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AUTHOR Milazzo, Patricia; And Others
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ABSTRACT

A learning opportunity risk is defined as an absence of instruction or insufficient attention to proficiency at an early grade of instruction in a subject matter which will generate serious learning problems in later grades. A method for identifying such risks has been derived from analysis of district-level Instructional Accomplishment Information (IAI) data bases. The method involves examination of patterns of instructional accomplishments in the first through sixth grades as they relate to the scope, sequence, and emphasis of grade-by-grade instruction. The operational elements of the method are: (1) learning opportunities--skill areas on which instructional time is actually invested in a given subject matter at a given grade level; (2) instructional accomplishments--the mean percentage of student performance arrayed by skill areas and school grades; and (3) learning opportunity risks--patterns of instructional accomplishments within and across grade levels that appear to depress subsequent instructional performance. The method is illustrated for the subjects of elementary school mathematics and reading in two rural southern school districts. (JD)

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Patricia Milazzo, Aaron Buchanan, Adrienne Escoe, and Richard Schutz

Abstract

A learning opportunity risk is defined as an absence of instruction or insufficient attention to a proficiency at an early grade of instruction in a subject matter that generates serious learning problems in later grades. A method for identifying such risks is described, deriving from analysis of district-level Instructional Accomplishment Information System data bases. The method is illustrated for the subjects of elementary school mathematics and reading.

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METHOD FOR ANALYZING DISTRICT LEVEL IAI DATA BASES TO IDENTIFY LEARNING OPPORTUNITY RISKS

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Introduction

The intention to diagnose learning difficulties is pervasive to instructional planning, delivery, and assessment, but the methods that are used are incomplete and often maladaptive. Conventional methods for instructional diagnosis (e.g., interpretation of grade equivalent scores using norm referenced data, or skill mastery based on data from criterion-referenced tests) tend to illuminate shortcomings attributable to students, education personnel, and/or education agencies rather than to shed light on intended accomplishments and unintended risks generated as a consequence of the investment of instructional time to date. Instructional Accomplishment Information (IAI) systems provide instrumentation for illuminating consequential relationships among learning intentions, opportunities, accomplishments, and risks. Information about instructional accomplishments contrasted with information about learning opportunities is the basis for a new and straightforward kind of analysis where discrepancies between instructional accomplishments and learning opportunities can often be interpreted as learning opportunity risks.

The present report, dealing with the identification of learning opportunity risks, extends the methodological procedures for analyzing IAI district level data bases. The methodology is compatible with and complements the methodology described and illustrated in earlier reports (Milazzo, Buchanan, & Schutz, 1981; Behr & Bachelor, 1981; Milazzo, 1981) dealing with the analysis of instructional accomplishments.

The methodology to be presented is most conveniently described via a particular application growing out of the Cooperative School Improvement Program of Educational Laboratories and R&D Centers, a program sponsored by the National Institute of Education and coordinated by the Council for Educational Development and Research. The data presented are from the implementation of a school improvement effort initiated by the Appalachia Education Laboratory and SWRL, collaborating with a State Department of Education and a major state university in the Deep South. Two rural districts with high concentrations of low SES students took the lead initiative in the improvement implementation.

Although the emphasis of the present report is methodological, the substantive results are also interesting. It is commonly held that the school achievement of low SES students in the rural south is particularly weak, and there is a good amount of data on national achievement tests to support such a contention. However, a different and far less gloomy perspective is obtained when the focus is placed on specific skills that students do or do not spend time learning and practicing. Data support a contention that SWRL has confirmed consistently in other situations: schools can demonstrate bona fide student accomplishments grade-by-grade in reading and mathematics on most of the critical building blocks for long-range skill development, as well as on other important skills (see Hanson, Bailey, & Schutz, 1980; Milazzo & Buchanan, 1981). Data consistently show that accomplishments are strongest where sets of materials, such as textbooks, concentrate instruction, and weakest where the concentration in these materials is thin and fragmented. No comprehensive set of materials is perfect. To the contrary, nearly all mathematics and reading textbook series used widely across the country have areas of concentration and "thin spots" in common. (See Buchanan, 1979; Escoe, 1981.) Textbooks generally provide necessary and sufficient guidance for many or most students to learn <u>some</u>, but not all, skills well.

There <u>are</u> serious problems in skill development in the elementary grades that have a long-range impact on achievement through the high school years. However, the actions necessary to eliminate a number of these problems are remarkably straightforward. Mostly, they involve small but highly consequential adjustments in instructional practices, and they are actions which schools can implement directly, over the short range, with a sure and swift effect on achievement. Most importantly, the patterns and conclusions that are characteristic of the present sample of low income, rural, southern students generally reflect the broader sample of students from most parts of the United States who have participated in SWRL's Instructional Accomplishment Information inquiry over the years. So, what is reported here as a specific inquiry of a specific geographic region, has meaning for a much broader population of students and schools. Finally, this regional iteration of a line of inquiry affords the authors another opportunity to clarify and enhance the notion of school improvement built upon solid information bases.

A description of the populations of students participating in the present inquiry and descriptions of the assessment instrumentation and administration procedures are provided in the Appendix, which readers interested in these technical aspects may wish to consult at this point.

Operational Elements of the Method

The method involves examination of patterns of instructional accomplishments as they relate to the scope, sequence, and emphasis of grade-by-grade instruction.

Learning opportunities constitute skill areas on which instructional time is actually invested in a given subject matter at a given grade level. These skill areas constitute the architectural framework of the IAI instruments that are administered to students.

Instructional accomplishments are expressed in terms of mean percentage of student performance arrayed by skill areas and school grades.

Learning opportunity risks are identified by examining the pattern of instructional accomplishments within and across grade levels to determine structural deficiencies that appear to depress subsequent instructional performances.

Not all deficiencies in instructional programs are critical. However, instructional flaws that occur at strategic points in the structure of K-6 instruction--in the supporting beams, if you will--are critical. To push the structural analogy a bit further, no one likes to live with weak construction in any part of a house. However, we can disregard weaknesses that appear during the course of the construction, if we can be confident that these apparent weaknesses will be eliminated during the later course of the construction and maintenance. It is not sensible to devote additional "remedial" attention to such matters; they are not structural risks. On the other hand, weakness in any supporting beam needs immediate attention; and the best opportunity to strengthen this part of the structure is early in the building process, before too much additional construction overlays it.

The Method Applied in Mathematics

The charts on the next two pages represent a reduction of the comprehensive IAI data from the two rural southern districts participating in this application. Skills categories typically found and emphasized in K-6 textbook series are listed in the left-most column, and the elementary grades are displayed across the top row. The cells in each chart describe 1) an overall performance level for each skill category and 2) particular information on the specific skills in each category that seem to explain the performance level. In a way, the charts are a "blueprint" of mathematics instruction and achievement in the two districts, and they look very much alike. The fact is that most districts participating in IAI inquiry over the years have achievement patterns similar to these patterns, be they suburban, urban, or rural, pacific northwest, west, midwest, or southwest districts.

District Number 1—Mid-Year Skills Inventory: Mathematics

Age/Grade Level[a] Skill Category	Grade 1 (n 195)	Grade 2 (n 163)	Grade 3 (n 151)	Grade 4 (n 165)	Grade 5 (n 147)	Grade 6 (n 150)
Number Recognition	70% Counting to 10 is strong (but place value to [illegible] a model of count) is very weak	74% Much stronger on place value with numbers to 99. Numbers to 999 are still difficult for most PVS users	55% Word form to 999 should be stronger. Although larger numbers and place value are coming along, more students should show proficiency here	66% Place value with large numbers is very difficult word form/standard numeral [illegible] for numbers less than 999,999 (millions were difficult for most PVS users)		
Order and Comparison of Whole Numbers	68% Number relationships (more/less) is weak. So is counting order	76% Very strong on number relationships at this grade. Only < > symbols are depressing the average	75% Counting order to 9999 coming along. Number relationships (more/less) could be stronger for larger numbers to 9999			
Addition and Subtraction Facts to 10	82% Facts should be stable for more students. More work on harder + − facts, especially −	63% Strong. Do best on addition facts	67% Hard subtraction facts could be stronger			
Addition and Subtraction Facts to 20		85% Strong. Could get even more students proficient on the hard subtraction facts. More practice				
Multiplication Facts with 0-5 as One Factor		46% About half of the students know these facts (will repeat in grade 3; Most PVS Districts look like this in grade 2)	72% More students are coming on line, but should be much closer to 100%	67% Most students have stable × facts. ÷ facts are stable for most, although could do better on 9s. Need this level of proficiency by end of grade 3/beginning of grade 4. (As well or better than most PVS users on this skill, however)	92% Most students have stable × ÷ facts. However hard × facts (7s, 8s, 9s) could be even stronger in the District. Should see this level of achievement by mid-year of grade 4	
Multiplication Facts with 6-9 as One Factor			44% By the end of grade 3, the number of students who can do the hard × facts needs to double or grade 4 will be very difficult			
Division Facts with 1-5 as Divisor or Quotient			62% Should have more students who can do the easy ÷ facts by mid-year. Will have trouble in grade 4			
Division Facts with 6-9 as Divisor or Quotient			36% The District needs to have most students proficient on the hard ÷ facts by the end of 3 or grades 4, 5, and 6 will be difficult, and the ÷ algorithm will be especially hard			
Addition and Subtraction Algorithms		58% Strong when there is no regrouping. Almost no students can + or − with regrouping. Work on this skill at grade 2 will help grades 3-5.	38% Most students cannot regroup, especially with subtraction. A lot more practice at the end of 2, beginning of 3	68% About like most PVS users. Serious difficulty with subtraction with regrouping. Addition with regrouping is more stable for most students	66% Regrouping in addition, even with large numbers, is stable for most students. Regrouping in subtraction with 4- and 5-digit numbers is not stable for many students	
Multiplication and Division Algorithms (1- and 2-digit divisors/multipliers)			19% Very weak. Probably better to work on × ÷ facts. Work on algorithms should be with easy facts only	62% 3 digits in dividend/multiplicand—most students cannot compute 2-place divisors, remainders, 2-place multipliers—are weak—most students don't know. 1 place multiplier is stronger		
Multiplication Algorithms (2- and 3-digit multipliers)					55% Most students are proficient with 1 place multipliers. 2 place multipliers are coming along and 3 place multipliers are weak	67% 2- and 3-place multipliers are stable for most students in the District. Division with 2-3 place divisors and 2 place quotients or with 0 in the quotient is still not stable for more than half of the students
Division Algorithms (2- and 3-digit divisors)					58% Most students are proficient with 1 place divisors, even with remainder. 2 place divisor with 2-place quotient is weak. (Remember 2-place divisor with 1-place quotient was weak in grade 4.)	
Recognition/Comparison of Fractions		24% Almost none of these students could give/associate a fraction with a set or region. Need to understand unit fractions, whole/part	4% Students in almost all districts in PVS are at about this performance level. Need to understand common fractions, whole/part, numerator, denominator	37% About 50% of students skipped this skill. Those who took it were weak on equivalent fractions which will hurt computation with fractions in 4-6	35% Very few students took this section of the survey. Most of these students do not seem to understand equivalent fractions or lowest terms fractions	38% Equivalent fractions are much better but still less than half the students can answer these questions in general
Addition and Subtraction of Fractions				14% About 80% of students skipped this skill. Those who took it could not compute with regrouping, or with unlike denominators or with mixed numbers. Still have to work on + − with unlike denominators in grade 5	31% Only a few students took this section and most could not + or − fractions with unlike denominators or with regrouping. They cannot do equivalent fractions, which makes regrouping difficult. They do well with multiplication of common fractions	27% Very few students took these items. Both + − of fractions with unlike denominators are improved as long as no regrouping. Almost no students can regroup
Multiplication and Division of Fractions						12% Almost no students could divide with fractions. Multiplication involving mixed numbers or answers in lowest terms also difficult for nearly all students
Recognition and Comparison of Decimals					21% Most students skipped this skill. Ones that took it could not do equivalent decimals, especially with ragged decimals	33% Some students can compare two ragged decimals in thousandths. Almost no students can give a decimal for a fraction
Addition and Subtraction of Decimals					49% The students who took these items could + − with decimals as long as not ragged decimals. Multiplication with decimals is coming along. Need practice on placing the decimal point	55% Coming along, still finding ragged decimals difficult—otherwise performances are high
Multiplication and Division of Decimals						21% Generally, students do not know where to put the decimal point, especially in division
Recognition and Comparison of Percents						14% Almost no students could give the percent form for a fraction. Will need this skill in grades 7-9
Geometry	84% Very strong on geometric shapes, patterns are a little difficult for all PVS users	86% Strong geometric shapes and properties				
Measurement	23% Unusually weak. Most other grade 1 students in Houghton Mifflin's MSM do well here. (Many students may not have rulers?)[b]	68% Time and money are about at the typical level of proficiency. Length to the nearest inch/cm still weak	46% Measurement skills are considerably out of line with other PVS users, time money combinations length—all reasonably easy to address in a few lessons	41% Still much weaker than most PVS users. Time to minute should be better. Almost no one can measure to nearest ¼ ½ inch. Can teach in a few lessons	32% Most students (70% or 50%) are still weak in measuring length to nearest ¼ inch. Metric geometry given formulas also weak	28% Metric geometry is difficult for most PVS users. Volume, area—even given formulas—don't stabilize in grades 5 and 6
			47% Generally reflects problems with [illegible]	39% Generally reflects difficulty with computation. Do very well on money problems	51% Strong performances on graphs and problem solving with money. Otherwise the low average reflects general difficulty with computation	22% Generally reflects difficulty in computing with fractions and percents and in applying formulas (perimeter, volume) to solve problems
General Notes	• Facts to 10 could be stronger. More practice • Number relationships should be stronger—more/less, [illegible] • Place value is weak but students typically do not [illegible] to well • Measurement is unusually weak and many students are not even assessed on this category[b]	• Hard subtraction facts could be stronger • Having more students able to + − with regrouping will allow for more success in the later grades. There's time in grade 2 to get ahead here. Most PVS users weak here • Measuring in inches/cm still weak • Recognition of unit fractions, familiar fractions important for later grades. Work on whole/part	• [illegible] facts with 0-9 as one factor need to be stable for most students by end of grade 3. More practice • Regrouping in + − is a real problem. More work at the end of grade 2, beginning of grade 3 • Measurement skills [illegible] • Recognition of common fractions and understanding of whole/part relationship of numbers is critical to success on equivalent fractions in grade 4, which is critical for computation with fractions at grades 4-6	• [illegible] should be stable for most students by [illegible]. Work on 2 place divisors with 1 place quotient will help grade 5 • Subtraction with regrouping should be stable for most students by [illegible] • Measurement is still [illegible] out of line with other PVS users, especially time and length • Need to know equivalent fractions or will not be able to handle computation with fractions in grades 5 and 6	• Most Districts in PVS have [illegible] • [illegible] • More work on equivalent fractions and ragged decimals	• Students will need to [illegible] • [illegible] • [illegible] with 2 place [illegible] • More work on 2 place [illegible] with 2 place [illegible]

[a] [illegible]

[b] Measurement at grade 1 [illegible] out of line with other PVS users [illegible]

Skill Category (Age/Grade Level*)	Grade 1 (n 54)	Grade 2 (n 68)	Grade 3 (n 151)	Grade 4 (n 233)	Grade 5 (n 159)	Grade 6 (n 90)
Number Recognition	70% Place value is unstable [illegible] for all PVS users but these students are weaker	59% Place value with 3-digit numbers is very weak	67% Trouble with reading word form of large numbers; place value still shaky	46% Very weak in reading word form of very large numbers; place value even shakier with very large numbers; the [illegible] symbols still difficult for many students		
Order and Comparison of Whole Numbers	71% Weak on number relationships (more/less); Counting order is weaker than for most PVS users	76% More/less is much stronger. Don't know [illegible] symbols	82% More/less still strong, even with large numbers. Still don't know [illegible] symbols			
Addition and Subtraction Facts to 10	81% Strong. Most users even stronger though	94% Facts to 10 are strong	96% Very strong [illegible] facts by mid year grade 3. Should come sooner			
Addition and Subtraction Facts to 20		81% Pretty good. Ought to work more on hard subtraction facts in grade 2				
Multiplication Facts with 0-5 as One Factor		40% Should be stronger. Will help performances in grades 3 and 4 if more students learn concepts behind simple facts here	74% Improving but should be stronger or grade 4 achievement will truncate. (Need work on multiplying with 0.1)	71% Multiplication facts are pretty strong however, even more work in grade 3 will help students performances on the algorithm in this grade and in grade 5. Division facts, especially the hard facts, are not stable; will have a serious effect on students performances on the algorithm in this grade and in grade 5	67% All strong but a little late. Should look like this by mid year in grade 4	
Multiplication Facts with 6-9 as One Factor			60% A little weak. Not bringing enough students along on the hard facts will slow down grades 4 5 progress			
Division Facts with 1-5 as Divisor or Quotient			59% A little weak. More drill at this grade level is important			
Division Facts with 6-9 as Divisor or Quotient			45% Don't know the hard division facts, especially 9s. More work at this grade			
Addition and Subtraction Algorithms		57% Difficulty with subtraction generally. Cannot regroup with subtraction at all and that will depress later performances	53% Regrouping with larger numbers (2-, 3-digit) is weak. *Especially* need work on regrouping with subtraction in grade 2	60% Addition algorithm is coming along but late, still cannot subtract with regrouping, and larger numbers compound difficulty	75% Addition algorithm is stable now; subtraction algorithm much stronger even with 4- and 5-digit numbers	
Multiplication and Division Algorithms (1- and 2-digit divisors/multipliers)			29% Weaker than most PVS users. Don't know algorithms generally. Basic facts with remainder, renaming, no renaming—all weak. Will depress grades 4, 5	47% Most PVS users are generally weak on the algorithms involving 2-digit multipliers/divisors, and remainders. Algorithms and facts are weaker than most PVS users		
Multiplication Algorithms (2- and 3-digit multipliers)					67% 1- and 2-digit multipliers much more stable; 3-digit multiplier has low performances	76% 2- and 3-digit multipliers much more stable. Division with 2-digit divisors and 2-digit quotients is much stronger. Some difficulty with division with zero in quotient
Division Algorithms (2- and 3-digit divisors)					62% 1-place divisors or quotients are stable now; 2-place divisor with 2-place quotient is very low	
Recognition/Comparison of Fractions		25% Very weak. Confusion about part/whole relationships. Don't know unit fractions	18% No PVS users do well here. Not recognizing whole/part; need work on common fractions	46% PVS users in general are weak. Performances on equivalent fractions are generally at the guess level	24% Equivalent fractions are generally not understood	58% Equivalent fractions, lowest term fractions are much improved. More than half the students are answering correctly on all
Addition and Subtraction of Fractions				31% PVS users in general are weak here. Addition with like denominators is strongest. Computation with unlike denominators is below the guess level	23% Almost no ability apparent to + or − fractions with unlike denominators. Do better with multiplication. From grade 4 through grade 5 computation with fractions is basically unlearned. Multiplication with common fractions is a little better	30% Continued difficulty with unlike denominators. Now asked to regroup with mixed numbers. Very weak
Multiplication and Division of Fractions						11% Most PVS users are weak [illegible] a little better
Recognition and Comparison of Decimals					35% Can give mixed numeral for a decimal and can compare decimals in hundredths. Ragged decimals are tough for all PVS users	40% Now comparing decimals to thousands. Ragged decimals are still difficult
Addition and Subtraction of Decimals					41% Most difficulty with ragged decimals. About half of the students can [illegible] with decimals. More practice should help especially practice with placing the decimal point in [illegible]	62% Very strong where there are no ragged decimals. Much improved in [illegible] ragged decimals especially in hundredths
Multiplication and Division of Decimals						26% Generally a problem with placing the decimal point. More experience
Recognition and Comparison of Percents						31% First time that students give a percent form for a fraction. Most students in PVS perform at about this level
Geometry	84% Strong on geometric shapes. Patterns with geometric shapes were [illegible] PVS users	83% Good recognition of shapes. Some difficulty when asked to distinguish squares from rectangles				
Measurement	15% [illegible]	78% [illegible]	40% [illegible] length [illegible]	46% [illegible] length to nearest [illegible]	24% Measurement [illegible]	32% [illegible]
Problem Solving			53% About as most PVS users. Most difficulty with problems [illegible]. These operations [illegible] new and difficult	34% [illegible] which are weak to start with	65% Generally [illegible] problems [illegible] algorithms [illegible] problems involving money denominations	61% [illegible] with fractions and percents [illegible] problems involving whole numbers
General Notes	• Generally could use more work in [illegible] facts and in number relationships (more/less, counting order) • Most students in PVS do not understand place value	• Generally these performances are consistent with larger PVS samples. Recognition of fractions and whole numbers are two skill areas that are low • [illegible] with regrouping should be stronger; will help later. Especially need to work on subtraction • Stronger [illegible] facts to 10 [illegible] • [illegible]	• Many students off grade with performances about the same as students at grade • Multiplication/Division facts need to be stronger by mid year. More practice on hard facts • Regrouping in subtraction a real problem. More work on the algorithm. They know the facts • [illegible] algorithm [illegible] grade 4 [illegible] • [illegible] • [illegible] fractions [illegible] understanding whole/part relationship [illegible]	• Many students off grade level with performances about the same as students at grade • Hard division facts are still weak. Multiplication facts could be stronger. (Want 90% of students highly proficient) • [illegible] • [illegible]	• Many students off grade level with performances about the same as students at grade • Algorithms for whole numbers are shaping up [illegible] is reasonably stable, especially since students are now computing with large numbers [illegible] • Fractions [illegible]	• The [illegible] algorithms are stable even when computing with large multipliers and dividends and 2- and 3-digit multipliers or divisors • Computation with decimals especially [illegible] is not [illegible] behind whole number [illegible] decimal point [illegible] • [illegible]

* [illegible] appropriate for the larger group

What are the serious structural weaknesses, i.e., the learning opportunity risks, in these two K-6 blueprints? If we were to focus only on apparent deficiencies, i.e., "low" performances, then we would find them mostly in the intermediate grades 4, 5, and 6. So that may seem like the most logical place to look for program weaknesses needing adjustment. It is not. Skills that are taught and assessed in the intermediate grades have many antecedents in the primary grades, rather than arising full blown in the intermediate grades. Many problems with low performance in grades 4 and 5 are cumulative ones that have developed over several years. While there are surely actions that need to be taken at the point where a problem is identified in the intermediate grades, even the most intense instructional attention will most likely be inadequate here. Structural weakness is least tolerable for skills that take 2 to 3 years to teach. Grade 1 may be too early to look for structural deficiencies in instruction that become apparent in low performances in the intermediate grades. On the other hand, weaknesses that are identified in grades 5 and 6 are probably <u>not</u> ones that schools ought to attend to first, because they often relate strongly to learning opportunity risks that were made at earlier grade levels. Grades 2 through 4, then, would seem to be the target years to look for and reduce such risks, particularly when the interest is in long range and significant improvement. This analysis will therefore focus on those grade levels in charts 1 and 2.

The process of analyzing district level data is straightforward. It produces a <u>description</u> of structural strengths and weaknesses common in K-6 textbooks series that are in widest use across the country. What the state of instruction should or could be is not the subject of this type of analysis. Given the scope, sequence, and emphasis of instruction as it is currently, the analysis identifies weaknesses in the architecture of the instruction which produce learning opportunity risks that can be removed or shored up to improve students' accomplishments.

Analysis begins by following each of the skills categories across several grade levels on each of the charts, but with particular attention to grades 2, 3, and 4. Several distinct characteristics become apparent:

1. Some skills categories include skills that are more discrete in the way they build across grade levels than are others. (Computation is not discrete; what is taught at one grade level is rigorously dependent on something having been taught a year earlier.) For example, although measurement skills may have certain important prerequisites just like computation, there is greater likelihood that teachers will be able to adjust the instruction that students have not had, but that should have been in place previously. Instruction in geometry, given the way it is presented in most textbooks, can also be adjusted with a similar level of local effort.

2. Some skills categories are clearly a reflection of others. For example, the development of problem solving skills, rightly or wrongly, is tied so closely to the development of computation skills step-by-step, that it often appears to have very little structure of its own. Therefore, it is never clear when looking at proficiency data on problem solving to what extent low performance is attributable to difficulty with the computation, not just at the point where performance is being assessed but at the point where learning was actually supposed to take place.

3. Some skills categories build on a groundwork of grade-by-grade development, but the amount of lesson space dedicated to them is diminished and fragmented. Recognition of fractions, particularly equivalent fractions, is a good example. Thin instruction on this kind of skill in grades 3 and 4 can seriously depress achievement in later grades. Often skills in this category have a real value independent of other skills, but just as important, they also serve as "enabling" skills to support the development of complex computation skills. However, not all of these skills are of equal importance in terms of their effect on long range accomplishments. There are some skills that tend to atrophy as soon as instruction on them stops. For example, performance on computation with expanded place value forms for whole numbers is strong in grades 2 and 3 where computation is first being taught. The purpose is to make it easier for students to see what is happening to place values when they perform the regrouping traditionally known as "borrowing" and "carrying," but performance on this skill decline steadily as soon as instruction on it stops about the end of grade 3.

4. The computation skills categories involving whole numbers and fractions are ones that most obviously build over 2 to 3 years in terms of instruction and achievement. Structural weaknesses in these matters are going to be the most apparent, and the action necessary to correct them in some ways requires the most uncomplicated commitment of time and resources.

Relative to long-range improvement in accomplishments, we have previously narrowed our search for learning opportunity risks to grades 2 through 4. Now a second level of analysis will narrow our focus even more. We will also focus on the kinds of skills that fall under points 3 and 4, not because skills under points 1 and 2 do not have a real importance of their own; of course they do. But skills in points 3 and 4 have a long range structural significance in terms of K-6 mathematics instruction that provides the opportunity to make major improvements across several years without catastrophic changes in the structure of instruction.

Grade 2

Given this focus and the underlying logic that supports it, the analysis begins at grade 2. The first step is to look down the grade 2 column for skill categories that show low performances, and then to follow the pattern across grades 2, 3, and 4, determining how performance is either maintained or problems compounded at the higher grade levels. Three skills categories stand out in grade 2 on both charts with clearly depressed performances:

- Multiplication facts with 0-5 as one factor.

  This category shows average performances of 46% on Chart 1 and 40% on Chart 2 in the grade 2 column. There is no question that many students are not proficient in this skill by the middle of grade 2. Follow the skill into grades 3 and 4 and even 5. By the middle of grade 3, performance has nearly doubled. An item-by-item analysis for this skill category showed that almost 80% of the third grade students could answer each item dealing with multiplication facts to 5. By mid-grade 4 more than 90% could do the simple multiplication facts. The data in these charts tell us that between the middle of grade 2 and the middle of grade 3, most students in both school districts in this analysis learn these facts. The conclusion is that this skill probably receives sufficient instructional treatment between the middle of grade 2 and the middle of grade 3 to disqualify it as learning opportunity risk. While there is room for local adjustments in instructional practices to improve grade 2 performance on multiplication facts to 5, given the nature of local priorities, the skill does not seem to require any more critical attention in grade 2, particularly when one looks at performance during the next year.

- Addition and Subtraction algorithms.

  Chart 1 shows an average performance of 59% and Chart 2 shows 57% in grade 2. This time, however, the skill category does not show significant improvements in grade 3 and only slight improvements in grade 4. It is not true that performance on these skills declines in grade 3, but the nature of addition and subtraction algorithms changes. Students were able to add and subtract 2- and 3-digit numbers without regrouping in grade 2. They had great difficultly regrouping with subtraction given 2-digit numbers in grade 2, and in grade 3 they are regrouping with 3-digit numbers. By grade 4, the addition and subtraction algorithms are applied to 4-, 5- and 6-digit numbers. Given this long range pattern, the low grade 2 performance does signal a serious weakness. There does not seem to be sufficient instruction between the middle of grade 2 and the middle of grade 3 to accommodate either the weak entry level on the addition and subtraction algorithms or the change from smaller to larger numbers in the higher grades. A close look at grade 2 of all of the widely adopted textbook series shows that even by the end of grade 2, there is insufficient lesson space allocated to teaching the algorithms involving regrouping, particularly with subtraction. There are no more than 2 to 5 lessons in any of the series, and the lessons occur in the last third to fourth of most textbooks. So it is likely that many students never reach these lessons in grade 2 instruction. This constitutes a learning opportunity risk.

- Recognition of fractions.

  In grade 2, the performances are 24% on chart 1 and 25% on chart 2. Following the pattern through grades 3 and 4, and even further into 5 and 6, it is clear that there is a serious learning opportunity risk here. Most students in both districts (and in districts generally, for that matter) do not learn to recognize a unit fraction or to develop much proficiency with part/whole relationships. In grades 3 and 4 the nature of the skill changes again and students are dealing with common fractions, comparisons of fractions, and equivalent fractions. Again, there seems to be a serious instructional deficiency in grade 2, and improvement at this early grade level should have a significant and positive impact on later achievement in grades 3 and 4. A look at instruction on fractions in grade 2 shows that most of the instruction on fractions in most programs occurs in the last third of the textbooks, and then there are typically about 2 to 5 lessons dedicated to the skill. Many students may not get to this part of their textbook, and for most students 2 to 5 lessons are probably not sufficient. In any case, by the middle of grade 3, almost no one can give a fraction for a region or set.

The analysis at grade 2 has identified two learning opportunity risks; i.e., skills categories with long range implications, where there is genuine structural deficiency in instruction that does not provide students an opportunity to build a knowledge base that will suppport increasingly more complex content. Addition and subtraction with regrouping, and Recognition of fractions are two skill areas that are treated in the last half of most grade 2 textbooks, with 2 to 5 lessons apiece, and which change in nature from one grade to the next, showing a serious compounding of achievement problems in grade 3.

Both of these risks could be reduced by 1) more lessons and 2) more attention to the specific errors that students make. Fortunately, grade 2 instruction does seem to have some "room" for 10 to 15 additional lessons in mathematics. The instructional program at this level is not as packed with skills to be taught, as it is in grades 4-6. Furthermore, students' performances give us workable insights into the sorts of lessons that are needed. For example, students do not have sufficient practice in subtraction with renaming 2-digit numbers. More work on this algorithm using addition and subtraction facts to 15 as vehicles (where most students are reasonably proficient in grade 2) should have an immediate impact on grade 2 performance and a longer range impact on grade 3 performance. Similar clues are evident in students' performances on fractions. Given a set or region with some parts shaded, students consistently give a fraction for the set by relating the shaded parts to the unshaded parts instead of relating the shaded parts to the whole (including both shaded and unshaded parts). Lessons that focus on the relationships of parts to a whole should improve grade 2 performances and provide a firmer basis for grade 3.

Grade 3

The same type of analysis can be completed for grade 3. Looking down the grade 3 column, a number of skills are weak:

- multiplication facts with 6-9 as one factor (Chart 1 = 44%, Chart 2 = 60%)
- Division facts with 6-9 as divisor or quotient (Chart 1 = 36%, Chart 2 = 45%)
- multiplication and division algorithms with 1-digit multipliers/divisors (Chart 1 = 19%, Chart 2 = 29%)

  Most students in these two districts have not learned the hard multiplication and division facts by the middle of grade 3; but by the middle of grade 4 most students can demonstrate high performances on this skill. If we were to use the same logic that we used with the easy multiplication and division facts in grade 2, then we would opt for some greater attention to these hard facts in grade 3, but not qualify this skill as a structural deficiency in grade 3. But that recommendation is premature. More analysis is in order. A special stress exists in grades 3 and 4 that does not exist in grade 2. Students are expected to learn the hard multiplication and division facts between the middle of grade 3 and the middle of grade 4 . . . and they generally do. At the same time they are expected to apply these facts to e algorithms involving 1- and 2-digit multipliers, 1- and 2-digit divisors, and regrouping . . . and they generally don't. Performances on the simple multiplication and division algorithms for these students, and for most third grade students, are at about the guess level. By the middle of grade 4, more students can compute with 1-digit multipliers and divisors, but most students are still learning to compute with 2-digit multipliers and divisors.

  How to relieve the stress? A good opportunity seems to reside in grade 3 with the hard multiplication and division facts. The stress in grade 4 can be relieved by finishing the hard multiplication and division facts by the end of grade 3, where there is room in the curriculum to add several lessons. Grade 3 instruction is still not as packed with skills to teach as grade 4 is. If most students can do these facts by the end of grade 3, attention can focus in grade 4 on applying them. Because of the special structural stress created by not knowing the hard multiplication and division facts by the end of grade 3, we will identify these skills as critically significant in grade 3.

On the other hand, the simple multipliciaton and division algorithms are clearly not learned by most third grade students in either of these districts (19% and 29% average performances). Is this a learning opportunity risk? Probably not directly. The algorithms require stable multiplication and division facts, and most students have not yet developed stable facts. The tendency in most of the textbooks used widely at grade 3 is to introduce the simple algorithms at the end of grade 3, but primarily as a preview of the serious instruction and learning that will occur early in grade 4 on the same skills involving 1-digit multipliers and divisors, and later on the more complex algorithms. Therefore, we will not qualify the matter as a learning opportunity risk. Schools may be able to partly improve students' achievement performances on the simple algorithms if they restrict the content to the easy facts, 1-5, which most students do know by the middle of grade 3.

- Addition and subtraction algorithms

  We noted in the grade 2 analysis that performances on the algorithms involving larger numbers and regrouping, especially with subtraction, were low for most third grade students in these two districts. If we believe our previous story on grade 2, there should be a serious improvement in grade 3 performance on these algorithms by way of improving grade 2 performance. Meanwhile, students currently in grade 3 can receive regular instruction to improve their performances on the algorithms: More problems that use the better-learned subtraction facts (to 15), regrouping with 2-digit numbers, etc. Therefore, we will not identify this skill as needing special attention at grade 3.

- Recognition and comparison of fractions

  The logic described above should be, and is, appropriate for this skill as well. However, the instructional deficiency on recognition of fractions is the most profound weakness in primary level instruction. Less than one fifth of the students in grade 3 could associate a common fraction with a set or region. All districts participating in IAI inquiry over the years demonstrate the same risk. Systematic practice at this grade level cannot do anything but improve performance. Students particularly should benefit from systematic instruction regarding what a fraction is not. It is not the ratio of a designated part of a whole (e.g., shaded dots) to an undesignated part of a whole (e.g., unshaded dots), but rather the ratio of the designated parts to all parts. Without this basic understanding, students will generally not be able to understand or identify equivalent fractions in grade 4 or the concepts that underlie addition and subtraction of fractions, which is introduced at this same grade level. This means that many students, most students really, will not learn the basic skills needed to work and progress regularly through large areas of the curriculum in grades 4, 5 and 6. We'll identify the skill as a learning opportunity risk meriting special attention at grade 3. For many districts, a partial solution involves simply assuring that all students work through the lessons that are provided in textbook programs. There is some evidence (Buchanan & et al., 1976; Graeber, 1977) that lessons are often skipped in the primary grades. Again, there is usually time to complete the available lessons on fractions provided in grade 3 textbooks, and even to add several additional lessons. There is no such time by grade 4.

Measurement and problem solving also show unusually low performance levels, and they will need routine instructional attention at grade 3. However, remember that the logic which underlies the method excludes these types of skills as learning opportunity risks, given current priorities embodied in K-6 programs.

Three skills categories, then, have been identified as learning opportunity risks at grade 3:

- Multiplication facts with 6-9 as one factor,
- division facts with 6-9 as divisor or quotient, and
- recognition of common fractions.

Grade 4

According to our logic, grade 4 is the last place we will look here for instructional weaknesses that have long range implications for mathematics achievement in the elementary grades. Looking down the grade 4 column, many of the skills categories that show the lowest scores were previously identified in grades 2 and 3 as needing special attention. The argument was that over one to two years, students who have had the benefit of the recommended adjustments on the addition and subtraction algorithm in grade 2, multiplication and division facts in grade 3, and recognition of fractions in grades 2 and 3 will enter the fourth grade with more stable skills. That is, many of the skills categories that presently show low performances in fourth grade, w''l show the effect of the recommended improvement efforts after one and two years, so that they should not need more than routine instructional attention. Therefore, at this point in the structure of K-6 mathematics instruction, maintenance of routine instructional attention is recommended for addition and subtraction algorithms, multiplication and division algorithms, and recognition and comparison of fractions. However, one "new" category enters the instructional program in grade 4, and students generally find it very difficult:

- Addition and subtraction with fractions

  Students in both districts were most successful with addition involving common denominators. Looking across the skills category to grades 5 and 6, we can see that proficiency does not improve, particularly when the skill category expands to include mixed numerals. Given long range implications, the category needs systematic and additional attention in grade 4. But we have already indicated that there are serious stresses in the grade 4 instructional program created by severe mismatches between expectations and available time. It is likely that schools will have much less opportunity to add several lessons to an already full school year, than in grades 2 and 3. There are partial adjustments, however, that are possible. Most students find the process of addition with fractions intuitively difficult, and a close look at performances on the IAI inventories gives us some insight into the kind of confusion that current instruction might focus on. A common error made by students is to add/subtract both numerators and denominators, especially when dealing with fractions with unlike denominators. (For example, students will often conclude that 3/4 + 5/6 equals 8/10.) Again, some attention to what not to do in addition and subtraction with fractions would be a useful complement to instruction that sets up the procedures that are appropriate. Also remember that students who enter grade 4 having benefited from adjusted instruction in grades 2 and 3 on recognition of fractions should have a better understanding of fractions, especially equivalent fractions, which should take much of the current mystery out of the addition and subtraction processes.

This basically concludes the mathematics analysis. There is more information to be obtained from an expanded analysis, but we have accomplished what we set out to do: to identify a small number of skills categories in the elementary grades where minor adjustments in instruction can significantly reduce learning opportunity risks and thereby produce important improvements in student performance, both in the immediate grade level where the adjustment is made, and in the long range across several grade levels.

The Method Applied in Reading

The charts for reading are organized in the same way as the previous charts for mathematics. Chart 3, or District 1, contains the complete list of skills and all six elementary grades, since this District participated in the inquiry at all of the grades. District 2 does not teach reading as a formal subject area beyond grade 4. For this reason, Chart 4 shows data for only those grades.

We will apply the same logic and procedures here that were applied in the previous section: a focus on grades 2, 3, and 4, and on skills that have long range implications for success in reading instruction. But a first look down the columns for grades 2, 3 and 4 shows an interesting finding that is consistent with other data bases generated by previous IAI inquiry in reading: There are no skills categories where performances are dramatically depressed. In fact, if we were to attend to average performance levels only, accomplishments are everywhere very good. It would be inadvisable to conclude from this finding that there are no learning opportunity risks in reading instruction at these grade levels and at later ones. However, the fact that the proficiency

Age/Grade Level*

Skill Category	Grade 1 (n = 278)	Grade 2 (n = 119)	Grade 3 (n = 157)	Grade 4 (n = 194)	Grade 5 (n = 142)	Grade 6 (n = 82)
Simple Consonants	75% Difficulty with minimal pairs in context (f/d, p/t, b/c) (comprehension?)	95%	88% Very strong performances variant g only difficulty			
Consonant Digraphs and Clusters	53% All coming along ok	92% Strong performances—main difficulty with ss	71% aw ow- to decoding elements are usually stronger at this grade level			
Simple Vowels	85% Medial o and i (probably Southern dialect?)	82% Strong—small difficulty with medial vowels				
Vowel Digraphs and Diphthongs	69% Glided i (ie) some difficulty	81% Strong (oa,o-e only difficulty)	77% Plural form of y ending noun (-ies vs -s) is weak			
Morphology	52% Find verb inflection difficult (-ing, base form -s)	80% Difficulty with verb inflection base form -s				
Word Meaning		69% Stronger performances than students in our larger data bases	77% Definitions, functional definitions present some difficulty			
Word Meaning: Definition in Context				78% Strong performances	79% Ok, only problem with uncommon word brisk	
Word Meaning: Dictionary Definition				71% Ok, students in our broad data base perform at this level		
Word Types				73% Ok, not focusing on the cue word "opposite." Problem with spelling homonyms (peak/peek)		
Word Formation				78% Suffixes in isolation and the technical term suffix give difficulty, but ok Students excel given context.		
Word Derivation					75% -ly adverb ending, in prefix were difficult	92% Strong. Only difficulty was with uncommon word
Sentence Meaning	66% Ok on *what* questions, *who, where, when* questions are difficult					
Story Meaning		62% Strong detail, weak title/main idea.	77% Strong detail, weak main idea, difficulty with sequence of events			
Comprehension: Minimal Context				87% Strong performances		97% Stronger performances than larger PVS data base.
Comprehension: Main Idea, Detail				70% Strong detail, weak main idea	78% Strong details, main idea improving	89% Strong Do well when main idea is stated and students select appropriate text
Comprehension: Sequence, Cause/Effect				80% Some difficulty with sequences of events	81% Ok, sequence of events improving	
Comprehension: Predictions, Conclusions				77% Good conclusions, could work on predictions	88% Predictions/conclusions very strong Classification item was difficult for most students	85% Strong Prediction involving "ethical" choice was difficult for all PVS users
Comprehension: Comparison, Classification						82% Strong.
Study Skills: Information Organizers				82% Strong performances Only difficulty was with cross references in index (see)		
Study Skills: Dictionary, Index					74% Guide words difficult where alphabetizing to the 3rd letter May not be familiar with footnotes	
Study Skills: Reference Aids						88% No difficulty in selecting appropriate reference aid given a problem
Literary Elements					85% Very strong Some students not familiar with *exaggeration*	
Literary Elements and Types						87% Most students in PVS had difficulty with figurative language, personification, classifying literature
Literary Types and Analysis					72% Ok some students may not know how to classify types of literature	
Literary Analysis						77% Inferring point of view was difficult for most in PVS
Literary Skills						92% Strong Minor difficulty with determining time of story action (past, present, future)
General Notes	• Not a critical reading skill but could work on verb inflections—especially base form/-s • More attention to *who, where, when* questions about a story	• Many students took the inventory below their grade level Generally, students at grade level showed the strongest performances • Not critical but some attention to verb inflections especially base form/-s • More attention to inferences gist of story main idea	• Many students took the inventory below their grade level* Generally, students at grade level showed the strongest performances • More attention to main idea, general sense of a story and to sequence of events	• Many fifth graders took this inventory Generally students at grade level showed the strongest performances • Need to work on main idea, central point of short paragraph summing up Also "getting ahead" of story, making predictions	• Many sixth graders took this inventory Generally students at grade level showed the strongest performances • Overall performances on each major category are very close to performances for large PVS samples. In some skills this sample shows stronger performances • Main idea needs attention	

* Students who took the inventory below grade level demonstrated the same patterns as students who were at grade level, so the general actions [illegible] group of [illegible] would be appropriate for the [illegible] group

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District: Number 2—Mid-Year Skills Inventory: Reading

Skill Category	Age/Grade Level[a] Grade 1 (n 86)	Grade 2 (n · 70)	Grade 3 (n 37)	Grade 4[b] (n 20)
Simple Consonants	78% Initial b final n (could be confounded by comprehension)	96%	85% Coming along -variant pronunciation of g difficulty	
Consonant Digraphs and Clusters	74% ck, sh/th, gl difficulty	96%		
Simple Vowels	77% Probably ok medial i (dialect problem—Southern speech?)	85% Probably ok medial u (dialect problem?)	80% Ok—difficult digraphs are coming along	
Vowel Digraphs and Diphthongs	66% Glided [illegible] culty	82% Probably ok difficulty with ai a e (dialect?)		
Morphology	63% Verb inflections ing base form / s difficulty	78% Verb inflection, base form / s difficulty	84% Plural of y ending noun vs 's, technical term compound do very well with affixes	
Word Meaning		85% Ok But not attending to the cue word 'opposite'	78% Functional definition difficulty ("hear")	
Word Meaning: Definition in Context				93% Strong performances
Word Meaning: Dictionary Definition				78% Stronger performances than most students in our sample data base
Word Types				78% Only problem s with selecting opposite tend to choose the synonym—a testing artifact mostly
Word Formation				89% Affixed words in isolation with technical terms (prefix suffix)—some programs don't teach this way—but strong performances with affixed words in context
Sentence Meaning	66% Do best with "what" questions; "when" question is very difficult			
Story Meaning		78% Problem with 2 inference questions, selecting title difficult for students at each age group	87% Sequence of events (first, next) difficult	
Comprehension: Minimal Context				81% Strong performances
Comprehension: Main Idea, Detail				72% Strong performance on detail main idea is very weak
Comprehension: Sequence, Cause/Effect				83% Strong performances
Comprehension: Predictions, Conclusions				81% Stronger performances than most students in our sample data base
Study Skills: Information Organizers				88% Very strong performances Only problem was with a see reference in an index—may only need more exposure
General Notes	• Many 2nd and 3rd graders took this inventory • Not a critical reading skill but need work on verb inflections especially base form ·s • More attention to *who where, when* questions.	• More 3rd and 4th graders took this inventory that did 2nd graders. However performances were best among 2nd graders • Patterns for older students paralleled these performance patterns above • Not a critical reading skill, but need work on verb inflections, especially base form ·s • More attention to making inferences, general "sense" of the story	• As many 4th graders as 3rd graders took this inventory However performances were best among 3rd graders • Patterns for older students paralleled these performance patterns above • Sequence of events	• 4th graders taking this inventory showed very strong performances, whereas 5th graders (only 2 students) were clearly special cases[a] • Main idea generally summing up what is read needs more attention

a Students who took the inventory below grade level demonstrated the same patterns as students who were at grade level, so the general actions implied for this group of students should be appropriate for the larger group.

b Difficult to say too much about these results, since this total number of students working at or below grade level is so small (n = 20) patterns in reading are different from those in mathematics is notable. Weaknesses in the architecture of reading instruction are not ascertainable by simply scanning the skills categories and the associated proficiency patterns. Large parts of conventional reading programs, unlike mathematics programs, are not cumulatively structured, particularly after grade 2. After grade 2, students are spending less time learning technical reading skills, and more time applying them to material with increasingly specialized lexicons, more complex syntax, longer texts, and more sophisticated messages. (See Fiege-Kollmann, 1978; Escoe, 1981.) Moreover, after grade 3, reading programs do not have the steady influx of new skills that are found in mathematics. Consequently, it is not sensible to look for learning opportunity risks in reading by focusing on discrete, prerequisite skills as such. Instead, structural deficiencies are likely to be found between the cracks of the skills that students cycle through over several years.

Grade 2

Scanning down the grade 2 column, the first five categories pertain to decoding and morphology skills that do not extend directly into grades 4 through 6, either in terms of the volume of content in each skills category or in terms of the impact on other skills categories. Presumably programs teach these skills so that students can perform the reading operation. A quick look across all grade levels supports the conclusion that proficiencies in these technical decoding skills are sufficiently stable, since most students are able to answer a variety of questions about the texts they decode.

Similarly, word meaning looks strong on both charts. The most consistent difficulty seems to be an artifact of the performance format for antonyms: Students have a strong inclination to select the synonym for a word and not the antonym. Students do demonstrate difficulty when less common words for their age/grade level are the target of assessment, and instructional attention to expanded vocabulary should generally improve students' learning opportunity. But the general category does not reflect a serious instructional defect.

One skills category shows a consistent difficulty on both Charts:

- Story meaning

  Two general types of skills are assessed here, recognition of detail, and recognition of main idea. Most participating students in both districts were able to answer direct who and what detail questions. However, less than half of the students in both districts were able to answer correctly items asking for the main idea or an appropriate title. We can follow this skills category across the grade levels: Grade 3--strong detail, weak main idea, drop down two categories to comprehension: main idea and detail in grade 4--strong detail, weak main idea; grade 5--strong detail, main idea improving. That is a little late. While students do demonstrate an understanding of the straightforward detail in the texts they read, they do not seem to be able to "sum up" or capture the gist of what they have read. Widely used textbook series frequently ask students to select the main idea for a passage in their workbook activities. However, recommended practices for teaching this skill are ambiguous at best and there is little direct opportunity to learn the skill. (It is interesting that many strongly intended skills in reading are treated much the same way that similarly highly valued skills in mathematics are treated, for example problem solving--students are generally just asked to "do it," to use their technical decoding or computation skills to "make inferences" or "solve problems.") Instruction on this skill is seriously deficient and there are long range learning risks if the weaknesses are left unattended. Methods have been developed and used to teach this type of summarizing skill. Escoe (1981) has identified a series of applied strategies for systematic instruction and practice on main idea. The adjustments in practice are not major, but they do require commitment of instructional time and enhancement of teaching and practice materials. Currently, teachers simply lack the instructional resources to do the best job of teaching main idea.

We shall find this same pattern and logic holding in grades 3 and 4 for several other highly valued intended reading skills. Moreover, the demarcation between many of these skills--sequence, cause/effect, main idea--is obscure . The skills are not discrete, which should imply that instructional practices do not need to be discrete. Rather, a direct instructional approach that teaches the dynamics of this collection of static abstractions would seem to be the economical and natural route to take.

Grade 3

The discussion for grade 2 on decoding, morphology, and word meaning can almost be repeated at grade 3. But the story meaning category needs to be considered anew:

- Story meaning

  Weak performance on main idea skills was again evident. On technical skills, for example decoding elements or computation facts, systematic attention to the skill in one grade usually mutes the urgency for special attention to the skill in the next grade level. But this expectation does not hold when treating intended skills that students cycle through over several years. No doubt, performance in handling main ideas in grade 3 will benefit from systematic attention to the skill in grade 2, but material at the higher grade level involves more complex cognitive skills and a broader experience base. Systematic instruction aimed at sharpening and stablizing the skill is still critically important. Since instruction on this skill at grade 3 is weak or absent, this is a learning opportunity risk. This grade level is particularly significant because it is a conventional benchmark year. Hereafter, students will be spending a lot more time reading to learn, not vice versa.

  The story meaning skills category at grade 3 includes another process skill--sequence of events--that is not unrelated to main idea. Students who cannot order events temporally may not fully understand what they read, which can impede their ability to "sum up" a text (Escoe, 1981). Many students were not proficient on the sequence tasks. Almost 40% of the students in District 1 could not answer a simple sequence of events question about a short story (e.g., "What happened first in the story?" or "What happened last in the story?"). Less than 50% of the students could answer both of these questions correctly. Partly, performances are an artifact of trying to capture this type of skill in a paper and pencil mode. That is, there is always the ambiguity of "first before what" and "last after what." On the other hand, students probably have not been taught strategies for tracking story events, given typical teaching material. Systematic attention to structured texts, where temporal sequence is carefully organized to follow a logical order, consistent with the general schooling experiences of many third graders, would help. (See Stein, 1978.) Escoe

(1981) again has identified a variety of strategies to support sequence of events instruction and practice.

Grade 4

There is little more to add to the story at the grade 4 level. The learning opportunity risks apparent in grades 2 and 3 are evident in grade 4. Main idea, sequence of events, and a related skill making predictions show weak performance levels. But again, widely used instructional materials intended for the fourth grade provide little direct guidance to teachers in terms of instructional practices. Rather, students are asked to apply the skills by answering questions about main idea, sequence, and probable occurrences.

In sum, elimination of the learning opportunity risks identified for reading should prove easy in practice, if complex in principle. That's a welcome switch in the typical relationship between research and use. Exhorting teachers to spend "time on task" teaching the "comprehension process" skills as independent proficiencies is unnecessary and misguided. The learning opportunity risk is not to be found in either the skills categories or in the "sum of the parts." Moreover, materials to operationalize the "task" are currently not now available in widely used instructional materials, and learning opportunity risk appears attributable to that fact.

It is easy to show for reading how conditions that create risks can arise. In the conventional way that reading text series are prepared, devoting attention to "process" skills can be expensive in terms of both production and use costs. The effort involved in generating instructional passages is tedious and time-consuming compared to the effort involved in generating word- and sentence-length units. And instructional passages, even when short, require a fair amount of page space. Moreover, for each passage, it is usually feasible to generate several questions about details in the text, but it is seldom feasible to construct more than one or two sequence-of-event questions and a single title/main idea question for the passage.

The specific activity entailed in eliminating learning opportunity risks in reading does warrant explicit attention. We will discuss that matter in the next section. The happy finding here is that in terms of the structure of reading instruction, the adjustments are equivalent to "fine tuning" that can be effected over the short run. The elimination of a risk can be accomplished without heavy retraining of teachers, heavy retooling of materials, or heavy readjusting of any other aspects of the prevailing instructional environment.

Deriving Action from the Analysis

Findings yielded by the application of the method lead to actionable conclusions, to activity based upon the conclusions to eliminate or circumvent the learning opportunity risks that have been identified. Such activity is the proof of the pudding, and it is of course in part situationally specific. However, it is possible to set forth some general "do's and don'ts." We shall first consider the "don'ts."

The conventional action would be to convert the risks into a list of "objectives" or "domains," and to expect teachers to teach them. Don't. It's a simple action, but too simple.

One step removed would be to provide teachers with curriculum guides where there are one or two example lessons. Teachers are then expected to develop parallel lessons in order to teach a specified set of skills. Don't. Although teachers can and do develop materials for use in their classrooms, for many teachers their teaching and record keeping responsibilities leave little time for development efforts.

A third common action would be to provide teachers with an index showing where particular skills are represented in several different textbook series and/or other instructional materials. Although the principle of indexing has potential utility in classroom practice, it too often proves to be unwieldly for routine instruction, and there are practical, pedagogical problems. For example, a skimpy instructional treatment in several different places is not the instructional resource that is in order. Again, don't.

These three categories of "don't" actions should be sufficient to make the general point: Time is a precious and fixed commodity for classroom teachers. When an action plan relies on "free" teacher time to develop and/or pull together large portions of instructional resources, the resulting burden in terms of stress on teachers' opportunity to teach is expensive and the actual cost will certainly outweigh the intended benefits.

The school district level, rather than teacher or individual school level, is the reasonable focus for initiatives to eliminate learning opportunity risks. These agencies generally provide one or more comprehensive textbook series. Teachers use these series as the backbone of their instructional programs. Where series are structurally weak, then the opportunity to teach is inadvertently weak. The serious problems arise where the text materials "fudge"; where they do not deal in a coherent, integrated instructional way with real stresses and strains in the K-6 sequence. Districts can obtain or generate coherent, integrated sets of lessons, including instructional and practice activities, which teachers can then use to temper or circumvent the learning risks.

Some subject matters are easier to accommodate than others. In mathematics, there is a great deal of redundancy built into a K-6 textbook series, and this feature can be put to good use. For example, in most series, attention to the hard multiplication facts in grade 4 is well integrated and reasonably thorough; but this is at grade 4, not at the end of grade 3, where our analysis has shown the need for additional lessons. The additional lessons already exist in most widely used textbook series, and placement is the problem. For skills like recognition of fractions, or main idea, the instructional treatment is likely to be skimpy. However, the district may well have a resource center where well-focused sequences of lessons can be found and organized for timely use by individual teachers. Moreover, supplemental teaching modules are available commercially, and many of them provide systematic instructional treatment of the kinds of skills identified earlier, even though they may not be organized in exactly the right way to meet every teacher's needs.

The problem of fitting additional lessons into the instructional program requires explicit attention. It is easier to fit say 10 to 15 additional lessons into the earlier grades than the later grades; but it is feasible to fit lessons into the upper grades, given district level attention to priorities for teaching and learning. It will be difficult wherever you try to fit additional instruction into a school year, but that does not make it any less critical to provide additional practice on skills that are key to students' future learning opportunity.

Once identified, there is nothing at all mysterious about a set of learning opportunity risks, and neither is there anything at all mysterious about their elimination. It involves the provision of adequate instructional resources for teachers to use in their teaching to give students an opportunity to learn. Of such is the profession of education.

APPENDIX

Population

The mathematics inquiry involved a total of 1726 students, and the reading inquiry 1185 students. Students attended two districts in one southern state, and they were in classrooms in five different schools. Approximately 1000 of the students participating in the mathematics inquiry came from District 1, and 700 from District 2. Most of the students participating in the reading inquiry came from District 1, approximately 1000; and there were approximately 200 students from District 2. Intact classrooms were generally assessed.

Administration Procedures

The IAI inventories were administered in late January to all participating students. Teachers were asked to complete their administration of the inventories over a two week period. Because of the nature of mathematics instruction, students were not expected to have been taught all of the content covered in the mid-year inventories. Therefore, teachers were advised to assign only those sections of the inventory that generally represented instruction in mathematics completed by mid-year. Students were instructed to skip entire, homogeneous sections of the mathematics inventory. Reading inventories were different. Teachers were encouraged to administer the entire inventory at every grade level to all of their students.

The inventories were not timed, and students were given a reasonable amount of time to answer all assigned sections of the inventories. At grades 1, 2, and 3, 40 to 60 minutes were reasonable for each inventory. At grades 4-6, 60 to 70 minutes were acceptable. In grades 1 and 2, for both reading and mathematics, teachers were allowed to administer the assessment item-by-item to the entire class or to small groups, and students marked their answers directly on the booklet. Students were encouraged to ask questions whenever they were unsure about an item format, picture cue, or direction. Teachers were told to help students to understand what was being asked, as best they could without giving away the answer. In grades 3 through 6, inventories were self-administered by students, who were allowed to ask teachers for help when an item format or direction was not understood.

Scoring and Reporting

Completed student materials were collected by teachers, checked for stray marks or other conditions that might interfere with electronic processing, batched and sent to a scoring center in Minneapolis. Booklets and answer sheets were scanned by a Sentry model 70 optical mark reader. Scanner tapes were preprocessed, input records diagnosed, and data bases corrected where there may have been processing complications. Reports were generated by an IBM 3033 computer and returned to participating students, classrooms, schools, and districts.

Instrumentation

Definitive descriptions of the PVS instrumentation may be found in: Proficiency verification systems, 1981 Brief, SWRL Educational Research and Development, Los Alamitos, California; Designing an instruction-referenced system for large-scale evaluation of school achievement, Aaron D. Buchanan and Patricia A. Milazzo, presented at the Third Annual Conference of the California Society of Educational Program Auditors and Evaluators, Los Angeles, May 12-13, 1977; PVS operations manual, SWRL Educational Research and Development, Los Alamitos, California, 1978; Proficiency verification systems (PVS): Index of mathematical skills, Aaron D. Buchanan, Technical Note No. 3-76-01, SWRL Educational Research and Development, Los Alamitos, California, 1976; Proficiency verification systems (PVS): Mathematics test development, Jannine Perkins, Technical Note No. 3-76-03, SWRL Educational Research and Development, Los Alamitos, California, 1976; Consistency of items across mathematics inventories of PVS, Jannine Perkins and Nancy Bennett, SWRL Educational Research and Development, Los Alamitos, California, 1978; Proficiency verification systems (PVS): Index of reading skills, Laila Fiege-Kollmann, Technical Note No. 3-77-01, SWRL Educational Research and

Development, Los Alamitos, California, 1977; Proficiency verification systems in reading, Laila Fiege-Kollmann, Technical Note No. 3-76-10, SWRL Educational Research and Development, Los Alamitos, California, 1976; Proficiency verification systems: The development of an information system for second grade reading, Laila Fiege-Kollmann and Patricia Milazzo, Technical Note No. 3-77-03, SWRL Educational Research and Development, Los Alamitos, California, 1977; Tryout of the reading proficiency skills inventory, Laila Fiege-Kollmann, Technical Note No. 3-78-11, SWRL Educational Research and Development, Los Alamitos, California, 1978.

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