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ABSTRACT

The purpose of this study was to investigate the relationship between the KeyMath Diagnostic Arithmetic Test and the California Arithmetic Test when used with children identified as having specific learning disabilities. The samples consisted of children in grades one through three enrolled in a diagnostic, prescriptive, remedial Resource Room program for children with specific learning disabilities. These children were from three of the eight schools housing the program. Both tests were administered in late September and early October and again in May. Pearson product-moment correlation coefficients were computed for each pair of variables, as were 95% confidence intervals. The validity coefficients and the lower limits of the 95% confidence intervals were significant at least at the 0.05 level. The results suggest that there is a significant positive relationship between the KeyMath and the California tests for the learning disabled population under study. (Author/SD)

The KeyMath Diagnostic Arithmetic Test: Use with Learning Disabled Students

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Various authors (Gronlund, 1971; Johnson and Myklebust, 1967; Jones, 1973; Lerner, 1971; Reisman, 1972) agree that diagnosis and evaluation should be available to students and should be used in planning an educational program for each individual. Included in the diagnosis should be both assessment of how the child learns (learning modalities, learning styles) and how much he has achieved in each of the academic areas. Evaluation should be continual so that program plans may be changed as necessary toward achieving whatever educational goals have been set.

There is much writing to be found in learning disabilities literature that focuses on perceptual development, language development, and reading, but relatively little available on arithmetic disabilities and their diagnosis.

The California Arithmetic Test (CAT) (Tiegs & Clark, 1963) has been widely used as an achievement measure. An advantage of this test has been the "Diagnostic Analysis of Learning Difficulties" which catagorizes the items and thus provides a gross approximation of strengths and weaknesses.

This and other standardized measures provide questionable results when administered to children in special education programs if normative data on such groups have not been established. Even when data is available on samples of handicapped children, the lack of national agreement on definitive identifiable characteristics and the inconsistency in labeling of groups such as emotionally disturbed, brain injured, learning disabled, dyslexic, etc. make generalization of test data dubious. Although use of criterion-referenced rather than norm-referenced tests has been proposed (Proger & Mann, 1973), the need for norm-referenced data to determine large scale program accountability in the public schools makes the rejection of norm-referenced measures unlikely.

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There is need for instruments that provide maximum achievement and diagnostic data and that can be administered by regular school personnel with a minimum of training. The KeyMath Diagnostic Arithmetic Test (Connolly, Natchman, & Pritchett, 1971) offers an alternative to the CAT.

Instruments

The CAT, which is administered to groups, provides grade level scores for Arithmetic Reasoning, Arithmetic Fundamentals, and Total Arithmetic. Both Upper Primary (UP) and Lower Primary (LP) forms include subtests in Meaning and Problems as the area of Reasoning; the UP form adds the subtest of Signs & Symbols. The area of Fundamentals includes the basic operations. Only addition and subtraction are tested on the LP form. The UP form tests all operations, but does not include the division score in the computation of the Fundamentals or Total scores.

The KeyMath is an individually administered test in easel form. It is designed to be used generally in grades K-6, but may be used with older subjects in clinical or remedial settings. Fourteen subtests are grouped into three areas as shown in Table I. A total grade equivalent score is provided as well as relative performance profiles between areas and between subtests.

The CAT is a speed test, whild the KeyMath is a power test. Both provide normative data, grade equivalent scores, a diagnostic record, and detailed instructions. Neither test provides normative data or reliability data for groups of children with specific learning disabilities.

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TABLE I

AREAS AND SUBTESTS OF THE KEYMATH

DIAGNOSTIC ARITHMETIC TEST

Content	Operations	Applications
Numeration	Addition	Word Problems
Fractions	Subtraction	Missing Elements
Geometry & Symbols	Multiplication	Money
	Division	Measurement
	Mental Computation	Time
	Numerical Reasoning	

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Method

Subjects for the study were enrolled in the Child Study Center Resource Room program in Howard County, Maryland. Children were accepted for the program according to the definintion set by the National Advisory Committee on Handicapped Children of the U. S. Office of Education: "Children with special learning disorders exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language. These may be manifested as disorders of listening, thinking, talking, reading, writing, spelling, or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do NOT include learning problems which are due primarily to visual, hearing, or motor handicaps, to mental retardation, emotional disburbance, or to environmental disadvantage." This diagnostic/remedial program was in operation in grades Kindergarten through three in eight elementary schools during 1972-73. Three Centers used both the CAT and the KeyMath in a pre/post test battery and provided the data for this concurrent validity sutdy.

Tests were administered in late September and early October 1972 (sample A, N=57) and readministered in May 1973 (sample B, N=68). There were 56 subjects who were in both samples A and B.

Raw scores of each subtest were recorded and grouped in order to test the following null hypotheses: there is no significant correlation between (1) the total scores of each test, (2) the Reasoning area of the CAT and the Content & Applications area of the KeyMath, and (3) the Fundamentals area of the CAT and the Operations area of the KeyMath. Means, standard deviations, and Pearson Product-Moment correlation coefficients were computed, and the significance levels of the lower limits of computed 95% confidence intervals were determined.

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Results

Comparison of the total scores of the CAT and KeyMath yielded validity coefficients of .9267 and .8552 for samples A and B respectively (significant at the 0.001 level). The lower limits of the 95% confidence intervals (A=.887, B=.775) were each significant at the 0.001 level.

In comparing the Content & Applications area of the KeyMath and the Arithmetic Reasoning area of the CAT, validity coefficients of .6688 and .5393 were obtained for samples A and B (significant at the 0.001 level). The lower limit r for sample A was .495 (significant at the).001 level), and for B was .345 (significant at the 0.01 level).

The correlation coefficients obtained by comparing the Operations area of the KeyMath and the Arithmetic Fundamental area of the CAT (A=.8940, B=.7760) were also significant at the 0.001 level, as were the lower limits of the 95% confidence intervals (A=.828, B=.659).

On the basis of this data all three null hypotheses were rejected.

Pearson r's, confidence intervals, and significance levels were also determine for each sample by grade and by sex. Validity coefficients for the tltal scores of the CAT and KeyMath were significant at the 0.001 level for each group. The lower limits of the 95% confidence intervals were significant ($p<.05$) for all groups with the exception of the third grade results in both samples.

Comparison of the KeyMath Content & Applications area and the CAT Reasoning area resulted in validity coefficients which were significant in all instances. The lower limit r's were significant for males and females in sample A, for first grade subjects in both samples, and third grade subjects in sample A.

The Operations area of the KeyMath correlated significantly with the Fundamentals area of the CAT in all instances, and each corresponding lower limit r was also significant.

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TABLE II

RAW SCORE MEANS AND STANDARD DEVIATIONS

	Mean		Standard Deviation	
	A (N=57)	B (N=68)	A (N=57)	B (N=68)
California Arithmetic Test				
Reasoning	14.7544	25.5147	9.8039	9.2049
Fundamentals	30.2456	45.8676	32.5315	33.7607
Total	45.0000	69.3824	37.5847	36.3614
KeyMath				
Content & Applications	43.6667	57.3676	17.9477	18.3416
Operations	15.9649	23.2353	8.2505	9.0110
Total	59.6316	80.6324	25.6519	26.8244

TABLE III

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS

CAT	KeyMath Diagnostic Arithmetic Test		
	Content & Applications	Operations	Total
	Sample A (N=57)		
Reasoning	.6688*		
Fundamentals		.8940*	
Total			.9267*
	Sample B (N=68)		
Reasoning	.5393*		
Fundamentals		.7760*	
Total			.8552*

*$p < .001$

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Discussion

With the learning disabled population under study, the KeyMath is as valid an instrument as the California Arithmetic Test for determining achievement levels. Thus, either test can be used to obtain achievement levels before and after instruction in order to obtain a gross measure of the progress made by each student and by each group between test administrations.

If, however, the testing is to be part of an educational evaluation, the KeyMath offers notable advantages over the CAT. The KeyMath tests more of the current math curricula, requires neither reading nor writing, offers a simplified visual presentation, and allows the skilled diagnostician to observe behavior closely during the individual administration. It gives an indication of the child's arithmetic functioning overall, between the areas of Content, Applications, and Operations, and between the fourteen subtests.

Further research is needed to determine the reliability and validity of the KeyMath with learning disabled students in general, and with groups of learning disabled students separated according to specific disabilities. Also, research is needed to determine which aspects of the KeyMath might be questionable in relation to a child's specific language disability. One approach to such a study would be the interpretation of a multiple correlation of the KeyMath and the ITPA.

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