Development and Validation of Curriculum-Based Measurement (CBM) for Identifying Students with Reading Difficulties

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Abstract

The role of classroom teachers in the early detection of learning difficulty/disability in school children cannot be ignored. When it comes to young children's literacy learning, there is substantial consensus that the teacher is the primary assessment agent (Johnston & Rogers, 2002). But classroom teachers also have a lot of responsibilities in school. As such, they need an assessment and identification approach that they can easily employ. Progress monitoring is one of the feasible and practicable methods in identifying students at-risk. Progress monitoring is a set of assessment procedures for determining the extent to which students are benefiting from classroom instruction and for monitoring effectiveness of curriculum (Johnson, Mellard, Fuchs, & McKnight, 2006). It makes use of Curriculum-Based Measurement (CBM), which has been demonstrated by research to effectively gather student performance data to support a wide range of educational decisions, such as screening to identify students with learning disability, evaluating referral interventions, and determining eligibility for and placement in remedial and special education programs (Deno, 2003). This study aimed to develop and validate a set of curriculum-based measurement (CBM) tools to identify students at-risk of reading difficulty in public schools. This study is relevant since the Philippine public school system is in dire need for an alternative method to identify and help students who are at-risk of reading difficulty that is not only valid and relevant, but also cost-effective, teacher-driven, and easily-implemented. The development and validation of CBMs for this study followed the following stages: (1) definition of criterion and performance standards (i.e., "what to measure?"), (2) development of CBM-ORF passages (i.e., "how to measure?"), and (3) assessment of the reliability and validity of the CBM (i.e., how technically adequate are the measures?).

Keywords: curriculum-based measurement, reading disability, test development

Introduction

Early intervention has been shown to help students overcome their reading difficulties and catch up with their peers faster. Citing research studies by the National Institute of Child Health & Human Development, National Institutes of Health, Lyon (2003) stressed that children, particularly kindergarten and elementary school students who have reading problems "can overcome their difficulties and can learn to read at average or above levels, but only if they are identified early and provided with systematic, explicit, and intensive instruction" (p.18).

The role of classroom teachers in the early detection of learning difficulty/disability in school children cannot be ignored. When it comes to young children's literacy learning, there is substantial consensus that the teacher is the primary assessment agent (Johnston & Rogers, 2002). But classroom teachers also have a lot of responsibilities in school. As such, they need an assessment and identification approach that they can easily employ. Progress monitoring is one of the feasible and practicable methods in identifying students at-risk. It makes use of Curriculum-Based Measurement (CBM), which has been demonstrated by research to effectively gather student performance data to support a wide range of educational decisions, such as screening to identify students with learning disability, evaluating referral interventions, and determining eligibility for and placement in remedial and special education programs (Deno, 2003).

This study aimed to develop and validate a set of curriculum-based measurements (CBM) that can be used by public school teachers in identifying students at-risk of reading difficulty.

The Concept of Curriculum-Based Measurement

Curriculum-Based Measurement (CBM) is a set of methods for indexing academic competence and progress that teachers could use efficiently and would produce accurate, meaningful information with which to index standing and growth of students (Deno, Fuchs, Marston, & Shin, 2001, p.508; Fuchs & Fuchs, 1997, p.3). It can be used to screen and identify at-risk students, evaluate pre-referral interventions, determine eligibility for and placement in remedial and special education programs, evaluate instruction, and evaluate reintegration and inclusion of students in mainstream programs (Deno, 2003).

According to Deno (2003), CBM is technically adequate, time efficient, and easy to use. It includes standard measurement tasks, set specifications for the selection of materials to be included in the assessment, and standardized sample duration, administration, student directions, and scoring procedures. In CBM, performance is repeatedly sampled across time, such that students respond to different but equivalent stimulus materials. On the other hand, Shinn (2002) characterized CBM as a set of DIBS or dynamic indicators of basic skills. It is *dynamic* since its measures are sensitive to the short-term effects of instructional interventions, designed as *indicators* of overall performance in an academic area, and intended to quantify student performance only in the *basic skills* areas of reading, spelling, mathematics, and writing, and not in other content area courses.

A CBM score can be viewed as a performance indicator since it produces a broad dispersion of scores across individuals of the same age (inter-individual differences) as well as across different time periods and different interventions for a given student (intra-individual improvement). As such, CBM simultaneously yields information about relative standing as well as change (Deno, Fuchs, Marston, & Shin, 2001).

In the area of reading difficulty, the most common components in the CBM-Reading include word identification fluency (WIF), phonological awareness, and letter knowledge for Grade 1 and WIF and oral reading fluency (ORF) for Grades 2 and 3 (Johnson, Pool, & Carter, n.d.). CBM-ORF focuses on two of the three components of fluency: rate and accuracy. Fluency rate is based on the number of correct words per minute (WCPM) and computed by subtracting the number of errors from the total number of words read. Errors include skipped words, mispronounced words, word substitutions, words in the wrong order, and struggling that lasts for 3-5 seconds. On the other hand, accuracy is computed by dividing CWPM by the total number of words read and multiplying the result by 100.

Stages in the Development of CBM-Reading

In the course of conducting their CBM research program, the University of Minnesota Institute for Research on Learning Disabilities (IRLD) addressed three key questions in developing CBM procedures: 1) "What are the outcome tasks on which performance should be measured? (What to measure"), 2) "How must the measurement activities be structured to produce technically adequate data?" ("How to measure"), and 3) Can the data be used to improve educational programs?" (How to use"). The questions were answered through systematic examination of three key issues relevant to each - the technical adequacy of the measures, the treatment validity or utility of the measures, and the logistical feasibility of the measures (Deno, 2003, p.4).

Given the above requirements, the development of CBMs may follow the following stages: (1) definition of criterion and performance standards (i.e., "what to measure?"), (2) development of CBM-ORF passages (i.e., "how to measure?"), and (3) assessment of the reliability and validity of the CBM (i.e., how technically adequate are the measures?).

Definition of Criterion and Performance Standards. According to Jenkins (2003), inasmuch as the immediate goal of screening is identifying students at risk for unsatisfactory outcomes, screening hinges on the selection of criterion measures and performance levels on those measures. Two decisions go into establishing a criterion. The first is deciding on a suitable measure (i.e., content standard); the second is deciding the performance level (i.e., performance standard) that distinguishes between adequate and inadequate skill. The choice of criterion measures and performance standard is critical because students performing satisfactory on one criterion may perform unsatisfactorily on a different criterion measure. Furthermore, for screening instruments to be useful, they must be sensitive to the skills that pertain at successive stages and grade-levels. They cannot adequately mark individual differences unless they are sensitive to the different skills and performance standards emphasized and required at different grade levels.

With regard to Philippine school setting, it is important to review the curriculum contents and the expected competencies per grade level to identify the standards set by the Department of Education. In 2010, the education department has outlined the expected competencies in all academic subjects in elementary education. The Basic Education Curriculum: Philippine Elementary Learning Competencies (PELC) for English is a listing of expectations in the four phases of Communication Arts – listening, speaking, reading, and writing (Department of Education, 2010). The expected outcomes for each phase are stated in behavioral terms. Reading involves skills in getting meaning from the printed page and includes skills for vocabulary development and levels of comprehension. In PELC-Reading , grade 2 students are expected to "read critically and fluently in correct thought units, texts for information and entertainment and respond properly to environmental prints like signs, posters, commands, and requests" (Department of Education, 2010, p.2). On the other hand, the content standards for Grade 2 competencies in English in the K-12 Basic Education Curriculum include oral language, grammar, vocabulary development, listening comprehension, attitude towards language, literature and literacy, and study skills (Department of Education, 2012).

Furthermore, to get a more comprehensive view of the expected reading skills and competencies per grade level, a review of research conducted abroad is worth considering, such as those carried out by the National Reading Panel. The National Reading Panel identified five critical areas for effective reading instruction. These include phonemic awareness (i.e., the ability to hear and manipulate individual sounds in spoken words), phonics (i.e. knowledge of the relationship between letters and sounds in spoken language), fluency (i.e., the ability to read text accurately, quickly, with expression, and with correct phrasing), vocabulary (i.e., knowledge of words required to communicate and comprehend spoken and

written language), and text comprehension (i.e., the ability to obtain and construct meaning from written language (RAND Reading Study Group, as cited in Waterford Institute, n.d.).

Development of CBM-ORF Passages. According to Jenkins (2003), for screening measures to be useful, they must be sensitive to the skills that pertain to successive stages and grade-levels. Measures or tests cannot adequately mark individual differences unless they are sensitive to the different skills emphasized at different grade levels.

Two types of performance have been used in CBM-Reading: some emphasizing accuracy while others, emphasizing fluency. Accuracy measures distinguish students according to the number or percent of correct responses on tasks (i.e., knowledge) while fluency measures distinguish students according to the number of correct responses per minute (i.e., knowledge and speed of processing) (Jenkins, 2003). The number of correct word choices per minute is the primary metric (Shinn, 2002).

Fuchs and Fuchs (2011) identified the correct CBM task for students who are developing at a typical rate in reading: Letter Sound Fluency (or Phoneme Segmentation Fluency) for Kindergarten, Word identification Fluency for Grade 1, Passage Reading Fluency for Grades 2-3, and Maze Fluency for Grades 4-6. DIBELS also make use of oral reading fluency (ORF) passages for Grade 2 students. Speece and Case (2001) in their study on the identification and classification of Grade 2 students with reading disability also made use of ORFs.

Establishment of the Technical Adequacy of the CBM-ORF and CBM-WIF. Different forms of reliability and validity indices have been used to establish the technical adequacy of curriculum-based measurement. Reliability measures included test-retest and alternate form while the criterion validity was measured by correlating the scores on the CBM measures with teacher ratings and norm-referenced tests of reading and mathematics ability (Foegen, Lembke, Klein, Lind, & Jiban, 2008; Jiban, Deno, & Foegen, 2009; Lembke & Foegen, 2005; Lembke, Foegen, Whittaker, Hampton, & Jiban, 2008).

Objectives of the Study

The study sought to develop and validate Curriculum-Based Measures (CBM)-Reading that are fitted to the context of the Philippine public school system and based on the Philippine Basic Education Curriculum (2010), K-12 Curriculum Guide (2012), and the National Reading Panel standards.

Method

The development of CBMs for this study followed the following stages: (1) definition of criterion and performance standards, (2) development of CBM-ORF passages, and (3) assessment of the reliability and validity of the CBM.

Table 1 presents the activities conducted in the CBM development and validation. Sources of data, sampling design, data gathering procedures, and data analysis are described specific to each stage.

Table 1
Activities Conducted During Phase I: Development of CBM-Reading

Stages	Activities
Definition of Criterion and Performance Standards	Review of the following: • Basic Education Curriculum: Philippine Elementary Learning Competencies (PELC) for English • K-12 Curriculum Guide – English (Grades 1 to 3 and Grades 7-10) • Five Critical Components of the National Reading Panel

Cont. Table 1	Content validation of curriculum map by US-based reading expert
	Use of the following performance standards:
	• Actual performance level and growth rate after 8 weeks of progress monitoring
	• Expected performance levels (i.e., performance goal and DIBELS' criteria of ≥26 CWPM) and expected growth rates (i.e., 1.1 growth rate and 2.0 ambitious growth rate) after 8 weeks of progress monitoring
Development of CBM-ORF Passages	Development of 30 ORF passages based on following sources:
	• textbooks used by Grades 1 and 2 students
	• commercially-available storybooks, and
	• grade level-appropriate reading passages available on websites
	Content analysis of 30 ORFs by 60 Grades 1-3 public school teachers
	Pretesting of ORF passages to 10 Grades 1-4 public and private students
	Subjecting of 30 passages to Spache Readabililty Test
	Selection of appropriate ORF passages, i.e., only those rated highly by teachers, can be read accurately and fluently by students, and with appropriate readability level
	Addition of six more ORF passages
	Revision and finalization of ORF passages
	Development of two sets of Word Identification Fluency (WIF) List based on Dolch Basic Sight Word List
Establishment of Technical Adequacy of ORF and WIF	Conduct of the following reliability tests:
	• test-retest reliability
	• alternate-form reliability
	Subjecting ORFs and WIFs to criterion validity test by:
	• correlating students' CBM scores with teacher ratings

Results

The following presents the development of the CBM Oral Reading Fluency (ORF) and Word Identification Fluency (WIF) tests as well as the establishment of their reliability and validity.

Development of Curriculum-Based Measurement

Definition of Criterion and Performance Standards. The criteria or standards used were primarily based on two sources: (1) Basic Education Curriculum: Philippine Elementary Learning Competencies (PELC) for English (Department of Education, 2010), and (2) K-12 Curriculum Guide – English (Grades 1 to 3 and Grades 7-10) (Department of Education, 2012). The national guidelines (i.e., National Reading Panel's 5 components) and key state standards for reading instruction in the US that were adopted by the Waterford Early Reading Program were also reviewed to guide in the identification of reading standards for Grade 2 students.   Based on these three sources, a curriculum map for Grade 2-ORF that spells out the expected skills and competencies was developed. A US-based reading expert then content-validated the curriculum map to determine its applicability and appropriateness to Grade 2 students' expected reading skills.

With regard to performance standards, two criteria were used as benchmarks: (1) actual performance level and growth rate, and (2) expected performance level (i.e., performance goal and DIBELS criteria of ≥26 CWPM) and expected growth rate (i.e., growth rate of 1.1 and ambitious growth rate of 2.0) after 8 weeks of progress monitoring (Table 2).

Development of CBM-ORF Passages and CBM-WIF Lists. A total of 30 ORF passages, which were appropriate over the first grading period, were developed. The passages were drawn from multiple sources: textbooks used by Grades 1 and 2 students both in Philippine private and public schools, commercially-available storybooks, and grade level-appropriate reading passages available on websites. Reading materials that were not

curriculum-related were also included since most current CBMs, such as the DIBELS, are generic and cover contents that were drawn from sources other than any specific school's curriculum.

The 30 prototype ORF passages were subjected for review by 60 Grades 1-3 public school teachers from Luzon who had a summer training program for multi-grade teachers. The teachers were asked to validate the reading passages based on five criteria: efficiency, accuracy, specificity, effectiveness, and sensitivity, using a 3-point rating scale.

Table 2
Criteria and Measures Used for Performance Standards

Performance Standards	Criteria	Measures
Actual Performance Level	Performance level at the end of 8-week progress monitoring	Correct words per minute (CWPM) on ORF or WIF
	Actual growth rate	$$\frac{\text{CWPM on Week8} - \text{CWPM on Week1}}{7 \text{ (weeks)}}$$
Expected Performance Level	Performance goal at the end of 8-week progress monitoring	ambitious growth rate (i.e., 2.0) X number of weeks (e.g., 8 weeks) + original performance level
	Expected growth rate	1.1 words per week growth
	Ambitious growth rate	2.0 words per week growth

Furthermore, the same passages were pre-tested to 10 Grades 1-4 public and private students to determine the readability and appropriateness of the reading passages and were tested for readability using the Spache Readability Formula. Only those that were rated highly and endorsed by the teachers, those that can be read accurately and fluently by the students, and those with appropriate readability level were selected. Furthermore, six more ORFs were drawn from the textbooks and reading program websites. Since it was observed that public school students had difficulty in reading some of the prototype ORF passages as compared with those from private schools, the prototype ORF passages were revised. A readability test, using the Spache Readability Formula, was again run on all the revised ORFs. ORF passages with 1.5 to 2.4 reading level (i.e., equivalent to Grade 2 level) were chosen.

Another type of CBM, namely the Word Identification Fluency (WIF) list was developed for Grade 2 students who do not have reading fluency skills. While WIF is normally used to monitor students' overall progress in reading at first grade, Fuchs and Fuchs (2011) suggested that "if the student reads fewer than 10 correct words in 1 minute, use the CBM word identification fluency measure instead of CBM PRF or CBM Maze Fluency for progress monitoring" (p.11). A total of 150 words were randomly chosen from the Dolch Basic Sight Word List (Shanker & Ekwall, 1998), from which two (2) sets of CBM-WIF with 50 words each were developed.

Validation of the CBM-ORF Passage and WIF List

To determine the technical adequacy of the CBMs, their reliability and validity indices were determined. Test-retest and alternate- form reliability were conducted for only three of the ORF passages and one WIF. Test-retest was based on the scores (i.e., CWPM) of 54 Grade 2 students. On the other hand, the alternate-form reliability was determined by correlating the three ORFS and WIF that were administered during the first day or the next testing session. This was done since according to Daniel (2010), "for a speeded measure such as oral reading fluency, which is scored on the number of words read correctly in 1 minute,

reliability must be based on scores from independent administrations… The ideal type of reliability study … is one in which scores on parallel (alternate) forms are obtained on the same day or within a span of no more than 2 weeks." (p. 1). Results in Table 3 present the reliability and validity coefficients of ORF and WIF as well as the criterion validity coefficient of the CBM-Reading.

Table 3
Test-Retest and Alternate Form Reliability and Criterion Validity of the CBM-Reading

Reliability/Validity	CBM	Reliability Coefficients
Test-Retest	ORF 1 (N=53)	0.98
	ORF 2 (N=44)	0.96
	ORF 3 (N=38)	0.98
	WIF (N=30)	0.92
Alternate-Form	ORF1 vs. ORF 2	0.98
	ORF1 vs. ORF 3	0.98
	ORF2 vs. ORF3	0.99
	ORF1 vs. WIF	0.64
	ORF2 vs. WIF	0.62
	ORF3 vs. WIF	0.59
Criterion Validity	CBM-Reading vs. Teacher Rating	0.58

The three ORF passages and the WIF list exhibited very high test-retest reliability, as shown by reliability coefficients of more than .90. This indicates that these CBM measures exceeded the acceptable reliability coefficient, indicating their ability to produce consistent results over time. Likewise, the correlations among the three ORF passages were very high, also surpassing the .90 mark. This indicates that the three passages were very similar. On the other hand, correlations between ORF passages and WIF list were moderate, ranging from .59 to .64.

The results were consistent with those found in the literature. Since the 1980's, studies conducted have "concluded that test-retest reliability coefficients of CBM reading ranged from .82 to .97 with most estimates being above .90… (and) parallel form reliability … from .84 to .96, with most correlations above .90" ("Historical Background", n.d., , p. 1).

The criterion validity CBM-Reading was measured by correlating the students' CWPM on the CBM-Reading with their class advisers' ratings of their reading proficiency using the Teacher Rating Scale on Student Reading Competencies. Fifty (50) of the initial pool of sample of 54 students who have complete data were included in the analysis. A correlation coefficient computed was .58, indicating moderate correlation between teacher ratings and CBM scores. This result was again consistent with those found in the literature. Hamilton and Shinn (2003) indicated that previous studies reported "moderately strong correlations between teacher judgment and the criterion reading measure – ranging from .41 to .86 (median $r = .73$)" (p.2).

Conclusion and Recommendations

The Philippine public school system is in dire need of assessment method to identify at-risk students, particularly students who are at-risk of reading difficulties/disabilities. Coming up with an identification methods that is applicable and valid in the public school setting is warranted since it was reported that in SY 2003-2004, only one-sixth to one-third of pupils in the City Schools Division of Manila could read independently at the desired grade level, with over one-third of the graduates identified as "frustrated" readers and another third as "instructional readers" by the end of the elementary cycle, both of which were below the desired reading level (Schools Division of Manila, as cited in Luz, 2007).

It is shown in this study that the use of Curriculum-Based Measurement (CBM) is applicable to the Philippine public classrooms. It is a feasible/viable, reliable, and valid

assessment method to identify students at-risk of reading difficulty. CBM is feasible since it can be used efficiently by the teachers, inexpensive, and administered many times in different but parallel forms during the school year (Shinn, 1989). This approach also resembles the classroom assessment and evaluation practices in Philippine classrooms. This also does not make use of foreign-made standardized intelligence and achievement tests, which are very expensive and believed to be inapplicable to the Filipino milieu. CBM is reliable since it can produce consistent results over time as shown in the test-retest reliability coefficients. It also showed high alternate-form reliability. CBM is a valid screening and identification tool since the measures included in the CBM are based on sound theoretical framework, on the expected competencies as defined by the Department of Education, and on the required developmental tasks for each level. It also exhibited criterion-related validity as it showed moderate correlation with teacher ratings.

While this study has shown the practical implications and the technical adequacy of CBM for use in the Philippine public school, more research need to be conducted, involving more schools, different grade levels, other subjects areas. Predictive validity of CBM also needs to be established by using various criterion measures of achievement.

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