

Diagnostic Assessment and Intervention for Mathematics



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The Case for Mathematics Intervention

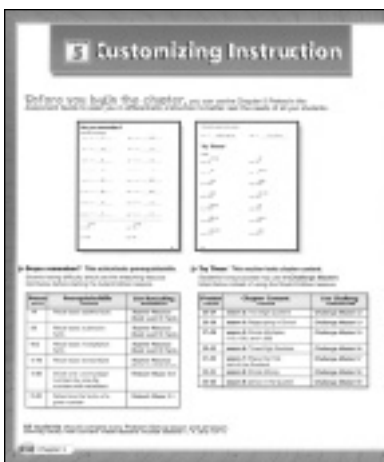
The importance of intervention for students in reading has long been recognized and numerous programs, such as *Reading Intervention for EARLY SUCCESS™* and *Soar to Success™*, have been developed to support struggling readers. As the authors of a recent National Research Council report point out, even though a good deal of mathematics instructional time in school is spent on remediation, “there are not nearly so many supplementary interventions in mathematics as there are in reading” (Kilpatrick et al, 2001, p. 19). There is research to suggest that early intervention can prevent full-blown problems not only in reading, but also in mathematics (Fuson, Smith, & Lo Cicero, 1997). In fact, high performing schools tend to “implement comprehensive systems to monitor individual student progress and provide extra support to students as soon as it is needed” (Education Trust, 1999).

Due to the variations in time spent outside of school in reading activities versus mathematical activities, and the many types and levels of representation involved in mathematics versus reading, it may be that direct school-based instruction plays “a larger part in most children’s mathematical experience than it does in their reading experience” (Kilpatrick et al, 2002, p. 19). Combined with ever more rigorous state and local expectations for student learning of mathematics and accountability systems, careful ongoing diagnostic assessment of student learning in mathematics linked to intervention has never been more important.

Assessment for Student Learning

Mathematics educators have always focused on assessment of student learning, carefully assessing what students have learned through chapter tests, semester tests, district tests, state tests, and norm-referenced standardized tests, just to name a few. This reason for assessment is an important component of a mathematics program. However, the authors of NCTM's *Principles and Standards for School Mathematics*, take a broader view of assessment under the *Assessment Principle*, where they recommend that "assessment should be more than merely a test at the end of instruction to see how students perform ... it should be an integral part of instruction that informs and guides teachers as they make instructional decisions. Assessment should not merely be done *to* students; rather, it should also be done *for* students, to guide and enhance their learning" (NCTM, 2000, p. 22). Consequently, a comprehensive mathematics program will include assessment *for* student learning in addition to traditional assessments *of* student learning.

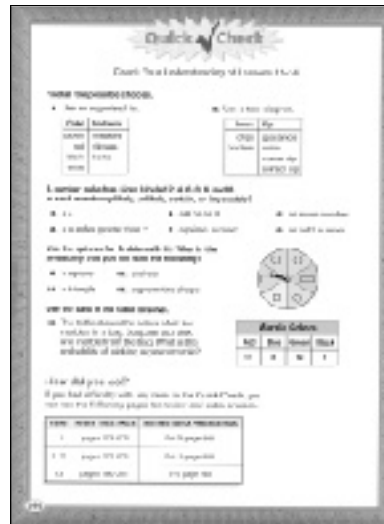
Assessment *for* student learning is only effective if it is diagnostic—guiding and supporting teachers in customizing instruction for individual student



Teacher's Edition, Grade 4, Chapter 5

at the beginning of each unit or chapter. These pre-chapter assessments, if comprehensive, should

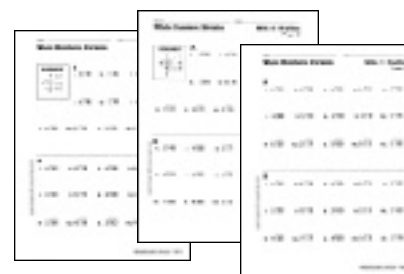
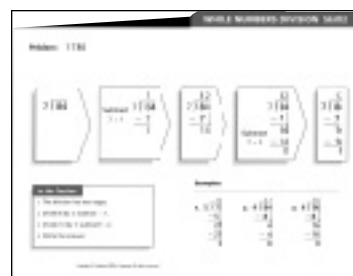
needs—and provides direct and systematic interventions when the results of ongoing diagnostic assessments call for them. This form of assessment should start at the beginning of the year and



Student Edition, Grade 5, page 282

cover both prerequisite material and new content. Items on the pre-assessments should be linked to "refresher" materials that can be used to fill skill or conceptual gaps, and challenge materials for students who already

know new material. A comprehensive system of intervention not only diagnoses problems, but also prescribes and provides the instructional materials teachers need to address students' needs. Once students enter a unit or chapter of instruction, periodic, quick and diagnostic assessments that immediately identify learning gaps and that are linked to systematic interventions are essential to keep students on grade level; to ensure mastery of concepts, skills, and problem solving; to help students meet state and district standards; and to help students perform well on state assessments.



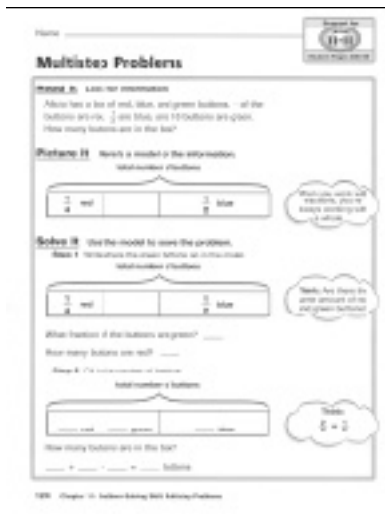
Grades 5-7, Computational Skills Tutorial kit

Providing Intervention

The traditional "extra practice worksheet" does not constitute an intervention system. Because a comprehensive mathematics curriculum is balanced with respect to conceptual under-

standing, procedural skills, and problem solving, so too must an intervention system diagnose, prescribe, and provide intervention resources for skills, conceptual understanding, and problem solving.

With respect to skills, the intervention needs to identify sub-skill weaknesses and then provide direct instruction and practice in those sub-skills. By breaking skills into their component skills, specific gaps can be identified and targeted. Struggling students benefit from additional teacher-directed instruction, clear examples, and sufficient practice and re-assessment.

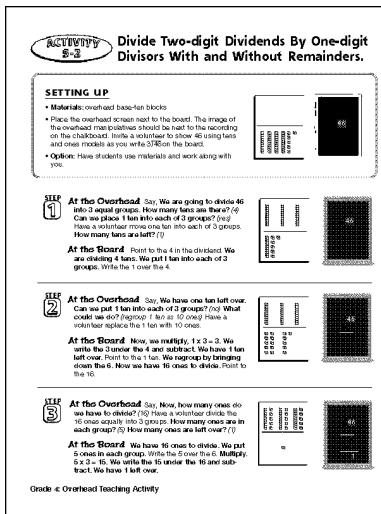


Problem Solving for Success, Grade 3

difficulties. Despite efforts to prevent problem-solving trouble, many students will continue to struggle with problem solving. Students' struggles with problem solving have to do with representing the problem situation and carrying out the problem solution. Therefore, effective interventions for problem solving focus on both problem representation and problem solution (Gagnon and Maccini, 2001). The greatest challenge for many students is getting from the words in the problem to a representation of the problem situation. For these students it is important to receive direct instruction in how to visualize a problem, construct a model, and set up a solution in addition to carrying out the solution.

Successful problem solving relies heavily on mathematics vocabulary and language, which is one of the reasons why a focus on vocabulary is evident in mathematics programs that emphasize conceptual understanding and seek to prevent problem-solving

With respect to conceptual understanding, learning difficulties can be prevented through carefully sequenced content; carefully stepped-out instruction; the use of sound mathematical models; and alternative approaches to topics provided in the text. Again,



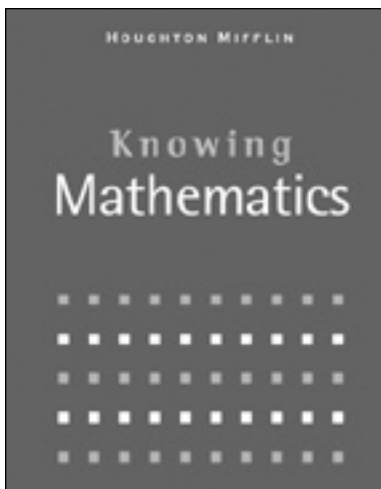
Overhead Teaching Activities, Grade 4

despite efforts to prevent student difficulties, some students will encounter conceptual misunderstandings. When conceptual problems occur, teachers need alternative models and methods of presenting concepts.

In many instances, students' conceptual difficulties have to do with their inability to visualize the mathematics and "see" the concept. In such cases, movable overhead teaching transparencies and activities can help students visualize and connect mathematical concepts. Effective mathematics programs provide teachers with these intervention resources and instructional supports.

Vertical Acceleration

Despite teachers' best efforts to keep all students on grade level, some students will fail to meet



grade-level standards. In addition, some students are already behind grade level by the time they enter the intermediate grades. These students require intensive intervention in addition to regular

classroom instruction. In order to be brought up to grade-level expectations, these students must be “vertically accelerated.” A vertical acceleration intervention, such as *Knowing Mathematics*, provides this acceleration by focusing only on key mathematical concepts and by approaching these concepts in a very non-traditional way.

Intervention and Equity

NCTM’s Equity Principle states that “excellence in mathematics education requires equity—high expectations and strong support for all students” (NCTM, 2000, p. 12). The authors of the Standards went on to write that “equity does not mean that every student should receive identical instruction; instead, it demands that reasonable and appropriate accommodations be made as needed to promote access and attainment for all students ... some students may need further assistance to meet high mathematics expectations” (NCTM, 2000, pp. 12-13).

More rigorous standards and the pressure of accountability have raised the stakes for both students and teachers. To ensure access to the standards for all students, classroom instruction is no longer sufficient. Effective mathematics programs now must also include a comprehensive diagnostic assessment and intervention system to keep students on grade level by supporting student mastery of skills, conceptual understanding, and problem solving. Equity in mathematics education requires nothing less.

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