."* It is up to the teacher to decide how to translate so general a goal into a rubric of specific, observable criteria that permits the teacher to rate the student on this item according to a 9-point scale. In developing such criteria, the instructor will want to consider:

- *taking into account student developmental considerations.* For example, "Without argument or complaint" may mean "without throwing a tantrum" for a kindergarten student but mean "without loud, defiant talking-back" for a student in middle school.

- *tying Report Card ratings to classroom behavioral norms.* For each behavioral goal, the teacher may want to think of what the typical classroom norm is for this behavior and assign to the classroom norm a specific number rating. The teacher may decide, for instance, that the target student will earn a rating of 7 ('Usually/Always') each day that the student's compliance with adult requests closely matches that of the 'average' child in the classroom.

- *developing numerical criteria when appropriate.* For some items, the teacher may be able to translate certain more general Report Card goals into specific numeric ratings. If a DBRC item rates a student's compliance with adult requests, for example, the teacher may decide that the student is eligible to earn a rating of 7 or higher on this item on days during which instructional staff had to approach the student no more than once about noncompliance.

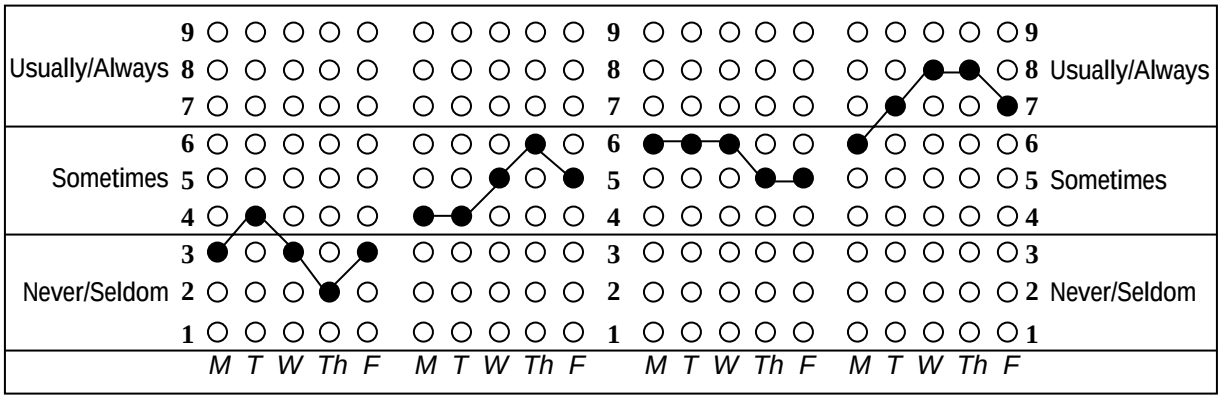
Charting Report Card Ratings. Daily Behavior Report Card ratings can be charted over time to provide a visual display of the student's progress toward behavioral goals. The sample DBRC (daily and weekly versions) included in this section has its own progress-monitoring chart, which permits the teacher to graph student behavior for up to 4 school weeks. The instructor simply fills in the bubble each day that matches the numerical rating that he or she assigned to the student for the specific behavioral goal. As multiple points are filled in on the graph, the instructor connects those points to create a time-series progress graph. (Figure 1 contains an example of a completed progress-monitoring chart.) When enough data points have been charted, the behavior graph can be used to judge the relative effectiveness of any strategies put in place to improve the student's behavior.

Using DBRCs as a Self-Monitoring Intervention. DBRCs are primarily used as a behavior-monitoring tool. However, teachers may also choose to use DBRCs as part of a student self-monitoring program, in which the student rates their own behaviors each day. If teachers decide to use student behavior report cards for self-monitoring, they should first identify and demonstrate for the student the behaviors that the

student is to monitor and show the student how to complete the behavior report card. Since it is important that the student learn the teacher's behavioral expectations, the instructor should meet with the student daily, ask the student to rate their own behaviors, and then share with the student the *teacher's* ratings of those same behaviors. The teacher and student can use this time to discuss any discrepancies in rating between their two forms. (If report card ratings points are to be applied toward a student reward program, the teacher might consider allowing points earned on a particular card item to count toward a reward *only* if the student's ratings fall within a point of the teacher's, to encourage the student to be accurate in their ratings.)

Figure 1: Example of completed DBRC progress-monitoring form

During instructional periods, the student focused his or her attention on teacher instructions, classroom lessons and assigned work.



Daily Classroom Behavior Report Card

Student: _____	Date: _____
Teacher: _____	Classroom: _____

Directions: Review each of the Behavior Report Card items below. For each item, rate the degree to which the student showed the behavior or met the behavior goal.

During instructional periods, the student focused his or her attention on teacher instructions, classroom lessons and assigned work.

Circle the degree to which the student met the behaviora goal:

1 2 3 | 4 5 6 | 7 8 9

Never/Seldom — Sometimes — Usually/Always

The student interacted with classmates appropriately and respectfully.

Circle the degree to which the student met the behaviora goal:

1 2 3 | 4 5 6 | 7 8 9

Never/Seldom — Sometimes — Usually/Always

The student completed and turned in his or her assigned class work on time.

Circle the degree to which the student met the behaviora goal:

1 2 3 | 4 5 6 | 7 8 9

Never/Seldom — Sometimes — Usually/Always

The student spoke respectfully and complied with adult requests without argument or complaint.

Circle the degree to which the student met the behaviora goal:

1 2 3 | 4 5 6 | 7 8 9

Never/Seldom — Sometimes — Usually/Always

Weekly Classroom Behavior Report Card

Student: _____

Teacher: _____ Classroom: _____

Directions: Review each of the Behavior Report Card items below. For each item, rate the degree to which the student showed the behavior or met the behavior goal.

Date	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__
Behavioral Target	**M**	**T**	**W**	**Th**	**F**
During instructional periods, the student focused his or her attention on teacher instructions, classroom lessons and assigned work. Select the degree to which the goal was met: 1...2...3...|4...5...6...|7...8...9 Never/Seldom Sometimes Usually/Always	____ Pts	____ Pts	____ Pts	____ Pts	____ Pts
The student interacted with classmates appropriately and respectfully. Select the degree to which the goal was met: 1...2...3...|4...5...6...|7...8...9 Never/Seldom Sometimes Usually/Always	____ Pts	____ Pts	____ Pts	____ Pts	____ Pts
The student completed and turned in his or her assigned class work on time. Select the degree to which the goal was met: 1...2...3...|4...5...6...|7...8...9 Never/Seldom Sometimes Usually/Always	____ Pts	____ Pts	____ Pts	____ Pts	____ Pts
The student spoke respectfully and complied with adult requests without argument or complaint. Select the degree to which the goal was met: 1...2...3...|4...5...6...|7...8...9 Never/Seldom Sometimes Usually/Always	____ Pts	____ Pts	____ Pts	____ Pts	____ Pts

Classroom Behavior Report Card

Excerpt from Wright, J. (2007). *RTI toolkit: A practical guide for schools.* Port Chester, NY: National Professional Resources, Inc.

Setting Up and Interpreting Time-Series Charts

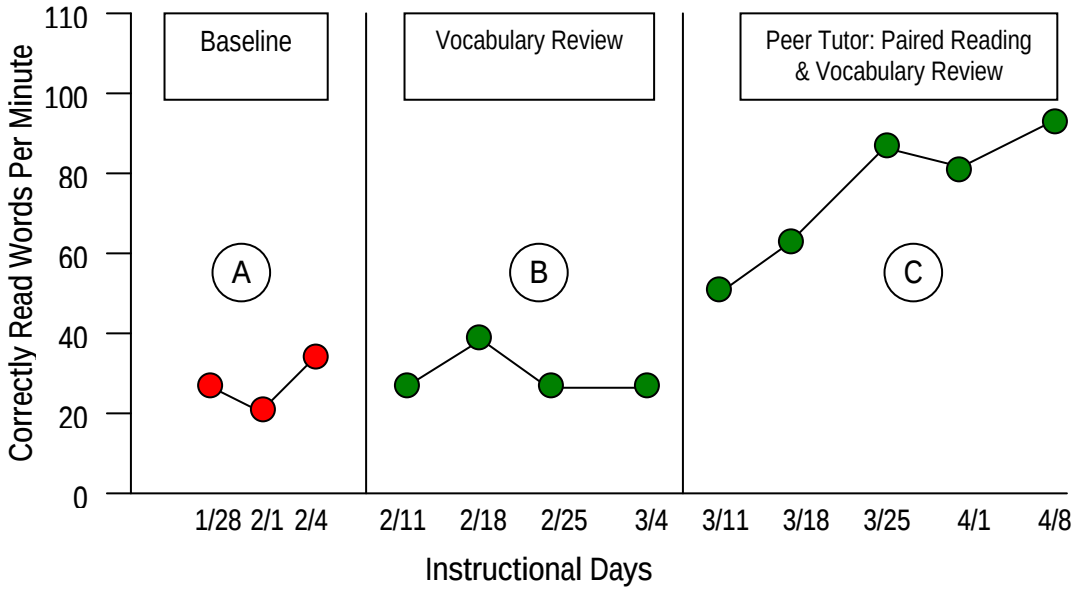
Response to Intervention requires that schools collect data on student progress over time to demonstrate whether an academic or behavioral intervention is working. It is much easier to see the student's overall rate of progress when data are converted to a visual display. The *time-series chart* is the type of visual display most commonly used to graph student progress. This brief tutorial will provide guidelines for setting up a time-series chart and interpreting plotted data (Hayes, 1981; Kazdin,1982).

Components of the time-series chart

Time-series charts are structured in a standardized manner to help viewers to better understand the data that they display. Some of the charting conventions described below (labeling of the chart axes, separation of data phases) are standard elements of time-series charts. Other conventions, such as use of aimlines, are most commonly used when charting Curriculum-Based Measurement data.

- *Labels of Vertical ('Y') and Horizontal ('X') Axes*. The vertical axis of the chart is labeled with the 'behavior' that is being measured. In the chart displayed in Figure 1, the behavior to be plotted is 'Correctly Read Words Per Minute'. The horizontal axis of the chart displays the timespan during which progress-monitoring took place. Our sample chart shows that the student was monitored from the dates of January 28 through April 8.

Figure 1: Sample Time-Series Chart With Curriculum-Based Measurement (CBM) Data



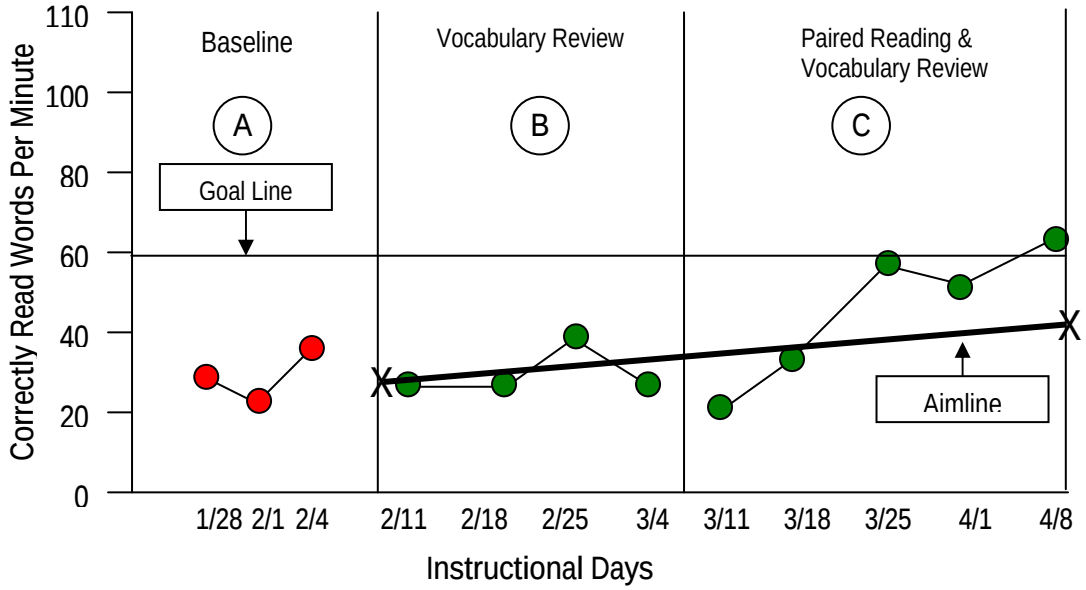
- *Phase Changes*. The chart is divided into *phases*, with each phase representing a time period in which data are collected under similar conditions. Phases are visually separated on the chart with vertical lines. Each phase is also typically labeled to indicate the intervention condition in effect during that phase (e.g., 'Baseline: Teacher whole-group math instruction'). Data collected within a phase are plotted as a series of connected data points. However, there is always a break in the plotted data between phases to indicate that the conditions under which

data were collected differed in each phase. In Figure 1, sections A, B, and C of the chart represent different phases.

- *Baseline Data*. RTI Teams will often collect *baseline* data to determine a student's starting point before an intervention is begun. Baseline data provides a snapshot of the student's level of academic or behavioral functioning before an individualized intervention is put into place. Phase A of the chart in Figure 1 shows an example of baseline data points. It is generally recommended that a minimum of 3-5 data points be collected during the baseline phase. If a visual inspection reveals that the overall trend of the baseline data is relatively flat or moving in the direction opposite that desired by school staff, the RTI Team concludes the baseline phase and implements the intervention. However, if the baseline phase shows a strong *positive* trend (moves strongly in the desired direction), the team should delay putting the intervention in place and continue to monitor student progress, since the instructional or behavioral strategies being used during the baseline phase are clearly benefiting the child.

- *Progress-Monitoring Data*. Once an individualized academic or behavioral intervention has been put into place for a student student, the RTI Team then monitors the intervention frequently (e.g., weekly) to track that student's *response* to the intervention. Sections B and C of the chart in Figure 1 display progress-monitoring data collected during two intervention phases.

Figure 2: CBM Time-Series Chart with Goal Line and Aim Line



- *Plotting Goal Line and Aimline.* When charting student progress, it is helpful to include visual indicators that show the *goal* that the student is striving to reach as well as the *expected rate of progress* that the student is predicted to make.

  The *goal line* is drawn on the chart as a vertical line that represents a successful level of performance. In Figure 2, the goal line for correctly read words is set at 59 words per minute, the typical skill level in the classroom of the student being monitored. The *aimline* is a sloping line that shows the rate at which the student is predicted to make progress if the intervention is successful. The aimline in Figure 2

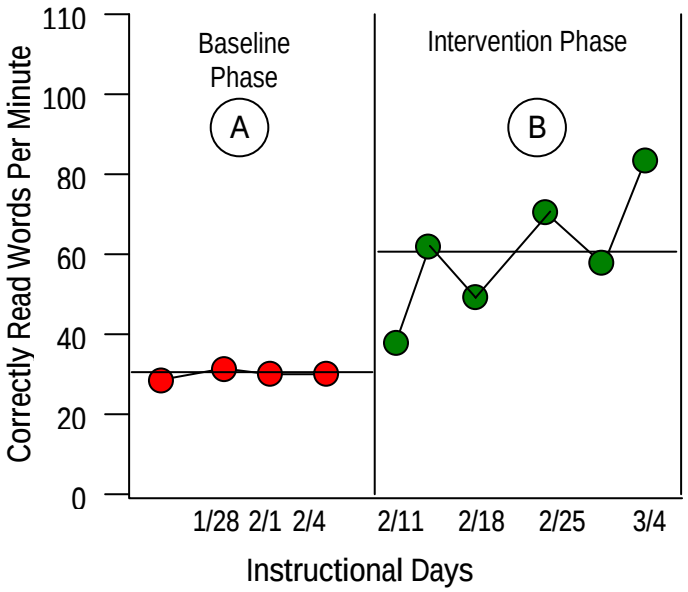
shows an expected increase of about 1.5 words per week in reading fluency. By plotting both goal line and aimline on the progress-monitoring chart, the RTI Team can visually compare the student's actual performance on a given day to his or her expected rate of progress (aimline) and eventual goal for improvement (goal line).

Visual interpretation of time-series data

When data points are plotted on a time-series chart, the observer can use techniques of visual analysis to uncover meaningful patterns in the data. Trend, variability, and level of data points can all yield significant clues to help in data interpretation.

- *Trend.* Trend is the slope of increase or decrease visible in charted data. A strong trend in the desired direction during an intervention phase would indicate that the intervention is having the predicted positive impact. The data series in section B of Figure 3 shows a much stronger upward trend than that in section A.

Figure 3: Level, Trend, and Variability of Data



- *Variability.* The amount of variability, or fluctuation, of data in each phase can have an impact on progress monitoring. When data in a series show little variability, RTI Teams may need to collect only a small amount of data to show a clear trend. When there is considerable variability, though, RTI Teams may be required to collect more data to discern the underlying trend. The data series charted in Phase B of Figure 3 shows much more variability than the series in Phase A.

- *Level.* The level of a data series is the average, or mean, of the data within that series. For example, in a data series with four values (45,58, 62, 47) , the level (mean) is 53. The level can be a useful method for summarizing the average for each data phase, particularly when there is a considerable amount of variability in the data. On a time-series chart, the level of a data series is usually plotted as a horizontal line corresponding to the mean of the phase. In Figure 3, the level of Phase B (60 correctly read words per minute) is considerably greater than that of Phase A (34 correctly read words per minute).

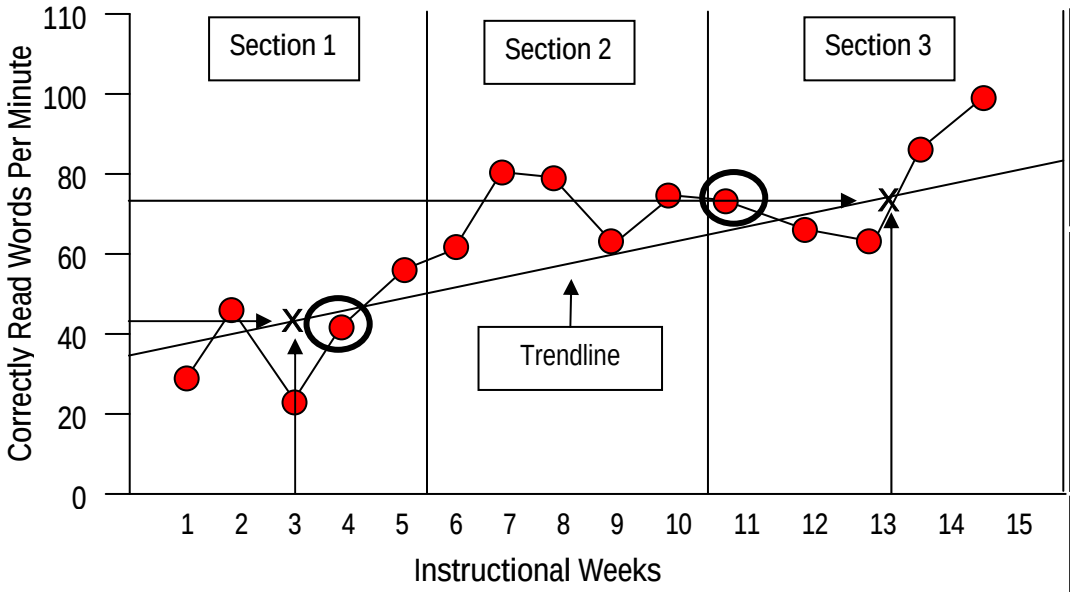
Plotting trendlines to determine the underlying 'trend' of charted data

Data points plotted on a time-series chart often have considerable fluctuation, or variability, making it difficult to 'see' the underlying trend of the data with any precision. Trendlines are straight lines superimposed on charted data to show a simplified 'best estimate' of the student's actual rate of progress. This section presents an easy method for plotting a trendline by hand.

Plotting trendlines with the Tukey method. To plot the trendline using the Tukey method, the observer 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 observer concentrates on the first and third sections of the graph, ignoring the middle section. In each of the two selected sections, the observer 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 observer 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 observer considers the middle, or median, point to be week 3.

Figure 5: Plotting a trendline with the Tukey Method



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

Step 2: In Section 1 and Section 3, find the median data point and median instructional week. In each section, mark the point on the graph where the two values intersect 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, S. (1992). Estimating trend in progress monitoring data: A comparison of simple line-fitting methods. *School Psychology Review, 21,* 300-312.

To locate the median number of observed behaviors on the vertical axis, the observer examines the data-points in the graph-section, selecting the median or middle, value from among the range of points. For example, if data-points for weeks 1- 5 in the first section are 30, 49, 23, 41, and 59, the median (middle) value is 41. When the observer 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 observer creates a trendline that provides a reasonably accurate visual summary of progress.

References

Hayes, S.C. (1981). Single case experimental design and empirical clinical practice. Journal of Consulting and Clinical Psychology, 49, 193-211.

Kazdin, A.E. (1982). Single-case research designs: Methods for clinical and applied settings. New York: Oxford Press.

Writing Curriculum-Based IEP Goals

Format for writing CBA Annual IEP Goals in Basic Skill Areas

Academic Area	Condition	Behavior	Criterion
Reading	In *[number of weeks until Annual Review]*, when given a randomly selected passage from *[level and name of reading series]* for 1 minute	Student will read aloud	At *[number]* correctly read words with no more than *[number]* decoding errors.
Math	In *[number of weeks until Annual Review]*, when given a randomly selected math computation problem type from *[level and name of math series]* for 2 minutes OR In *[number of weeks until Annual Review]*, when given a math worksheet with the following math computation problem(s): *[description of problem type(s)]* for 2 minutes	Student will write	*[Number]* Correct Digits
Written Expression	In *[number of weeks until Annual Review]*, when given a story starter or topic sentence and 3 minutes in which to write	Student will write	A total of • *[number]* of words or • *[number]* of correctly spelled words or • *[number]* of correct word/writing sequences
Spelling	In *[number of weeks until Annual Review]*, when dictated randomly selected words from *[level and name of spelling series* or *description of spelling word list]* for 2 minutes	Student will write	*[Number of correct letter sequences]*

Adapted from: Fuchs, L. S. & Shinn, M. R. (1989). Writing CBM IEP objectives. In M. R. Shinn (Ed.), *Curriculum-based measurement: Assessing special children* (pp. 130-152). New York: Guilford.