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Assessment and Data-Based Decisions in Contemporary Classrooms

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Abstract— **In the United States, the No Child Left Behind Act (NCLB) in 2001 and Individuals with Disabilities Education Act (IDEA) in 2004 have together made it possible for students with diverse educational needs to be educated in general education classrooms. To be able to address students' needs efficiently and effectively, teachers need to collect data on students' current level of performance, design instruction using evidence-based strategies, implement instruction, and make data-based decisions to evaluate effectiveness of their instruction by continuously monitoring student achievement. Using four hypothetical cases, this paper illustrates use of curriculum-based measurement (CBM), a research validated approach, to assess and progress monitor students' performance in reading and mathematics, and also illustrates with examples how the process can help teachers make required data-based decisions during the progress monitoring phase.**

Keywords— **Data-based decisions; Curriculum-based measurement; Assessment; Progress monitoring; Teacher education; Diversity in classrooms**[1]

I. INTRODUCTION

Today's startling classroom diversity reflects a major demographic shift around the world. In the United States, the No Child Left Behind Act (NCLB) in 2001 and Individuals with Disabilities Education Act (IDEA) in 2004 have together made it possible for students with diverse educational needs to be educated in general education classrooms. These laws require that students with diverse educational needs have access to the same curriculum as everyone else. More recent educational reforms and a push towards standards-based education require more than mere physical accesses to general education classrooms for students with diverse educational needs. Access to general education curriculum is no longer synonymous only with physical access to general education classrooms. The laws require that students who cannot not be physically included in general education classrooms and are in other alternative settings be given opportunity to learn the same content, thus making access to general education curriculum, if not general education classrooms, possible for *all*.

In schools across the United States a three-tier model of intervention, also known as RtI or Response to Intervention, is employed to assess and teach *all* students. Since the passage of Individuals with Disabilities Education Improvement Act (IDEIA) or IDEA (2004), this three-tier model has been assisting teachers in providing all students in contemporary classrooms pre-referral early intervention services, thus reducing a need for possible special education referral. Educators are required to document all efforts made to provide quality, research-based core curriculum to all students giving them a fair chance to improve, before any possible referral can be made for special education services. The intensity of intervention increases across the three tiers or levels of intervention to prevent both, academic and behavioral problems in students. A student receiving early intervention gradually moves up to the third tier or level if intervention provided at level one and level two is found to be not helping student. A noteworthy point to be made is possibility of a two-way movement of students in this intervention process. This two-way process ensures that students who respond to timely more intensive intervention at a higher (second and third) tiers or levels have a chance to be move back to the Tier-1 intervention level. A key requirement of the process of providing this pre-referral intervention in different tiers is consistent and regular monitoring of these early intervention efforts and students' response to the efforts/intervention and documentation. Such educational reforms have also resulted in increased level of accountability expected of education professionals in meeting high standards for student achievement [1]. To be able to keep track of students' achievement educators in contemporary classrooms have to be competent in assessing students' baseline performance in academic areas and behavior, set appropriate goals based on their baseline performance, implement evidence-based instruction, monitor student's progress as a result of intervention planned and implemented, evaluate effectiveness of intervention, and make ongoing decisions about further action or instruction. In short, to be able to address students' needs efficiently and effectively, teachers need to be competent in assessing, teaching, collecting relevant data, and monitoring progress. With the existing diversity in contemporary

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classrooms educators trying to meet demands of this diversity need to understand the critical importance of collecting data, interpreting the data, and making instructional decisions based on this data.

This paper

- describes curriculum based measurement (CBM), a formative means of measuring students' progress in classrooms,
- provides step-by-step procedures teachers can follow in using CBM to assess students' baseline performance, set realistic goals/objectives based on researched-based norms, implement intervention using evidence-based practices, and monitor student progress towards the set goals, and
- describes how teachers can collect regular data, plot the data, interpret data, and make valid data-based decisions about effectiveness of their intervention.

CBM is a *formative assessment* that is ongoing during an instructional period, rather than a *summative assessment* given at one point in time at the end of an intervention. This formative nature of CBM ensures timely and ongoing decisions to help students. Four hypothetical cases described in this paper illustrate use of curriculum-based measurement to assess present level of performance of students in reading and mathematics, set relevant goals, and monitor student performance regularly in response to intervention provided. Students in these four hypothetical cases (see Figure 1, Figure 2, Figure 3, & Figure 4) are at four different grade levels. A brief listing of general steps to assess baseline performance, and monitor progress to make data-based decisions in the areas of reading and mathematics precedes a detailed description of the process, including graphical representation of progress monitoring. Finally, using three other examples (Figure 5, Figure 6 & Figure 7), the paper illustrates decisions teachers can make using these data during response to intervention (RtI).

CURRICULUM-BASED MEASUREMENT

Deno [2] described curriculum-based measurement (CBM) as a set of standard procedures that are technically adequate, have standard measurement tasks, prescriptive stimulus materials, details of administration and scoring, are time efficient, and easy to use. Reliability and validity, the two primary characteristics of CBM according to [2] have been achieved through standardized observational procedures for repeatedly sampled performance on core reading, writing, and arithmetic skills. Specific design criteria of CBM that include having sufficient reliability and validity, ease in using and understanding which makes it convenient for teachers to employ them easily, ease of explaining the results to others, and comparatively low cost make it easy for school-wide use [3]. Support for successful use of CBM spans across 27 years. Stecker, Lembke, and Foegen [1] cited several studies done between 1988 and 1995 that researched into the technical adequacy of CBM. The authors described yet another benefit of CBM as being less susceptible to possible bias associated with gender, race or ethnicity, or disability status than some other types of assessment, because the measures rely on direct assessment of student performance. CBM is a formative evaluation as student's progress is measured during the acquisition of a skill and as such, it is an optimal assessment technique for monitoring progress. In 2005 [4] examined use of curriculum-based measurement in assessing progress in reading in Hebrew. The authors found a moderate to strong concurrent validity with Kauffman Assessment Battery for Children (K-ABC). The study suggested that "CBM would be an applicable, feasible, and efficient method for the assessment of reading in other countries throughout the world" [4:516]. Fore, Burke, and Martin [5] posited that determinations of special education eligibility for many African American children and youth, as well as other children from minority groups are largely based on IQ and published norm-referenced achievement tests. As such, the authors indicated a strong need to use research-validated tool such as CBM, a problem-solving instrument in assessing students. Fore, Burke, and Martin [5] believed the use of CBM would prove to be a viable alternative to the current model of testing that is biased toward African American children and youth. The study providing an overview of CBM concluded that "more research and further discussions need to occur to establish the necessary links between CBM and many racial minority issues related to academic performance" [5:22]. Yeo [6] conducted a multi-level meta-analysis of 27 studies to examine relationship between curriculum-based measurement and statewide tests for reading. The study found a strong ($r = .689$) correlation and concluded that CBM is a good indicator of overall reading competence and indicated that " the large correlation coefficient presented in the study may encourage hesitant teachers to administer CBM as a formative assessment tool that may help schools prepare for statewide achievement tests" [6:420]. In 2012 [7] examined predictive validity of applied curriculum-based reading measures in an RtI system for students in grades 4 and 5. They analyzed the characteristics of CBM assessments of reading fluency, vocabulary, and reading comprehension and how they predicted performance on a state reading test. The study concluded by reporting a strong relation between the CBM vocabulary measures and the state test and suggested that "evidence-based reading CBM system can be important for school and district administrators, instructionally meaningful for general educators, and of practical benefit for elementary students" [7:621].

Curriculum-based Measurement: Administration

This section lists general steps used in administering these measures. A detailed discussion and description of steps for conducting CBM for specific components of reading and mathematics follows these general steps.

General Steps:

- Identify students (student) to assess and decide on the target area (mathematics, reading, and writing) and specific components or skills in the target areas (fluency, vocabulary, comprehension, computation, math facts, etc.)

- Collect different but equivalent grade-level probes, also known as measures (for baseline score and progress monitoring scores) for the target areas available for a charge from [8] and free from [9]. For each probe, get a teacher's copy with answer key and students' copy without an answer key;
- Get a stop-watch, clipboard, and a pencil and a copy of standardized script of directions needed during administration of probes
- Administer grade-level probes, score the probes following scoring guidelines available in manuals obtained through [8] for a fee, or obtained free of cost from [9] and compare to expected performance using grade level norms table available in manuals obtained from[8] and [9],
- If student's score does not fall within the guidelines for instructional level range according to the norms, drop back grade level and repeat the above steps until instructional level/grade level is determined using norms table
- Find the current/baseline level and baseline score once instructional level is determined by administering probes, and scoring
- Find the target score or performance goal using procedure listed in the manuals and draw an aim line
- State expected goal in clear, measurable terms
- Provide intervention (record details of intervention) using evidence-based practices
- Monitor progress once, preferably twice a week by administering progress monitoring probes and scoring student performance
- Chart/graph data obtained
- Interpret the graph and make continuous decisions based on interpretation of data

<u>Detailed Steps</u>

In reading, CBM described in this study includes two types of tasks. The first is *MAZE* task (Figure 1, Case One) where students read passages either silently or aloud for 3 minutes. These grade-level passages have every seventh word deleted after the first complete sentence. For a deleted word student is given three choices, one of them being the correct word. Students read the passage for 3 minutes and restore the correct word. Total number of words correctly restored (WCR) is recorded. The second task is *reading fluency* (Figure 2, Case Two) where students read aloud grade-level passages for 1 minute and the number of words read correctly (WRC) is recorded. These passages are between 150-350 words in length depending upon the grade-level. CBM can also be conducted with younger children to assess and monitor progress in early reading skills such as letter recognition, letter-sound relationship, and vocabulary, as well as spelling and writing. The measures, also known as *probes*, are commercially available according to grades from [9] free of cost or can be purchased from [8]. Websites for both are included in the reference section. Using norms tables available for all measures and areas at these sites, teachers determine student's instructional level, which is between 25th and 75th percentile. If a student's scores do not fall within the instructional range (determined by comparing to the available norms tables) teachers drop a grade-level and repeat the assessment until student's correct instructional level is found. Once the *instructional level for the students is obtained, student's current level* of performance in both reading fluency and maze tasks is obtained by giving three passages and finding a median score known as the 'baseline score'. Once a baseline score is determined, the next step is to find a 'goal score'. To find the goal score an expected growth rate per week is obtained using *expected growth rates tables* available from [8] or [9]. Using the growth rate, a goal/goal score is calculated using the following formula [baseline score + (growth rate X number of weeks of intervention)].

As seen in Figure 1, the baseline scores are 25, 24, 39 with 25 as median score or baseline score for MAZE and (78, 82, 86 with 82 as median and the baseline score) for reading fluency (see Figure 2). The baseline score and goal score are plotted and connected on an equal interval graph, to find aim-line. Graphing tools are also available through [8] and [9] (Please see reference section for details of Websites) with an explanation of detailed steps to be followed. Intervention is then provided using evidence-based practices and progress towards the goal is plotted by collecting data twice a week. During intervention, if three consecutive data points (known as three-point rule) fall below the aim-line, intervention is changed. If three consecutive points fall above the aim-line, goal score can be adjusted upwards using a higher growth rate per week (Figure 2).

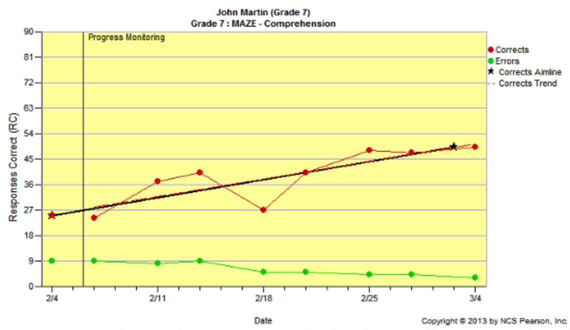

Figure 1: Intervention and progress monitoring in 'reading comprehension' using MAZE probes. AIMSweb Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

<u>Case 1(Figure1)</u> *John is a 7th grader and struggles in both reading and mathematics. Based on his scores John is considered to be at risk of failure in both reading and mathematics. John has been struggling with OCD (obsessive compulsive disorder) for many years. John is able to work independently and does ask questions and seeks help when needed. John is administered MAZE probes at 7th grade level. His scores indicate an average level of performance and he is assessed and found to be at average level or instructional*

level at 7th grade and at 30 th percentile. His baseline and progress monitoring as such are done with 7th grade MAZE passages with a goal of improving his reading and comprehension. Using his data (see Data Set 1) John's goal is calculates as follows:
*25(baseline) + (1.5[growth rate]x16[# of sessions]) = 49 [goal] words correctly restored **(WCR)***

*In **8** weeks or 16 sessions, John will restore **49** words in 3 minutes from Grade 7 MAZE progress monitoring passages with no more than 3 errors.*
For progress monitoring two new passages at Grade 7 level are obtained from [8] and administered. Mean or average of the two scores provides data point for the session.

Data Set 1(for Figure 1) E denotes number of errors (Baseline/median & mean for progress monitoring)

2013	Baseline			Progress Monitoring					
Dates	2/4	2/4	2/4	2/6		2/11		2/13	
WCR	25	24	39	24	25	38	36	39	35
		25 E 9		24.5 E 9		37 E 8		37 E9	

Progress Monitoring									
2/18		2/20		2/25		2/27		3/4	
26	28	40	41	50	47	48	46	50	49
27 E5		40.5 E8		48.5 E4		47 E4		49.5 E3	

John's goal is calculated as 49 correct words from a baseline of 25(median of three scores) words. Baseline is obtained in one session using three MAZE probes and finding a median of these sores on 2/4/2013 (February 4). Starting from 2/6/2013 intervention is provided using various evidence-based practices to teach reading comprehension, vocabulary, and improve speed/fluency. Progress is monitored twice a week using probes from [8]. Data are plotted using AIMSWeb software available from [8]. Johns WCR (words correctly restored) improves faster but errors decrease at a slower pace. Further help with regular progress monitoring may improve John's comprehension and MAZE scores.

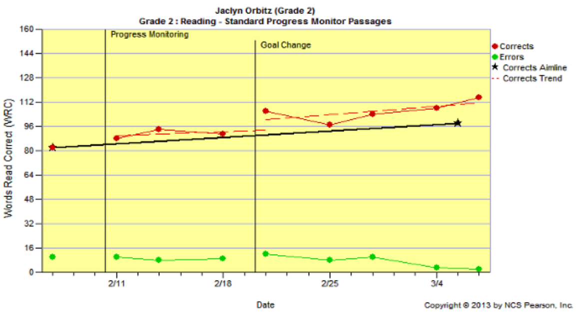

Figure 2: Intervention and progress monitoring in 'reading fluency' *AIMSweb* Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

Case 2(Figure2) *Jaclyn is a lovable 3rd grader, confident, observant, with a keen interest in learning new things. Jacky has slight spasticity in her right side which has also affected her speech to a certain extent. She struggles with reading fluency and mathematical commutations. Based on her assessment results Jacklyn's teacher decides to provide intervention to improve her reading fluency. After the initial administration of reading fluency passages (probes) at third grade using R-CBM passages , her instructional level is determined to be at Grade 2 for words read correctly in one minute. As such, her baseline in reading fluency is obtained using probes at second grade level and progress monitoring is carried out with reading fluency probes R-CBM at Grade 2 level obtained from [8]. Jaclyn's goal is calculated as follows using data obtained (See Data Set 2).*

***82**(baseline score) + (**1**[growth rate] x **16**[# of sessions]) = **98** [goal] words read correctly (WRC)*
*In **8** weeks or 16 sessions, Jaclyn will read **98** words correctly with no more than 2 errors in 1 minute using Grade 3 progress monitoring passages.*

Data Set 2 (for Figure 2) E denotes number of errors (Baseline/median & mean for progress monitoring)

2013	Baseline			Progress Monitoring					
Dates	2/6	2/6	2/6	2/11		2/13		2/18	
WRC	78	82	86	89	88	95	93	89	93
		82 E 10		88.5 E10		94 E 8		91 E 9	

Progress Monitoring									
2/20		2/25		2/27		3/4		3/6	
105	107	95	99	104	104	110	107	114	116
106 E 12		97 E 8		104 E 10		108.5 E 3		115 E 2	

Jaclyn is provided intervention for both vocabulary and fluency using evidence-based practices. As seen above, during the first three consecutive sessions she is falling consistently above the aim-line (three-point rule). As such her goal is readjusted using a higher estimated growth rate and the new goal is set as:
***82** + {**3** (growth rate) x **10** (remaining sessions)}= **112**.*
Intervention and progress monitoring is continued. Data are plotted using AIMSWeb software available from [8]. The graph shows a baseline phase or baseline score, the first intervention phase with original calculated goal, and a second phase with adjusted higher goal indicating 'goal change'. Intervention is continued and Jaclyn's goal of 112 correct words per minute and number of target errors is achieved. Intervention and regular progress monitoring is continued for improved reading fluency.

*In math***,** CBM procedures described in this paper include math computation (M-COMP) as in Figure 3 and math concepts and applications (M-CAP) tests as in Figure 4. For M-COMP, grade level probes are commercially available and can be obtained free from [9] or can be purchased from [8]. For math computation students are given 2 minutes to complete computation problems with a maximum of 25 problems on one probe sheet representing the skills that students need to know and master in the academic year. Probes chosen for the entire period of intervention are equivalent but different in terms of number of problems representing different skills. While scoring, total number of correct digits (CD) in answers and not just the correct answer is counted. Using norms tables available through [8] or [9] teachers determine students' instructional level. If students' scores do not fall within the instructional level range (determined by comparing to the tables) teachers drop a grade-level until students' instructional level is obtained. Once the instructional level for correct digits is found, students' current level of performance in computation is obtained by giving three equivalent probes and finding a median score known as the *'baseline score'*. To calculate a goal, an expected growth rate per week is obtained, using a norms table available through [8] or [9]. Using growth rate, a goal is calculated using the following formula *[baseline score + (growth rate [from norms table]) X number of weeks of intervention]*. As shown in Figure 3, the baseline scores for Jaime are 25, 29, and 40. Median (middle score) for the three scores is 29and is student's baseline score. The baseline score and goal score are plotted and connected on an equal interval graph to obtain *aim-line.* Graphing tools are available through [8] and [9]. Intervention is provided using evidence-based practices and progress towards the goal is plotted by collecting data twice a week. If three consecutive data points fall below the aim-line, or three points fall above the aimline, *three-point rule* is applied. This rule states that during intervention, if three consecutive data points fall below the aim-line, intervention is changed; if three consecutive points fall above the aim-line, goal score can be adjusted/recalculated using a higher growth rate per week.

AIMSWeb [8] also provides Mathematics Concepts and Applications(M-CAP, see Figure 4) measures or probes to assess conceptual understanding, procedural fluency, problem solving, reasoning in mathematics, and includes domains such as number sense, operations, patterns and relationships, data and probability, measurements, geometry, algebra as recommended by the National Council of Teachers of Mathematics (NCTM). Guidelines to obtain probes, administer, and score are provided in detail by [8] for a charge. The time allotted for the probes varies according to grades. The time allotted to solve the problems for grades 2-6 is 8 minutes and for higher grades time allotted is 10 minutes. AIMSWeb [8] provides 33 equivalent probes for all grades. Scoring key is available for each probe. Unlike M-COMP no partial credit is given for correct digits in an answer. The answer is either correct or wrong. Points for correct answers vary from 1-3 with a 0(zero) for wrong answer. The *points* value may vary across grades and is also available at [8]. As with M-COMP student's instructional level is found by administering probes at grade-level, scoring, comparing to the norms to determine if student is within the instructional or average level range (25^{th} to 75^{th} percentile). Once students' instructional level is found, procedure for obtaining a baseline score, goal score, plotting aim-line, monitoring progress and providing intervention is the same as for M-COMP described earlier. AIMSweb [8] provides a norms table by grades for expected *rate of increase* (ROI) at each grade level.

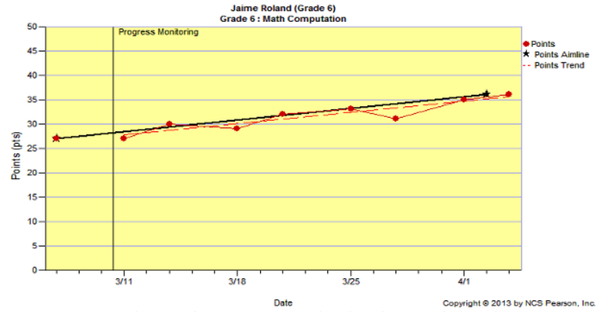

Figure 3*:* Intervention and progress monitoring in 'mathematics computation' *AIMSweb* Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

Case 3 (Figure 3): *Jaime is a 6 th grader struggling with multiple step multiplication and division problems. To find her instructional level teacher retrieves three sixth grade probes from [8] and reads the directions to Jaime and administers the three probes giving two minutes for each probe. After scoring the probes Jamie has 25, 29 and 40 correct digits (See Data Set 3) on the three probes. A median point of 29 is above the* 50^{th} *percentile, which is within (average) instructional level. The baseline of 29(median of three scores) is a reference point to be used to find the aim or goal score and subsequently the aim-line. To obtain the goal the teacher takes the baseline data point of 29 and calculates the goal score using the following formula:*
*29(baseline) + (0.45[growth rate] x16[# of sessions]) = 36 [goal] correct digits CD****)***
This means that after 8 weeks of intervention Jamie should be scoring 36 correct digits in allotted time.
Jaime's goal in math is as follows: In eight weeks, Jaime will score 36 correct digits in 2 minutes using 6^{th} *grade math CBM progress monitoring probes from [8]. Jaime will receive intervention over the eight weeks working on multiplication and division with twice weekly progress monitoring.*

Data Set 3(for Figure 3)

2013	*Baseline*			*Progress Monitoring*		
Dates	***3/6***	***3/6***	***3/6***	***3/11***	***3/13***	***3/18***
CDs	***25***	***29***	***40***	***27***	***30***	***29***
		29				
Progress Monitoring						
3/20	***3/25***	***3/27***	***4/1***	***4/3***		
32	***33***	***31***	***35***	***36***		

After finding baseline score and calculating a goal, Jamie is provided intervention in math using evidence-based strategies. At each session Jamie receives a probe with 25 computation problems involving multiplication and division to be solved in 2 minutes. The probes are scored for correct digits and not a correct final answer as per CBM guidelines. As seen in the graph Jaime's score fluctuates initially but shows a steady *progress towards the planned goal of 36 correct digits. Intervention and regular progress monitoring using CBM can be continued for improved performance on computation problems.*

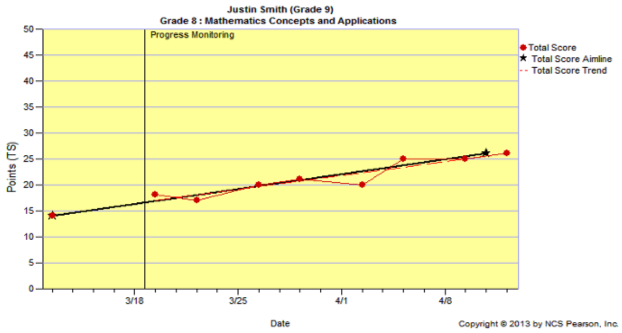

Figure 4: Intervention and progress monitoring in 'mathematics concepts and applications' *AIMSweb* Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

Case 4(Figure 4) *Justin is a student in 9 th grade in a general education classroom. Justin's primary difficulties in math lie with computation and complex word problems. Specific difficulties in these areas include numeration (he sometimes does not properly add, subtract, multiply, or divide, especially when working with negative numbers, fractions, and decimals) and the ability to properly interpret word problems into solvable equations and values. Justin's instructional level is found at Grade 8 and he is given Grade 8 concepts and applications (M-CAP) probes where he scores 12,17,14 points (Data Set 4)with a median of 14 placing him at between* 50^{th} *and* 75^{th} *percentile (average level.. His goal is calculated with a growth rate of .75 per session using the following formula 14(baseline) + (0.75[growth rate] x16[# of sessions]) = 26 [goal] points) which will place him at 90 th percentile.*

The goal for Justin as such will be: In 8 weeks Justin will score 26 points on AIMSWeb Grade 8 M-CAP probes in 10 minutes with intervention and twice weekly progress monitoring.

Data Set 4(for Figure 4)

2013	*Baseline*			*Progress Monitoring*		
Dates	*3/12*	*3/12*	*3/12*	*3/19*	*3/21*	*3/26*
Points	*12*	*14*	*17*	*18*	*17*	*20*
		14				

Progress Monitoring				
3/28	*4/2*	*4/4*	*4/9*	*4/11*
21	*20*	*25*	*25*	*26*

Justin's goal is calculated as 26 points with a baseline of 14 points. Intervention is provided with various evidence-based practices to teach various mathematical concepts and their application using probes from [8]. Probes are scored using answer key provided for each probe. Data are plotted using AIMSWeb software. After first five sessions that show a little fluctuation, Justin's scores on M-Cap improve steadily reaching the goal of 26 points on Grade 8 M-Cap probes given 10 minutes to complete. Justin's intervention can continue and he can now be given Grade 9 probes to see if instructional level is met with Grade 9 probes. Teacher can work towards helping Justin achieve maximum points at Grade 9 and take him to the 90^{th} *percentile level.*

Response to Intervention, Implementation, and Decisions

Response to Intervention (RtI) is a recommended (not mandated) framework to provide quality, evidence-based early intervention to all students based on their needs to prevent possible academic and behavioral problems in children. The multi-tier nature of this framework helps educators provide timely intervention to all students based upon their specific needs as a whole class, small groups, or individual basis. Response to intervention or RTI was initially introduced as an alternative to the discrepancy model of identifying specific learning disabilities (SLD) by providing early intervention rather than waiting to fail approach of the discrepancy model. However, with the passage of Individuals with Disabilities Education Improvement Act of 2004, also known as IDEA, 2004 and the No Child Left Behind (NCLB) of 2001/2002, response to intervention or *response to instruction* as some term it has become a framework for providing quality, research-based early intervention to *all* students in general education classrooms. This early intervention provided through a multi-tiers approach is to prevent possible special education referrals if students respond to instruction at the first three tiers of instruction.

Implementation of RtI involves a tiered approach of specialized instruction [10]. The first three levels of instruction provided in general education classrooms increase in intensity from level one/tier-1 to level three/tier-3. At Tier-1, all students are provided quality, evidence-based instruction and teachers administer screening assessments, also known as universal screening, to assess students' response and progress. Students who do not respond to this intervention in about 10-12 weeks (may vary in different school districts) are provided Tier-2 instruction. At this level, students are provided additional intensive evidence-based intervention in small groups daily in areas targeted as deficit areas. This additional focused intervention in target areas may be for 30 minutes of more. Students' response to this additional intervention is monitored bi-weekly. If students respond to instruction within the first 10 weeks, they are returned to the universal instruction and screening level of Tier-1. Those who fail to respond adequately using grade-level norms [10] are moved to the next, more intensive level of instruction at Tier-3. At Tier-3, intervention is more intense and is provided on individual basis rather than small groups. The intervention at this level may involve 2 additional sessions of 30 minutes each on individual basis. Progress is monitored bi-weekly to assess students' response and progress. Students who respond to this individual intense instruction continue receiving universal instruction and intervention in general education classrooms at

Tier-1. Students who fail to respond to third tier intensive instruction may be referred to a multi-disciplinary team for evaluation and assessment using standardized instruments for possible special education services. Parents are notified and parental consent is obtained before carrying out the evaluation to decide possible eligibility for special education services.

Decision process during RtI requires that educators continuously monitor students' response to this intervention/ instruction, document progress made during this intervention/instruction and take necessary, timely action to help the students at each tier of instruction to prevent possible special education referrals and labeling due to academic and/or behavioral problems. According to [7] The National Center on Response to Intervention outlined four essential components of RtI process: including a school wide, multilevel instructional and behavioral system for preventing school failure; screening; progress monitoring; and data-based decision making for instruction, movement within the multilevel system, and disability identification. It is imperative that educators interpret data collected and make valid decisions to help children. Reutebuch [11] provided twenty suggestions for successful implementation of RtI. The author highlighted importance collaboration with various professionals, parents and families, seeking support from relevant sources for sustainability , and a need for teachers to keep themselves updated and abreast of developments as the most important elements of RtI.

McArthur and Barton-Arwood [12] in 2009 provided details of visually interpreting data and using 4-point rule which identifies struggling students if four consecutive data points fall below the aim-line or the goal-line. Dykeman [13] in 2006 suggested using learning-curve comparison between children suspected of having learning disability and those demonstrating typical performance. The author described how a reduced learning-curve in all areas may suggest a slow learner or possible developmental delay and a reduced learning curve in specific content areas may suggest a learning disability specific to the area(s). In another more recent study in 2012, [14] discussed outcome of a literature review of about 50 years related to progress monitoring and decision rules. Two categories of decision rules reported included: data point decision rules which depend on the evaluation of data points against an aim line which defines the expected trajectory of growth, and trend line rule, which depends on estimates of the observed growth rate, or slope. The study also concluded that it is very important to review progress monitoring practices carefully and ensure data are of good quality when using interpretation of progress monitoring in RtI or in deciding effectiveness of any intervention. Their recommendations for directions future research studies could take included studying quality and utility of the two types of decision rules; the data point decision rules, and trend line decision rules. Overton [3] described methods teachers can employ to interpret data obtained during intervention and progress monitoring using curriculum-based measurement. The author recommended following guidelines for making decisions regarding intervention effectiveness:

- An agreement among the team members involved regarding criteria used to make decisions
- Consensus regarding what would be considered reliable changes and the nature/how much change is needed to make decisions during progress monitoring
- Established criteria for intervention effectiveness if no guidelines exist for a particular measure
- Criteria to move a student from one RtI tier to another.

The following section illustrates absolute change, percentage change, PNDS or percentage of non-overlapping data points, and visual inspection data methods which teachers can employ in making data-based decisions during progress monitoring.

Absolute change is the simplest of five methods. Finding absolute change involves subtracting the baseline score (median score) from the final score.

As seen in figure 5, Lilliana's baseline score (median of three points) is18 and the highest score achieved is 40. Applying this simple method to Lilliana's hypothetical data set in Figure 5, for 'mathematics concepts and application', absolute change is 22 (40-18) points. If absolute change is being used to decide intervention effectiveness, Overton (2012) suggested that the RtI team decide on a criterion such as percentage accuracy rather than a raw score of absolute change.

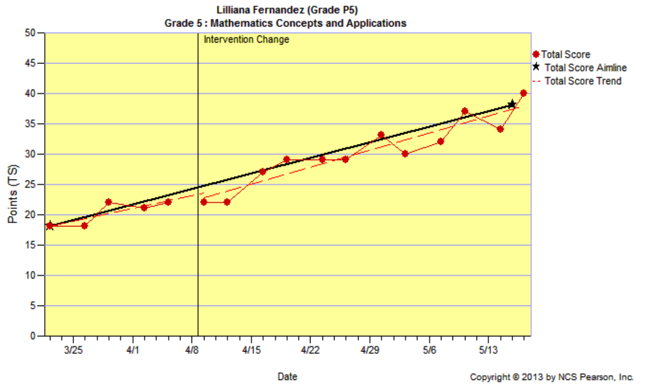

Figure 5: Using Data to Calculate Percent Change
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Goal Statement for case 5 Lilliana: In 8.0 weeks, Lilliana Fernandez will achieve ***38*** *Points from grade* ***5*** *Mathematics Concepts and Applications. The rate of improvement should be* ***2.50*** *Points per week. The current average rate of improvement is* ***2.70*** *Points per week.*

Data Set 5(for Figure 5)

Date	***3/21***	***3/26***	***3/28***	***4/02***	***4/04***	***4/09***	***4/11***	***4/16***	***4/18***
Total Score	***18 19 16***	***18***	***22***	***21***	***22***	***22***	***22***	***27***	***29***

Date	***5/23***	***5/25***	***4/30***	***5/02***	***5/07***	***5/09***	***5/14***	***5/16***
Total Score	***29***	***29***	***33***	***30***	***32***	***37***	***34***	***40***

The **second** method, *percent change*, is another simple method recommended by [3] of interpreting data. To calculate percent change the average of baselines performance is compared with average of performance during intervention and a percent change is calculated.

In Lilliana's (see Figure 5) case percent change as a result of intervention can be calculates as:

Mean of intervention (27.9) - Mean of baseline (17.6)/Mean of Baseline (17.6) = 58.5%

Interpretation of this change for data-based decisions to be made in a particular student's case depends upon prior established criteria by the RtI or other intervention teams regarding intervention effectiveness.

The underlying premise of *Percentage of non-overlapping data points (PNDs),* a **third** method, is that the progress during any intervention is represented by the points in intervention that are plotted after intervention begins and which are not represented during baseline.

The procedure to calculate PNDs with reference to the data seen in Figure 6 is as follows:

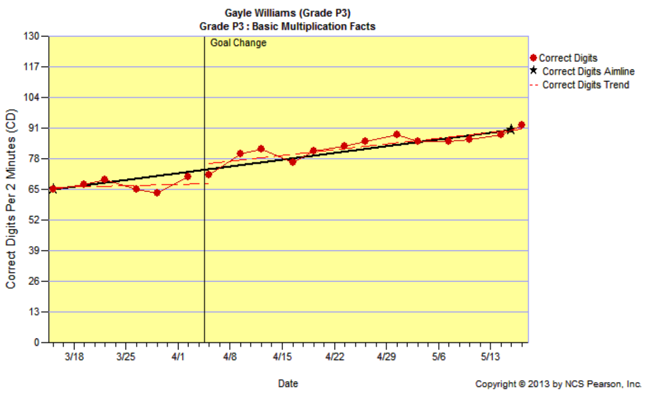

Figure 6: Using Data to Calculate Non-Overlapping Data Points *AIMSweb* Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

*Goal Statement for Case 6, Gayle: In **9.0** weeks, Gayle Williams will achieve **90** Correct Digits per 2 Minutes from grade **P3** Basic Multiplication Facts. The rate of improvement should be **2.78** Correct Digits per2 Minutes per week. The current average rate of improvement is **1.99** Correct Digits per 2 Minutes per week.*

Data Set (for Figure 6)

Date	*3/14*	*3/19*	*3/21*	*3/26*	*3/28*	*4/02*	*4/04*	*4/09*	*4/11*
Digits	*67 65 62*	*67*	*69*	*65*	*63*	*70*	*71*	*80*	*82*

4/16	*4/18*	*4/23*	*4/25*	*4/30*	*5/02*	*5/07*	*5/09*	*5/14*	*5/16*
76	*81*	*83*	*85*	*88*	*85*	*85*	*86*	*88*	*92*

- *Determine the highest data point achieved during baseline period, which is 67 in Figure 6.*
- *Count the total data points in intervention that are above the highest data point in baseline and divide that number (15 in this case) by the total number of data points during intervention (18 in this case):*
  15 /18
- *PND for this intervention is 15÷18 = .83 x 100 = 83%*

Gayle's intervention provided for improving basic multiplication facts according to [3] is effective (between 70 % and 90%). This outcome of 83% indicates that 83% of the data points are above the highest data point before the intervention began. Anything above 90% is considered very effective, and a PND calculated between 50% and 70% is considered effective but questionable according to Scruggs and Mastropieri. Lastly a PND below 50% indicates an intervention that is not effective in meeting student's needs.

Another easy and quick **fourth** method suggested is *visual inspection* (see Figure 7). In Jackie Smith's case for example, the teacher inspects the student's graph representing her performance during intervention to determine whether (1) data are moving in the right direction and (2) positive movement is consistent over time [3:213].

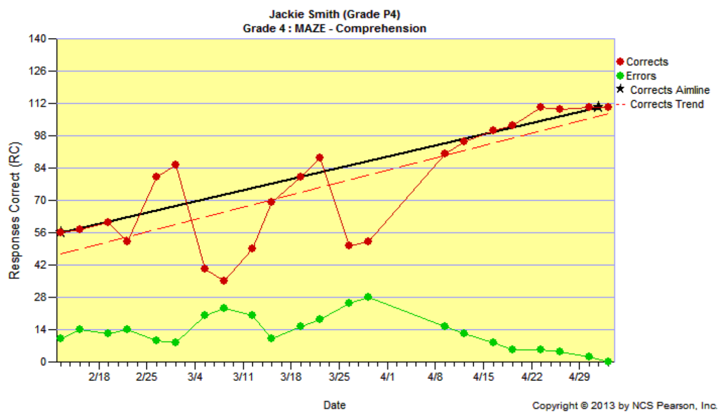

Figure 7: Using Data for Visual Inspection *AIMSweb* Copyright ©1212 NCS Pearson Inc. Graph Produced with Permission, All Rights Reserved.

*Goal Statement for Case 7, Jackie In **11.0** weeks, Jackie Smith will achieve **110** Responses Correct with **2** Errors from grade **4** MAZE - comprehension. The rate of improvement should be **4.91** Responses* *correct per week. The current average rate of improvement is* ***5.32*** *responses Correct per week.*

In the hypothetical case of Jackie Smith (Figure 7) for example, although the direction of movement is upwards initially, data points (Data Set 7) plotted after the fifth, sixth, and seventh sessions consistently fall below the aimline. Applying the 3-point decision rule recommended by [8] and [9], the teacher could decide to change intervention. This rule states that if three consecutive data points fall below aimline it may be interpreted that the intervention is not be effective and as such, needs to be changed.

Data Set 7 (for Figure 7)

Date	2/12	2/14	2/19	2/21	2/26	2/28	3/05	3/07
Correct	53 59 **56**	51	60	52	80	85	40	35
Errors	10	14	12	14	9	8	20	23

Date	3/12	3/14	3/19	3/21	3/26	3/28	4/09	4/11	4/16
Correct	49	69	80	88	50	52	90	95	100
Errors	20	10	15	18	25	28	15	12	8

Date	4/18	4/23	4/25	4/30	5/02
Correct	102	110	109	110	110
Errors	5	5	4	2	2

If the teacher knows possible reason for this downward trend, for example, consistent environmental disturbance during assessment beyond teacher's control, home situation, or student's health condition, teacher could continue with the intervention without applying the 3-point rule to assess effectiveness of intervention. A visual inspection in Jackie's case shows repeat of this downward trend of data points after the first drop in performance. The intervention however, as indicated is effective in increasing Jackie's performance and meeting the set target.

Research reviewed recommended use of CBM measures to assess student performance in reading and mathematics, make intervention decisions based on the initial or baseline performance, monitor effect of intervention by regularly collecting data during intervention, and finally make data-based decisions based on interpretation of performance data collected. Research also consistently emphasized quality and efficiency in use of CBM measures, during progress monitoring, and during interpreting data obtained during progress monitoring. It is critically important that teachers and team members charged with the responsibility of making valid decisions based on data collected using CBM measures adhere to quality consistently.

CONCLUSION

Curriculum based measurement or CBM can be administered in all classrooms by teachers to assess current level of performance of their students in reading, and mathematics using specific grade-level content. CBM can also be used for assessing and providing intervention in early reading and early numeracy skills, as well as spelling, writing, and in content area instruction. Using hypothetical cases this paper illustrated use CBM in monitoring student performance the areas of reading fluency, reading comprehension, mathematical computations, and mathematical concepts and applications to assess baseline performance, plan intervention, monitor progress during intervention, and make data-based decisions during intervention.

There are several ***benefits*** of using CBM to students, teachers, schools, and school districts.

- There is a need worldwide for competent teachers able to address diversity in their classrooms that may be related to culture, ethnicity, ability/disability, social class, religious beliefs, and gender/sexual orientation. CBM, which is a research validated, formative approach to assessment, empowers teachers to address this diversity.
- Being formative (given repeatedly over time) assessment, CBM helps teachers gather data on students' achievement on an ongoing basis.
- The process of gathering data to make educational decisions also forms an integral part of response to intervention (RtI) process.
- CBM is a dependable tool which teachers can use to assess diverse needs of students, plan and implement intervention in response to these needs, monitor students' response to intervention, evaluate effectiveness of intervention, and make ongoing data-based decisions to provide timely support to all students.
- Students benefit from timely early intervention provided at all levels of intervention and may be spared a label of needing special education services.
- Regular and systematic progress monitoring is an evidence-based practice that will help all students in classrooms at the universal Tier-1 level and not just those students who may need Tier-2 and/or Tier-2 and Tier-3 interventions.
- Early intervention and progress of students may reduce a need for costly special education services and these students may be helped with needed supports based on outcomes of intervention instead with quality early intervention services
- Available funds as such, can be channeled to help students who are in need of special education services.

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