



Critical Issue: Mathematics Education in the Era of NCLB—Principles and Standards

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ISSUE:

Since the move toward national and state standards began in the late 1990s, national educational standards have been developed in most subject areas. [The National Council of Teachers of Mathematics \(NCTM\)](#) has outlined principles and standards for the discipline of mathematics. Their [Principles and Standards for School Mathematics](#), published in 2000, reflects a concern that students in the United States are not mathematically literate and often fail to see the relationship between mathematics learned in school and real-life situations.

The [Principles and Standards for School Mathematics](#) are expressed as six principles (equity, curriculum, teaching, learning, assessment, and technology) and [10 standards](#) (five content and five process standards: number and operations, algebra, geometry, measurement, data analysis and probability; problem solving, reasoning and proof, communication, connections, and representation) (NCTM, 2000c). Schools and communities, with guidance from the standards document, must determine how to embed these standards and principles into their schools' mathematics instruction. Furthermore, the [No Child Left Behind \(NCLB\) Act](#) (2002), reauthorization of the Elementary and Secondary Education Act, presents schools with a huge challenge: To offer rigorous curriculum content, instructional methods, and forms of assessment that not only are aligned with state standards and/or the NCTM *Principles and Standards for School Mathematics*, but also to ensure that their students score

well and continue to make adequate yearly progress (AYP) on state assessments.

This Critical Issue presents an overview of mathematics standards and assessment issues. It also offers valuable accountability information to individuals, both those very experienced and knowledgeable about mathematics standards and novices. The Critical Issue begins with background information so that the reader can appreciate what is at stake. It then addresses the question of "how do we know whether students are reaching the standards through the assessment given and the interpretation of those assessments?" It takes the reader through what parents, students, and professionals should know is important in the management and application of standards-based instruction and to accomplish the goals of NCLB. The Critical Issue also provides different points of view of the critics. The key question addressed in this issue is: What approaches are necessary to further integrate *Principles and Standards for School Mathematics* into classroom practice to improve mathematics instruction and meet the accountability outlined by the NCLB legislation?

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OVERVIEW:

A Brief History of Mathematics Standards Development

The move toward national and state standards for mathematics instruction and outcomes was given major impetus with the publication of a 1989 report on the implications of then current practice. According to *Everybody Counts: A Report to the Nation on the Future of Mathematics Education* (Mathematical Sciences Education Board [MSEB], 1989), American children have mathematical skills that are insufficient for problem solving in the workplace and for mathematical literacy at the college level. The report states, "Current mathematical achievement of U.S. students is nowhere near what is required to sustain our nation's leadership in a globally technological society" (MSEB, 1989, p. 1).

In response to this growing concern about students' mathematical understanding, NCTM published [Curriculum and Evaluation Standards for School Mathematics](#) (Suydam, 1990). In publishing this breakthrough document—the first set of national standards in a major content area—NCTM began a discussion about what students should know and be able to do in certain grade levels (K–4, 5–8, and 9–12). Following the publication of curriculum standards, NCTM published in 1991 the Professional Standards for Teaching Mathematics and followed with Assessment Standards for School Mathematics in 1995. These two documents expanded upon the standards-based movement by including models for both teaching and assessment.

However, because of considerable criticism of the first set of standards for not paying sufficient attention to basic skills, NCTM started a revision. The second version added language emphasizing

basic skills. The revised standards were published in 2000 as *Principles and Standards for School Mathematics*. This new set of standards, while built upon the foundation of the previous standards document, differs from the original in important ways. Primarily, it integrates the classroom-related portions of all three prior works and reorganizes standards content into four grade bands: prekindergarten through Grade 2, Grades 3–5, Grades 6–8, and Grades 9–12. According to NCTM (2002), the new standards document "keeps the direction and core messages of the original standards documents while updating the information to reflect current research on mathematics teaching and learning, the wisdom we have gained in more than 10 years of promoting standards-based reform, and advances in technology" (p. 1). The new edition of standards includes the following (NCTM, 2002, pp. 1–2):

- A common set of 10 standards that articulate the growth of mathematical knowledge across the grades, rather than a different set and number of standards for each grade band.
- Four grade bands (i.e., PK–2, 3–5, 6–8, 9–12) instead of three, allowing more focus on, and detail for, the elementary and middle grades.
- Recommendations for the mathematical learning of preschool children.
- A new standard on representation that outlines the processes and outcomes of acquiring and demonstrating mathematical concepts mentally, symbolically, graphically, and by using physical materials.
- The addition of principles that outline the particular characteristics of high-quality mathematics education that can be used as a guide for decision making.
- Significantly more citations from research to support the assertions made.
- An electronic edition (*E-Standards*) of the print document as well as electronic examples to enhance the discussions in the book.

To support the research base of the revised mathematics standards, NCTM published *A Research Companion to Principles and Standards for School Mathematics* (Kilpatrick, Martin, & Schifter, 2003). The research companion addresses the issues of research and its role in setting the standards in the mathematics classroom. The comprehensive analysis provides the reader with current thinking about school mathematics education. The book is divided into three sections discussing research on principles and standards, perspectives on teaching and learning, and the creation of the mathematics standards. Topics covered in the research companion include assessment, mathematical power, professional development, and the content standards. The articles are written by multiple experts and noteworthy authors such as Deborah Ball, Joan Ferrini-Mundi, Robert Siegler, Patrick Thompson, and Erna Yackel.

The other source for the research base is the article, "[Scaling Up Innovative Practices in Mathematics](#)

[and Science](#)," written by Thomas Carpenter and his colleagues (2004) at the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA), a former mathematics and science center located at the University of Wisconsin–Madison. Their eight years of classroom research shows there are three key instructional practices that are fundamental in allowing new visions of mathematics and science to become the norm in the classroom. Those practices—modeling, generalization, and justification—are supported by long-term research as critical yet still invisible practices necessary for students to be successful and productive in learning mathematics and science.

Assessing Standards-Based Mathematics: NAEP, TIMSS, and NCLB

Although most American students can demonstrate mastery of basic mathematics facts, many are not capable of using this knowledge to solve everyday problems. Standards-based reform has many curricular and instructional prerequisites, which require teachers to use specific knowledge and skills and to know what works in mathematics education.

Knowing what works in education requires teachers be knowledgeable about research-based materials. The [What Works Clearinghouse](#) was established in 2002 by the U.S. Department of Education's Institute of Education Sciences to provide educators, policymakers, researchers, and the public with a central and trusted source of scientific evidence of what works in education. The clearinghouse currently features mathematics middle school curricula research studies.

In this new era of accountability under NCLB, alignment with state standards is an important criterion with major impact on definitions of quality data. "States will be held accountable for deliverables (e.g., adequate yearly progress determinations, annual report cards, [and] diagnostic assessments aligned with academic standards and linked to the state's assessments," said Glynn Ligon (2004, p. 1), president of ESP Solutions Group, at the Empowering Accountability and Assessment Using Technology Summit 2004. The summit highlighted the need for adequate information systems as well as the need to collect and report quality data.

NAEP Mathematics Assessment

For more than 20 years, the National Center for Educational Statistics (NCES) has used the [National Assessment of Educational Progress](#) (NAEP) to monitor the educational achievement of American students and changes in that achievement across time. Through random-sampling testing, NAEP results help us to understand the extent to which our students can solve problems with their mathematical knowledge. According to NCES:

"[NAEP is the] source for information on mathematics and science achievement at key stages of education across the country using nationally established external benchmarks of performance (e.g., basic, proficient, advanced). The frameworks and benchmarks are established by the National Assessment Governing Board (NAGB) and are based on the collaborative input of a wide range of

experts and participants in the United States from government, education, business, and public sectors. Ultimately, they are intended to reflect the best thinking about the knowledge, skills, and competencies needed for students to have an in-depth understanding of these subjects at different grades." (Scott, 2004, p. 2)

In the past, the NAEP test was administered to schools on a voluntary basis. Under NCLB legislation, schools accepting Title I funds must agree to administer the NAEP test if they have been randomly selected.

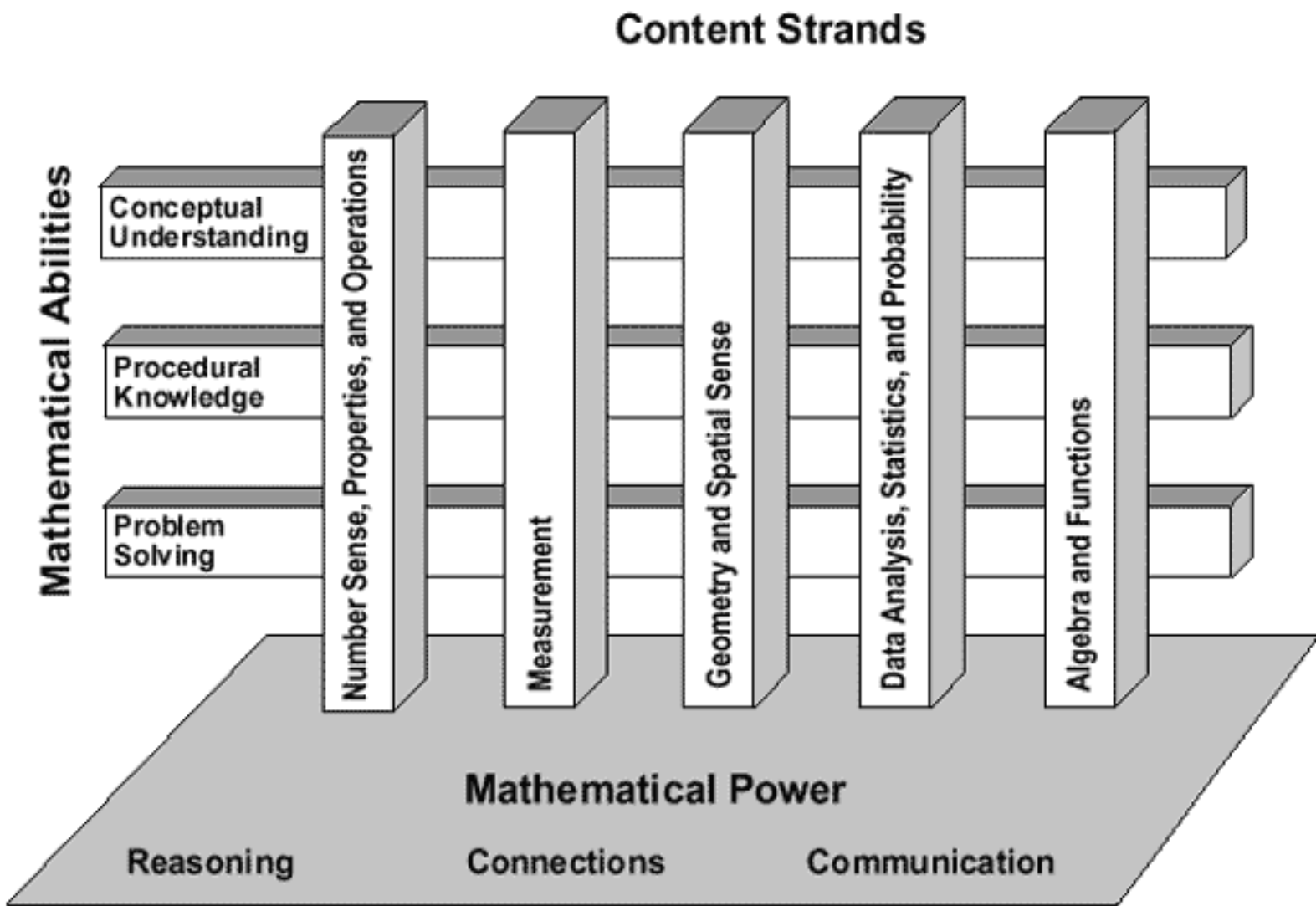
Following the NCTM mathematics standards publications, NAEP published an assessment framework for mathematics called the *NAEP Mathematics Framework*. This 1996 document, developed by the [National Assessment Governing Board](#) (NAGB), describes the skills and content measured in the assessment. The [NAEP mathematics assessment](#) was developed using this framework. The 1996 mathematics framework reflected then-current curricular emphases and objectives, yet still maintains a connection with the 1990 and 1992 assessments (NCES, 2004). It focuses on five broad strands of [mathematics content](#): (1) number sense, properties and operations; (2) measurement; (3) geometry and spatial sense; (4) data analysis, statistics, and probability; and (5) algebra and functions (NCES, 2004). The 1996 framework also includes three types of [mathematical abilities](#): conceptual understanding, procedural knowledge, and problem solving.

Since the *Curriculum and Evaluation Standards for School Mathematics* was published in 1990, NAEP mathematics assessments have continually been updated as new mathematics standards evolved and have focused on fostering mathematical knowledge and power in the nation's students (NCES, 2004). Mathematical power is defined as consisting of a few elements. According to NAGB:

"Mathematical power is characterized as a student's overall ability to gather and use mathematical knowledge through exploring, conjecturing, and reasoning logically; solving nonroutine problems; communicating about and through mathematics; and connecting mathematical ideas in one context with mathematical ideas in another context or with ideas from another discipline in the same or related contexts." (Orrill & French, 2002, p. 35)

The 1996, 2000, and 2003 nationwide mathematics assessments focused on reasoning and communication by requiring students to connect their learning across mathematical content strands (NCES, 2004). Figure 1, taken from the [Mathematics Framework for the 2003 National Assessment of Educational Progress](#) publication, shows the relationship among the mathematical abilities, content strands, and power as described in the mathematics framework (NCES, 2004; Orrill & French, 2002, p. 11).

Figure 1. Framework for the 1996, 2000, and 2003 Mathematics Assessments



Based on NCES (2004), the mathematics framework specifies the percentage distribution of items to be devoted to each content strand by [Grades 4 and 8](#). The level of mathematics proficiency is determined for students in Grades 4, 8, and 12. NAGB's Loomis & Bourque (2001) provide a document, titled [National Assessment of Educational Progress Achievement Levels 1992–1998 for Mathematics](#), with descriptions of the NAEP mathematics achievement levels (basic, proficient, and advanced), cut scores, and sample questions with illustrations of student knowledge and skills required within each achievement level. According to the document, which could well serve as a reference booklet for parents and teachers interested in learning about the NAEP assessment, the following definitions of the achievement levels in Table 1 apply to all subjects and all grades assessed by NAEP.

Table 1. NAEP Achievement-Level Policy Definitions

Basic Basic denotes partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at each grade.

Proficient

Proficient represents solid academic performance for each grade assessed. Students reaching this level have demonstrated competency over challenging subject matter, including subject-matter knowledge, application of such knowledge to real-world situations, and analytical skills appropriate to the subject matter.

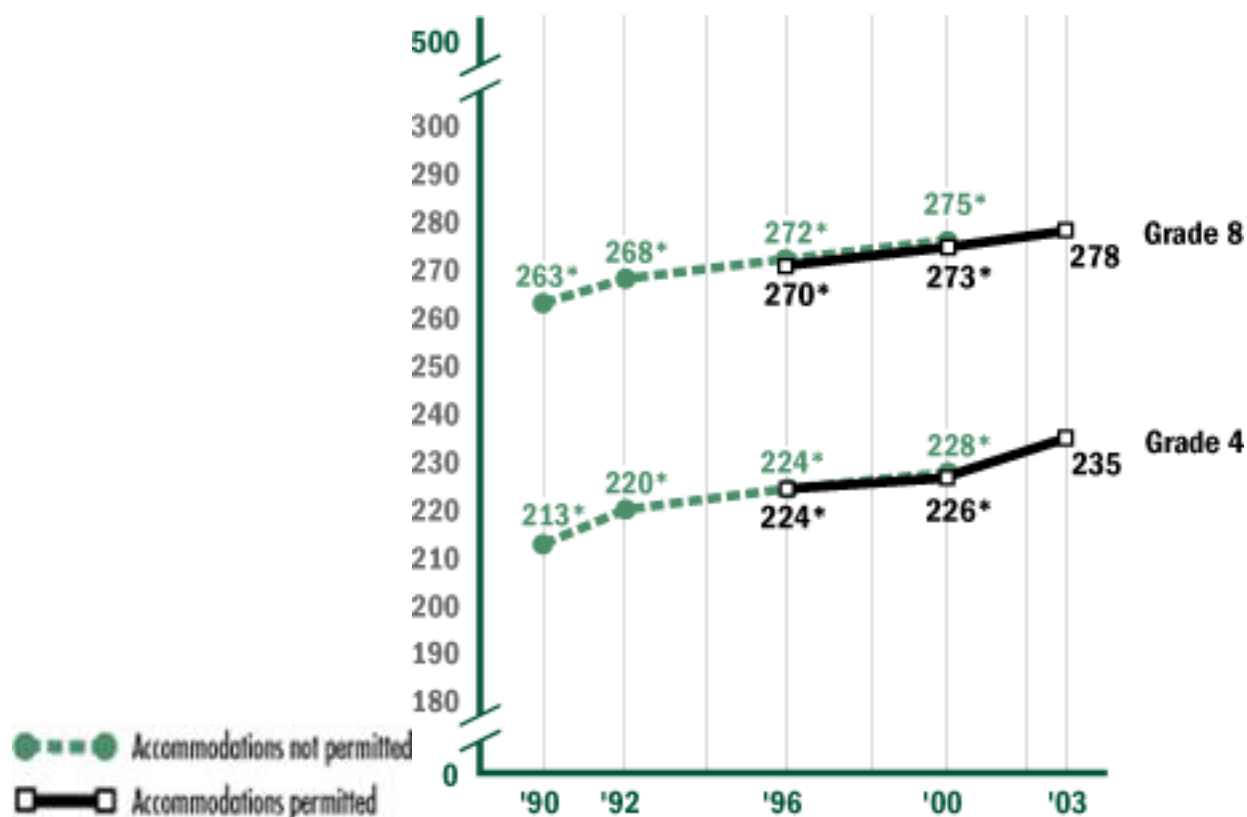
Advanced

Advanced represents superior performance.

The 2003 NAEP assessment has brought encouraging news about student achievement in at least a few levels. Regarding mathematics results, Stevens (2003), an NAGB member, claimed, "Something positive is happening in our schools" (p. 1). Indeed, results of the [2003 NAEP](#) (NCES, 2005) show that overall mathematics scores are improving, especially in the fourth grade. It is significant that this improvement coincides with the growth of the standards movement and the fact that elementary students are exposed to *all* NCTM standards, where before the emphasis in mathematics instruction was primarily on computation.

As Figure 2 shows, growth is seen in both Grades 4 and 8.

Figure 2. Average Mathematics Scale Scores, Grades 4 and 8: 1990–2003



Source: NCES, 2004: <http://nces.ed.gov/nationsreportcard/mathematics/results2003/natscalescore.asp>

The graph shows the upward trend in scale scores over a 13-year period for Grades 4 and 8, both for students allowed accommodations (changes in testing conditions as required by individualized education programs) and not. In fourth- and eighth-grade mathematics, the scores in 2003 were higher than in all

previous assessment years. The increases are evident at all three levels of student proficiency, as seen on the [NAEP Mathematics Achievement Levels](#) Web page (NCES, 2002).

Stevens (2003) called the achievement results at the Basic level "real progress" (p. 3). Yet he also raises the question of how the nation's students could reach the next level—proficiency. "To reach Proficient on NAEP, students must be able to apply the math they've learned to different, often unfamiliar situations, to set up problems as well as to solve what they are given," says Stevens (2003, p. 3). Even though the results do show some increases at the Proficient level in both fourth and eighth grades, the concern is with the racial gap that exists at the achievement level: "The proportion of black fourth graders reaching Proficient has climbed from just 1 percent in 1990 to 5 percent in 2000 to 10 percent in 2003. In the last three years the proportion of Hispanics reaching this level rose from 7 [percent] to 16 percent. But among white fourth graders, 43 percent now reach the Proficient level; among Asians it's 48 percent" (Stevens, 2003, p. 4).

Ensuring equity and excellence lies at the core of systemic reform efforts. The core of educational equity is to ensure that every student has access to challenging curriculum that supports his or her personal, academic, and professional goals. Regardless of differences of race, ethnic group, gender, socioeconomic status, geographic location, age, language, disability, or prior academic achievement, all students deserve equitable access to challenging and meaningful academic learning and achievement. However, access is often not enough. Equally important factors are high expectations and strong support (NCTM, 2000c). Such integrated concepts of equity have been progressively developed, defined, and articulated to school communities across the country. NCTM highlights the following components of the Equity Principle:

- Equity requires high expectations and worthwhile opportunities for all (NCTM, 2000c, p. 12).
- Equity requires accommodating differences to help everyone learn mathematics (NCTM, 2000c, p. 13).
- Equity requires resources and support for all classrooms and all students (NCTM, 2000c, p. 14).

NCREL's *Pathways to School Improvement* Critical Issue "[Remembering the Child: On Equity and Inclusion in Mathematics and Science Classrooms](#)" (Hambrick & Svedkauskaite, 2004) provides a definition of equity and an overview of the issues in mathematics and science education. The overview is supported and enhanced with links to many additional resources and includes suggestions for teacher professional development, goals, action items, and managing implementation pitfalls. The article discusses equity issues regarding student groups singled out in NCLB: students who are socioeconomically disadvantaged are from major racial and ethnic groups, have disabilities, or have limited English proficiency. Additional information on how states and regions are closing the achievement gap can be found on NCREL's [Closing the Achievement Gaps](#) Web site (n.d.). [Sample mathematical problems](#) are available on the *NAEP* Web site (NCES, 2004).

TIMSS Assessment

Similar to NAEP, the Trends in International Mathematics and Science Study (TIMSS) also measures mathematics proficiency at the fourth and eighth grades, using sample-based assessments. While NAEP illustrates American students' progress in mathematics, TIMSS illustrates America's progress compared with other nations.

TIMSS provides international comparative information on mathematics achievement in the primary and middle grades in the United States:

"Like NAEP, its assessments are based on collaboratively developed frameworks for topics from curricula in mathematics ... to be assessed; but unlike NAEP, the framework and related consensus process involves content experts, education professionals, and measurement specialists from many different countries." (Scott, 2004, p. 2)

In 2003, comparisons of the mathematics and science achievement of fourth graders were made among 25 participating countries. U.S. fourth graders exceeded the international averages in both mathematics and science. In mathematics specifically, U.S. fourth graders outperformed their peers in 13 of the participating countries (NCES, 2003). Students in three countries—Chinese Taipei, Japan, and Singapore—outperformed U.S. fourth graders in both mathematics and science (NCES, 2003).

Among eighth graders, however, the comparisons were made among 45 participating countries. Similar to the fourth graders, U.S. students exceeded the international average in mathematics and science. They outperformed their peers in 25 countries in mathematics and 32 countries in science (NCES, 2003). Students in seven countries—Chinese Taipei, Estonia, Hong Kong SAR, Hungary, Japan, Korea, and Singapore—outperformed U.S. eighth graders in mathematics and science (NCES, 2003).

According to Plisko (2004), associate commissioner of NCES, "TIMSS provides an important external perspective on the performance of U.S. students" (p. 5) TIMSS as well as NAEP assessments have the most in common of all in terms of content and cognitive demand (Plisko, 2004).

Assessment in the Era of NCLB

Although NAEP and TIMSS measure student achievement, NCLB requires each state to demonstrate accountability through making AYP. Because of this new requirement, all states are working to design and implement yearly tests in reading and mathematics from Grades 3–8, and a test to be administered once between 10th and 12th grades. In addition, each state must administer assessments in reading and math at three grade spans (3–5, 6–9, and 10–12). Science tests must be developed and administered during the three grade spans by 2007–08. Testing performed by NAEP and testing required by NCLB do not coordinate well in terms of test years and yearly testing of all grades. NAEP administers tests in Grades 4, 8 and 12. TIMSS operates on a similar schedule. For the latest information on NAEP and TIMSS and their relevance to NCLB, visit the NAEP and [No Child Left Behind](#) section of the *NAEP*

Web site.

NCLB also has set similar requirements to those of NAEP for standards and proficiency, yet the legislation leaves up to the states how to articulate each level of achievement. According to NCLB (2002), academic content standards should be challenging and "specify what children are expected to know and be able to do, contain coherent and rigorous content, and encourage the teaching of advanced skills" (Part A, Sec. 1111(b)(D)(i)(I–III). They should align with each state's academic content standards; "describe two levels of high achievement (proficient and advanced) that determine how well children are mastering the material in the state academic content standards; and describe a third level of achievement (basic) to provide complete information about the progress of the lower-achieving children toward mastering the proficient and advanced levels of achievement" (NCLB, 2002, Part A, Sec. 1111[b][D][ii][I–II]).

Accountability Factors

One way that the United States has addressed American students' progress in mathematics as well as other subject areas has been to develop a nationwide system of academic standards that define content and assessments. NCLB has formalized this system and strengthened Title I accountability by requiring states to implement statewide accountability systems covering all public schools and students.

Challenging Academic Content Standards

The NCLB-mandated accountability systems must be based on challenging state standards in reading and mathematics, annual testing as described previously, and annual statewide progress objectives ensuring that all groups of students reach proficiency within 12 years (i.e., by 2014). To ensure that no group is left behind, assessment results and state progress objectives must be broken out by poverty, race, ethnicity, disability, and limited English proficiency.

Forty-nine of the 50 states have adopted state-level standards in mathematics. Ohio provides an excellent example of how national standards and state standards can be correlated (Ohio Department of Education, n.d.). The [Ohio Department of Education](#) Web site provides academic content standards in all subject areas, an alignment toolkit, and a district curriculum alignment tool so that individual districts can create their own standards documents based on the state standard subsets. Additionally, Ohio has compiled a model curriculum made up of standards-based mathematics lessons in all standards and all grade levels. Ohio also provides its constituent districts statewide with research-based opportunities for mathematics and science professional development (i.e., [Ohio Mathematics Academy Program and Ohio Science Institute](#)) developed by Miami University, the Ohio Department of Education, and the Science and Mathematics Network.

Formative Assessment

Assessment is a central focus of the standards movement and is perplexing to many teachers. Often

teachers feel formal assessment and testing take too much time from their instruction. But they feel pressured to learn to incorporate as much assessment analysis as they can into their instructional methods. Combined with pressure to teach to the standards, teachers may often feel they are teaching to the test.

To alleviate the tension teachers feel about assessment, it is important for them to know the specific short- and long-term goals and purposes of assessment. There are several purposes of assessment in mathematics education. They include monitoring student progress, planning instructional activities, and formulating education policy (Champagne, Sherwood, & Cezikurk, n.d.). The *Assessment Standards for School Mathematics* (NCTM, 1995) presents six standards for mathematics assessment. In *Principles and Standards for School Mathematics*, NCTM concluded that exemplary mathematics assessment based on those standards should do as follows (NCTM, 2000c, p. 22):

- Reflect the mathematics that students should know and be able to do.
- Enhance mathematics learning.
- Promote equity.
- Be an open process.
- Promote valid inference.
- Be a coherent process.

Adequate Yearly Progress (AYP)

NCLB requires that each state defines AYP for school districts and schools within the parameters set by NCLB (U.S. Department of Education, 2004). The process for [defining AYP](#) is as follows:

"Each state sets the minimum levels of improvement—measurable in terms of student performance—that school districts and schools must achieve within time frames specified in the law. In general, it works like this: Each state begins by setting a starting point that is based on the performance of its lowest-achieving demographic group or of the lowest-achieving schools in the state, whichever is higher. The state then sets the level of student achievement that a school must attain [after two years] in order to [continue to show] AYP. Subsequent thresholds must increase at least once every three years, until, at the end of 12 years, all students in the state are achieving at the proficient level on state assessments in reading and language arts [and] math." (p. 11)

School districts and schools that fail to make AYP toward statewide proficiency goals will, over time, be subject to improvement through corrective action and restructuring measures aimed at getting them back on course to meet state standards. Schools that meet or exceed AYP objectives or close achievement

gaps will be eligible for [state academic achievement awards](#): States may financially reward teachers in schools that receive academic achievement awards (U.S. Department of Education, 2004).

Administration and teachers share the responsibility for AYP. [The failure of one subgroup to make AYP](#) can cause the school to be labeled as *needing improvement*. This label means that all students in the school are offered the opportunity to transfer to a different school in the district, with transportation provided. If improvement is not seen (i.e., AYP is missed again), low-achieving students become eligible for supplementary educational services (such as tutoring) at district expense.

Finally, the school may be required to replace certain staff, fully implement a new curriculum, or, in the end restructure the school either as a charter school, replace all staff, or turn the school over to the state or a private company. ([View NCLB regulations on AYP.](#))

Such stringent AYP processes require school and district administrations to find the most effective interventions for low-achieving students in order to best use, and in some cases retain, their federal Title I dollars, in addition to ensuring that their current staff and new hires meet the definition of highly qualified.

Highly Qualified Teachers

NCLB requires highly qualified teachers in each classroom. To be deemed highly qualified, teachers must have the following:

- A bachelor's degree.
- Full state certification or licensure.
- Proof that they know each subject they teach.

Teachers (in middle and high school) must prove that they know the subject they teach with one of the following:

- A major in the subject they teach.
- Credits equivalent to a major in the subject.
- Passage of a state-developed test that qualifies as a high, objective, uniform state standard of evaluation ([HOUSSE](#)).
- An advanced certification from the state.

- A graduate degree.

NCLB allows states to develop an additional way for current teachers to demonstrate subject-matter competency and meet highly qualified teacher requirements. Proof may consist of a combination of teaching experience, professional development, and knowledge in the subject garnered over time in the profession. However, time teaching a given subject alone cannot be used to qualify as "highly qualified."

These requirements can be daunting for schools and districts. Teachers at the middle and high school levels who find that they are not considered highly qualified as described above may find themselves unable to obtain a teaching position, released before achieving tenure, or if tenured, moved to teach a subject in which they are deemed highly qualified even if they have taught mathematics for years.

Teachers in Community Unit School District 200 in Wheaton, Illinois, use a number of ways to stay current in the teaching field.



[Gabriela Castillo, a first-grade bilingual teacher at the district's Johnson Elementary School, says ways such as methods or mathematics courses offered through the district, collaboration with fellow teachers, and teacher observations can help her sharpen her instructional skills and professional knowledge.](#) [Video: 1:00]

Teachers and school districts have already found it a challenge to design curricula, instruction, and assessments that meet, exceed or coordinate national, state, and local district standards. The challenge does not end there because NCLB accountability requirements mean that schools and districts must quickly implement best practice as determined by [scientifically based research](#) in mathematics instruction while ensuring that all teachers meet the definition of high quality.

Meeting Accountability Requirements

With the advent of NCLB, all of these accountability factors form the basis for educational success, while high-stakes tests determine students' and schools' educational future. As NCTM (2000b) states, such tests "are used to make significant educational decisions about children, teachers, schools, or school districts" and make "the determination of such things as graduation, course credit, grade placement, promotion to the next grade, or placement in special groups" (p. 1). Such an accountability system makes it imperative to implement NCTM principles and standards in curriculum, instruction, and assessment as well as to better understand the needs of the NCLB identified subgroups.

To summarize, NCLB requires the following:

- Statewide assessments based on challenging state standards.
- Increasing achievement over each year (AYP) so that all students reach 100 percent academic

proficiency by 2014.

- Student scores reported out in subgroups (poverty, race, ethnicity, disability, and limited English proficiency).
- Highly qualified teachers.

NCTM Recommendations

To meet the NCLB requirements in regards to the subject matter of mathematics, NCTM (2002) recommends the following key elements.

Students Should Learn and Experience Mathematics in a Standards-Based Classroom. Standards-based instruction allows teachers and students to be on the same page by specifying how teachers and students will meet their education goals, including specific concepts, order, or instructional materials (Krueger & Sutton, 2001). In standards-based instruction, standards delineate what matters, provide clarity and a fixed point of reference for students and teachers, guide instruction so that it is focused on student learning, provide a common language to have conversations, help ensure equal educational opportunities, assist in identifying struggling students, and meet federal guidelines (Ohio Department of Education, n.d.).



[A standards-based classroom also can help create a safe environment for students in the classroom, says Castillo, a first-grade bilingual teacher.](#) [Video: 1:35]

Because national mathematics standards are voluntary and do not prescribe a single approach to teaching the subject, it is up to the individual local educational entities to determine the mathematics course content, organization, focus, and delivery. In the classroom, students should be learning how to apply their mathematics knowledge to the real world and share their learning processes with fellow students (NCTM, 2002). As they learn mathematics, students should use a range of mathematical and technological tools such as manipulatives, calculators, and computers (NCTM, 2002). The role of the teacher is to probe student thinking by posing problems, asking questions, and encouraging exploration of solutions (NCTM, 2002). One of the challenges with standards is that even though they do provide a direction for learning, they may sometimes be too rigorous or become the sole measure of how students learn. There may be danger in allowing standards to entirely drive the curriculum.



Matt Jewell, an English language learner (ELL) teacher at Madison Elementary School in Wheaton, Illinois, [points out his concern with using standards as a sole measure of achievement.](#) [Video: 2:41]

Students Need Multiple Opportunities to Apply Basic Skills to Problem Solving. Students inevitably

have to solve problems in their daily lives. In the mathematics classroom, the essential task is to have students problem solve in ways that apply and challenge their basic skills. This process of helping students connect basic skills to the problem-solving process should start as early as the first grade.



[Castillo, a first-grade bilingual teacher, says, knowing what higher-grade-level teachers need helps her reinforce the necessary and appropriate student skills.](#) [Video:1:36]

The emphasis should be on building students' mathematical power (i.e., enhancing their ability to reason, problem solve, make connections, communicate with their fellow students, and use representations in their solutions) (NCTM, 2002). In the classroom, problem solving comes first and learning basic skills becomes a part of what it means to problem solve. Fostering both computational skills and conceptual understanding will allow students to solve problems that they encounter in their daily lives (NCLB, 2002). This skill is critical for all students, including those with limited English proficiency.



[ELL teacher Jewell tells us about how applying problem solving to their daily lives and their subject areas can enhance student understanding.](#) [Video: 1: 57]

Students Should Be Empowered to Use a Full Range of Technological Tools.

Technology has considerable potential for increasing interest in, and improving the quality of learning in, the mathematics classroom. Effective use of technology is possible only if sufficient attention is given to creating and coordinating appropriate curricula, instructional pedagogy, and assessments. Such effort needs to be supported by classroom access to sufficient technology, access to the Internet, and, especially, the ability of the teacher to model the necessary uses of the technology.



Gilbert Valdez, Ph.D., codirector of the North Central Eisenhower Mathematics and Science Consortium, says [technology adds productivity to learning.](#) [Video: 1:20]

Students Should Be Provided with Assessments that are Ongoing, Continual, and Multifaceted. An earlier tendency in the United States has been to implement standardized testing as a means to improve schools, starting with a district level and going up to an international level (Stiggins, 2004). The mistake, it appears, was to "believe that once-a-year standardized assessments alone can provide sufficient information and motivation to increase student learning" (Stiggins, 2004, pp. 22–23). A single annual test is grossly inefficient. Teachers must also be equipped and encouraged to use formal and informal formative assessment year-round to drive their teaching in ways that influence student habits inside and outside the classroom, and ideally, in the long run. As Dr.



Valdez says [states need to recognize that learning is about big concepts and something that has meaning for a lifetime.](#) [Video: :36]

While summative assessment is used for accountability to showcase and prove that

students gained knowledge over a certain time, formative assessment is valuable in its intent to improve learning and to change instruction based on results. Therefore, it is important to know the different purposes and intents of both assessments.



According to Dr. Valdez, [the two tests have two different, purposes and, and intents.](#)
[Video: :30]

NCTM (2002) advocates that students be given ample opportunities to demonstrate their mathematical understanding through a variety of assessment techniques such as portfolios, discussions, presentations, and projects, in addition to the traditional approach of written tests. NCREL's *Pathways to School Improvement* Critical Issue "Multiple Dimensions of Assessment that Support Student Progress in Science and Mathematics" (NOTE: please hyperlink to the article when it is posted) provides more information on assessment issues from various perspectives.

What Do These Recommendations Mean for Classroom Teachers?

The creation and delivery of such "students should" and "students need" recommendations cannot happen without dedicated teachers. However, these NCTM instructional recommendations are dependent on teacher willingness, preparation, and support. To create and sustain these classroom learning experiences, teachers need to do the following:

- Be highly qualified.
- Be aware of students who are in subgroups in their classroom (e.g., ELL students or students with disabilities).
- Provide instruction that develops conceptual understanding while teaching and applying basic-skills problem solving.
- Allow students to tackle real-life mathematics problems.
- Encourage students to talk and communicate about their learning and progress on the problem.
- Accept and encourage different approaches to solving a problem.
- Use various technology tools.
- Differentiate instruction.
- Perform constant and ongoing assessment.



[ELL teacher Jewell details an example of how teachers can make learning relevant to student's life.](#) [Video: 1:36]

Classroom Strategies for Meeting Standards

A mathematics classroom that is standards based should have four embedded central strategies, according to an *ENC Focus* issue (ENC, 2004) "Looking Into a Standards-Based Classroom":

- Inquiry and problem solving.
- Collaborative learning.
- Continual assessment embedded in instruction.
- Higher order questioning.

However, in an elementary classroom, teachers are often challenged by the need for their own comfort in using technology; enhancing students' problem-solving skills and critical thinking with their knowledge of basic skills; employing constant assessment; and, last but certainly not least, their own need for broad and deep knowledge of mathematical content. Indeed, the research is showing that the more elementary school teachers understand the mathematical content behind what they teach, the greater student achievement is and the less likely students are to develop misconceptions that interfere with their learning in later years. Teachers who know the mathematics content more deeply are more likely to skillfully guide class discussions. Teachers' sound conceptual base is the hallmark of standards-based classroom learning because it supports the process standards of *Principles and Standards for School Mathematics*. Taking time to enhance the mathematics-content knowledge of elementary teachers is problematic because they are also responsible for teaching all the other content areas as well. However, the evidence suggests that this would be time well spent.

Based on the message from the *Principles and Standards for School Mathematics* that all the process skills be taught at every grade level, all teachers should do the following:

- Be encouraged to pose real-world problems.
- Ask questions that encourage student thinking and exploration of different solutions.
- Ensure they are teaching all required mathematical skills and concepts.
- Encourage appropriate use of technology.

- Employ constant assessment.

This is particularly challenging in classrooms that operate on a bell schedule, which segments the day into less than one-hour class periods. Teachers in that situation may only teach mathematics; however, they have many more students to teach.

Overall, all teachers of mathematics, whether at the elementary or secondary level, have to be aware of the national, state, and local mathematics standards and principles as well as best practice in teaching and assessment. Teaching in a standards-based classroom could require huge changes in a teacher's approach to the students.



GOALS:

In the era of NCLB, mathematics education should encompass the following goals:

- All school districts will implement a curriculum aligned with an NCTM standards-based curriculum and verify that alignment with state and district expectations.
- All school districts will provide high-quality professional development on standards-based instructional strategies.
- All school districts will implement an assessment plan as described by NCTM and required by NCLB.
- Teachers at all grade levels will have multiple opportunities to further develop strong mathematics content knowledge (be highly qualified) and be knowledgeable of the teaching and instructional practices that foster mathematical literacy in *all* of their students.
- [All students will be mathematically literate](#) (Romberg, 2001). NCTM has carefully articulated five content standards as well as five process standards that help to define mathematical literacy for PK–12.



[ELL teacher Jewell defines what it means to be mathematically literate.](#) [Video: 1:36]

- Create a climate that facilitates students solving problems and communicating with each other. Mathematics needs to not only be related to the other disciplines but related to the world. Mathematics is not a procedure; mathematics defines solving problems whether the tool is estimation, analysis, or computation.



ACTION OPTIONS:

These goals present an enormous challenge: to create and implement a comprehensive and long-term plan for the improvement of mathematics curricula, instruction, and assessment in the education system. They have been thoughtfully articulated to maximize the goal of mathematical literacy for all students. However, the education stakeholders at the school, district, and state level must commit to far-reaching analysis, training, and persistent application of such actions.

What approaches or action options could these stakeholders take to ensure that NCTM's *Principles and Standards for School Mathematics* are integrated into classroom practice to improve mathematics instruction and meet the accountability outlined by the NCLB legislation?

The following action options are sorted by stakeholders most directly responsible for their implementation: students, teachers, administrators, and parents and community leaders. Contemplated by stakeholder, they capture the depth of the individual commitment necessary for ongoing success. Viewed as a whole, they capture the scale of the institutional effort needed to ensure mathematical literacy for all students.

To become mathematically literate, students must be empowered to do as follows:

- Experience mathematics in the context of the guidelines outlined in the NCTM PK–12 *Principles and Standards for School Mathematics*.
- Develop an understanding of the full range of mathematical content topics.
- Model, ground, and enrich their understanding of concepts by linking them to multiple forms of representation (e.g., diagrams, graphs, tables, simulations/computer visualizations, manipulative and symbolic expressions). One of the classic ways to help students see the practicality of mathematics is to use hands-on activities.



[Barbara Campbell, a school teacher with 30 years of teaching experience, says, manipulatives can help students make sense of the abstracts they are learning.](#)



- Develop skills and processes of problem solving, reasoning, communicating, and connecting concepts within and outside of mathematics.
- Make appropriate and ongoing use of technology, including (but not limited to) calculators and computers as tools for learning mathematics. (Read the [NCTM's Technology Principle](#).)
- Continue to assess their own mathematics learning and progress.
- Apply mathematics learned in school to real-world situations.

To facilitate students becoming mathematically literate most effectively, teachers should do the

following:

- Become knowledgeable in the mathematics content for which they are responsible.
- Become knowledgeable of their district/state/national standards for mathematics curriculum, instruction, and assessment.
- Become knowledgeable about current research on the teaching and learning of mathematics (See the [National Research Council](#) Web site.)
- Reexamine their belief systems to address any unconscious assumptions toward equity and do everything possible to eliminate the vestiges of discrimination still in our schools. (Read NCREL's Critical Issue "[Remembering the Child: On Equity and Inclusion in Mathematics and Science Classrooms](#).")
- Participate in selecting and/or adopting curricula, textbooks, and instructional materials/ programs, and in decision making relative to assessment issues (e.g., grading and reporting) where possible and appropriate.
- Create a climate that facilitates students communicating with one another in the language of mathematics, listening carefully to each other's ideas, taking effort to express clearly their own ideas, and showing mutual respect for each other. (See NCREL's [Pathways Facilitates Students Communicating With One Another in the Language of Mathematics](#).)
- Find innovative and creative ways to connect to the ideas and experiences of students, thereby teaching mathematics in the context of meaning and real-world application, rather than merely teaching formulas and procedures.
- Plan lessons that involve students in the crucial elements of mathematical discovery and engage them in an active process of learning in which they create and discover mathematical concepts. (Samples and ideas can be found at the [Illuminations](#) Web site.)
- Implement ongoing assessment aligned to the standards in ways that allow students to demonstrate their understanding, not merely to regurgitate the facts.
- Involve students in project-based problem solving, which includes both computational skills and conceptual understanding.
- Focus on making meaningful connections between mathematical content and specific problem-solving processes and strategies.
- Seek ways to relate mathematics learning to other disciplines, to form mathematical connections, and to structure teaching and learning through problem-centered methodologies.
- Use technology to enhance and extend classroom experiences where and when appropriate. (See NCTM's [Illuminations](#) Web site for examples.)
- Use alternative forms of assessment, including performance-based assessment tasks that are consistent with the instructional goals and the conceptually oriented aims of the curriculum. (See NCREL's [Pathways Performance-Based Assessment Tasks](#).)
- Use research-based assessment strategies for diagnosing each student's strengths and weaknesses, especially for the subgroups as identified by NCLB.
- Examine their own current practice and take advantage of opportunities for ongoing learning of new instructional strategies linked to effective practice such as participating in workshops, attending professional meetings, reading professional journals, and conducting classroom

research. This can be as simple as teaching a mathematical concept in different ways to determine how to reach students that do not respond to traditional mathematics teaching.

To be effective student and teacher facilitators, administrators should do the following:

- Participate in the process of articulating the new vision of mathematics and help to work out its implications for changing curricula, instruction, and assessment in mathematics.
- Develop criteria for implementing mathematics curricular materials that enable standards-based teaching and learning.
- Work with and involve teachers centrally in designing and evaluating programs for professional development that are aligned with researched-based best practice.
- Incorporate the principles and standards from *Principles and Standards for School Mathematics* into observation and coaching tools.
- Review and share current research on the teaching and learning of mathematics.
- Create staff and team time for staff as they implement a standards-based curriculum to align assessments and problem-solve implementation issues.
- Inform public of the goals of the math program and ways parents, caregivers, and the community can support students in learning mathematics.
- Create a group of influential stakeholders; inform them about the criteria for and strengths of the newly adopted learning materials for mathematics, and use them as a sounding board and feedback group to stay on top of the community/parent viewpoint of implementation issues. (See [*No Small Task: Changing Math, Changing Minds.*](#))
- Develop a district plan to sustain the implementing of the new curriculum materials over several years in ways that support professional development in both content and pedagogy, and to increase the effectiveness of and fidelity to the new curriculum materials.

To facilitate and enhance the learning of students, parents and community leaders must do the following:

- Enhance mathematics teaching and learning by creating partnerships between schools, community facilities, and businesses. Include activities such as mentorships, experiential learning opportunities, and coinvestigations whereby students and community members solve community problems.
- Support teachers and schools that are seeking to align assessment with curricular goals.
- Provide learning opportunities in the home, allowing students to participate in activities that stimulate reasoning and problem solving, and share those activities with their parents. Also, bring parents to schools.



[Seasoned school teacher Campbell says parent presence is very motivating to students.](#)

[Video: :50]



IMPLEMENTATION PITFALLS:

There have been many positive changes and much progress in institutionalizing the learning guidelines and expectations of the standards movement. But with that progress has come many challenges and pitfalls for schools trying to implement standards-based instruction. In most cases, standards are a starting point for curriculum development, but by themselves are not nearly ready for direct use in classrooms because they are often very general, and yet can still take years to achieve. Further, the standards were created by advocates of mathematics education and literacy. Thus, when all are considered together, they present educators with the task of crowding into 12½ years what some experts believe is more than 19 years of learning expectation. As a result, standards are often addressed in a hit-and-miss fashion. Several other pitfalls are discussed below.

Misaligned Curriculum and Assessment

Testing and assessment programs that are not coordinated with the instructional aims and curricular goals such as those derived from *Principles and Standards for School Mathematics*, can be significant obstacles to implementing reform in U.S. instruction, and assessment. (See NCREL's [Pathways Testing and Assessment Programs That Are Not Coordinated With the Instructional Aims and Curricular Goals](#).) Teachers and school district administrators often feel significant pressure for their students to perform well on these tests (especially in the era of NCLB). Yet the tests often monitor the achievement of computational skills rather than the reasoning and problem-solving abilities of students. To avoid such a pitfall, tests need to align, of course, with the curriculum. However, students also should be tested for higher skills that align with district, school, and classroom goals.

There are major efforts under way to incorporate such assessment practices. Teachers and administrators can lead in advocating for such changes by seeking positions on state panels that review the development of state assessments and review items. Recent research summarized by the National Research Council in two publications—[Adding It Up: Helping Children Learn Mathematics](#) and [How Students Learn: History, Mathematics and Science in the Classroom](#)—can help identify best practices in learning strategies for students, and mathematics concepts and skills that can be taught more effectively to provide stronger foundations for later mathematical learning.

Mathematics Taught in Isolation From the Real World

Another pitfall is the pervasive practice of teaching the procedures of mathematics detached from the meaning and applications of these procedures in the real world. There are a host of reasons for linking procedures-instruction consistently and effectively to real-world application. (Many are discussed elsewhere in this report.) Schools and classrooms moving toward more of an emphasis on teaching students both what to do and why will want to explore the roadblocks to this practice. Marilyn Burns, a founder of [Math Solutions Professional Development](#), shares her ideas about helping children learn in the mathematics classroom; talks about how teachers can learn to really understand mathematics; and

suggests ways to help parents understand the role of the NCTM standards in the classroom (Herrera, 2005).

Short-Term and Unsustained Professional Development

Many curriculum materials are implemented with only one or two days training from the publisher. Then principals and district administrators, too often, expect that the curriculum will be successfully implemented. Both the research into implementation of standards-based curriculum materials and the standards of the [National Staff Development Council](#) indicate that ongoing, sustained, and coherent professional development is needed to successfully implement a curriculum, align it to state and district standards, and generate fidelity to the curriculum. A curriculum series cannot be blamed for lack of student achievement if there is no indicator that series has been [faithfully implemented](#), taught as intended, and that assessments used for student achievement align with both the curriculum materials and the intended learning outcomes as indicated by state and district standards.

Insufficient Attention to Student Subgroups

Not reaching all students could be a significant pitfall, especially students who fall into subgroups such as English language learners, students with disabilities, students from racial/ethnic backgrounds, and those who are economically disadvantaged. Teachers and administrators who are unaware of best practice teaching and learning strategies for specific subgroups are less likely to attempt to reach all students' learning needs, and either alter their teaching practices, or inquire about additional help.

Underutilized and Undertrained Use of Technology

Instructional integration of technology is more difficult than it may seem. For smooth integration, a district's technology must be available, maintained, and deployed consistently across classrooms and district in ways that make instructional sense. Further, integration efforts require software readily available that was thoughtfully chosen to integrate with curriculum. Equally important is that teachers need to have significant amounts of professional development on the use of the available technology. Teachers are often running into challenges, including a lack of student access to technology at home, schedule conflicts in computer labs, limited interaction with colleagues, lack of focus on technology within curriculum materials, and simply, overall lack of technology knowledge. Using calculators with students is a common, yet underused way to integrate technology into mathematics assessment. However, calculators should be used appropriately, effectively, and in a developmental way (e.g., for functions at the K–5 level, for fractions at the 4–6 grade level, and graphing calculators at the middle and high school level).



DIFFERENT POINTS OF VIEW:

In the era of NCLB, it is easy and comfortable to rely solely on curriculum and

instruction that are determined by the high-stakes assessment tests. When parents, administrators, and teachers focus only on meeting AYP, they find it easy to advocate abandoning a standards-based system that includes content and processes that have not been tested.

Some educators dismiss the idea of standards and feel it runs counter to the goal of enhanced professionalism, since it takes the decision-making power over what is taught out of the hands of teachers and into the hands of a national standards-setting body. They feel standards, at least when used in a rigid and highly prescriptive manner, are anathema to professional autonomy. Thus, they conclude that the attempt to set forth standards in mathematics curriculum, instruction, and assessment—nationally centralized or not—is misguided.

Further, questions have been raised about whether the NCTM *Principles and Standards for School Mathematics* extol the right standards. Some dissenters claim that the *Principles and Standards for School Mathematics* has an inadequate research base, that fluency with algorithms and computational procedures is not adequately emphasized, and that the expansion in content is unnecessary. This position was carried out in public view in California in the late 1990s. California went so far as to develop its own framework and standards, claiming that basic skills were being ignored. A strong "overemphasis on pedagogy at the expense of mathematical content knowledge spawned several new curricula" (Wu, 2001, p. 1). Washington has a Web site titled [The Educational Deform Watchdog Page](#), which states opinions on mathematics instruction, including technology use, assessment, and even block scheduling.

Critics also state there is too much emphasis on technology and calculator use, too much estimation to the detriment of calculation, not enough early emphasis on fractions, and too much emphasis on data collection. This issue merited a response from NCTM to a *Wall Street Journal* article in 2000, which stated that "The majority of experts on elementary-school learning maintain that, for students who lack basic number proficiency, calculators may provide only the illusion of progress" (p. 1). NCTM's then-President Lee Stiff, responded to it as a "troubling, and rather one-sided picture of the use of calculators in math education" (NCTM, 2000a, p. 1).



ILLUSTRATIVE CASES:

- [Project REAL](#)

Learning Point Associates

Project REAL (Rural Education Aligned for Learning) was developed as an intervention for six troubled school districts in rural southeastern (Appalachian) Ohio. Its primary goal was to improve the teaching and learning of mathematics and science. By the end of the project, all districts were off academic watch and two were recognized as exemplary. The Web site contains lesson plans used in Project REAL.

Additional Links

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Mathematical Sciences Education Board

<http://www7.nationalacademies.org/mseb/>

<http://www.nationalacademies.org/nrc/>

National Academy of Sciences

500 Fifth St. N.W., 11th Floor

Washington, DC 20001

Phone: 202-334-3012

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National Center for Education Statistics

[Institute of Education Sciences](#)

[U.S. Department of Education](#)

1990 K St. N.W.

Washington, DC 20006

Phone: 202-502-7300

E-mail: <http://nces.ed.gov/nationsreportcard/contactus.asp>

National Council of Teachers of Mathematics

<http://www.nctm.org>

1906 Association Drive

Reston, VA 22091-1593

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Fax: 703-476-2970

Trends in International Math and Science Study

<http://nces.ed.gov/timss/>

National Center for Education Statistics

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[References](#)



[Adobe Reader FAQ](#)

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Gabriela Castillo: Strategies for Staying Current and Highly Qualified

Gabriela Castillo

First Grade Bilingual Teacher
Johnson Elementary School
Wheaton, Illinois

VIDEO TRANSCRIPT:

Well, it's interesting because in our district we have what we call University 200 courses where the teachers could take these course through the district, and it's paid for through the district, and we can. They're professional development and there's a lot of math and math courses that we can take, you know, to learn a new math method and et cetera. But probably the best thing that I could do is to collaborate with my team members because our team members come from...different areas, different colleges. And so when we collaborate together, I think that I get a lot from them, they get a lot from me and...I think that that's just a way for me to keep my instructional level. And I've also had the... opportunity to observe a lot of teachers using different math concept—math methods...and things like that.



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Gabriela Castillo: Classroom Environment

Gabriela Castillo

First Grade Bilingual Teacher
Johnson Elementary School
Wheaton, Illinois

VIDEO TRANSCRIPT:

I think probably the most important thing...that I try to create here in my classroom, is to create an environment where the kids...are comfortable, they feel safe...and therefore, they are able to ask a lot of questions, they're able to ...not feel afraid, you know...to ask those questions. And another important thing also is that the students have to be aware of what the objective is for the week, for the month, you know, for the day. So they have to also... [be] aware of [what] that standard is and what they have to be held accountable for. And...in a standards-based classroom, you know, students are constantly, actively engaged, whether it's, you know, problem solving or using manipulative, or,...so forth. And also, you know, there's constant discussion among the students, you know—mostly among the students. The teacher, a lot, works as a facilitator in ... a classroom so she—there is like direct instruction, there is modeling, but the students have the opportunity ...to think outside that scope. You know... they can—they have the opportunity to...work together and... use those higher thinking skills,...which is very ...in a standards-based classroom. And... of course, you know, through the direct instruction and through the modeling, we are teaching them to become independent learners eventually.

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Matt Jewell: On Standards as the Sole Measure of How Students Learn

Matt Jewell

English Language Learner Teacher
Madison elementary School
Wheaton, Illinois

VIDEO TRANSCRIPT:

I think that standards really do provide kind of a line to follow, as I said earlier. But, I think I do worry that when you look at the template of, let's say, what kindergartners are supposed to know, and what first graders are supposed to know there can be a real temptation to start saying: In maybe two or three years this...that...okay, this is what the first graders needed to know back in 2005, but now, it's 2008, why can't the kindergartners learn that? So we, we start moving that grid down to where we're expecting a lot more from kids at a younger age. So, I think that's not all bad, but in a sense, it could be bad when what we see as education is kind of grasping some of these quantifiable figures because there are a lot of nonquantifiable figures that are learning. So...I guess my one problem with standards is if the standards become the sole measure on how kids are growing and learning. Because kids can learn, let's say, in math or in reading, without just knowing who is the author, what was the conflict, kind of this analytical approach. They can learn by just enjoying the story, by learning what good and what, what was good about this story. So, I think that there is a tendency to go to the other side on the continuum and say, well, the standards now have to drive entirely the curriculum. And they drive what we understand students have learned, when I don't think that that's always it. And I worry that sometimes standards then will continue to expect more from the kids younger, as we kind of define our standards. Now, that's more of a philosophical issue, but that is a challenge for me as I see high expectations, high pressure, and perhaps, even defining kids who can't reach those kinds of heights at the time schedule we expect, of being kind of defined as, you know, having trouble learning or, you know. So I think that there is, somewhat, in a high-stakes standards game, that if ... it's not done well and not done with some—by educators, it can mean defining students based on whether they received—they got that, that they mastered that particular standard. And I don't always think...that learning is measurable quite like that.

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Gabriela Castillo: Connecting Basic Skills to Problem Solving

Gabriela Castillo

First Grade Bilingual Teacher
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Wheaton, Illinois

VIDEO TRANSCRIPT:

Well, at the first-grade level, I think a lot of teachers would say, you know, I'm not held accountable for those tests because those ...high-stakes tests don't start until third grade. But the last two years, I've had the opportunity to be on the school improvement team, and I've had the opportunity to...work with teachers in the upper grades where they are held accountable for those high-stakes testing and in...the message that's being sent out, it's like it's...not just those teachers' responsibility. It is our responsibility to prepare those students to take those high-stakes tests, even at first-grade level. You know, so,...to hear what their needs are, what their concerns are at the third-, fourth-, and fifth-grade levels has changed my instructions so that I am preparing them for, you know, for problem solving, which is a big thing...in those high-stakes testing, you know. So...we're doing a lot of problem solving, not only problem solving but we're creating...the problems. We have also...I have also...tried to create a balance where not only are the students using those analytical skills to problem solve in math, but also, there's a good balance of also... of computation. They also need to be able to compute and ...use those higher level thinking skills. You know, so there has to be a balance there. And it's...been nice to hear, to work with those upper-grade teachers so that I know what their needs are... and to see how everything spirals up, you know, even from kindergarten, first-grade through the upper grades.

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Matt Jewell: Apply Problem Solving to Daily Lives

Matt Jewell

English Language Learner Teacher
Madison elementary School
Wheaton, Illinois

VIDEO transcript:

It's...trying to help them see the practicality of math in every day. So I have to look at an ELL student's family background too, to see what types of exposure...they might be getting at home. I think that there are some practical things, like I said earlier, that students can be engaged in that will help them develop greater and greater number sense. And so I know that in parent/teacher conferences, it's important for me to point out some of the techniques that parents can use because, you know, parents are very busy and some ELL parents are working a tremendous amount in the evenings or second shift. So, to help remind, or give them some strategies to use to help ...them to engage their child in math. Counting how many, you know, aisles there are at Target or, you know, doing a kind of math game with the dishes or something, or with our cooking and how to kind of incorporate it into everyday life, I think is very important. And then the responsibility for me as a teacher, not only to help the family at home, but how can I help them at school by doing practical activities, hands-on activities that aren't just rote memorization, aren't just rote worksheets, but get at using math to solve problems. So I feel like I have to apply it to everyday life even in the classroom, so that they are interested and they see it: That they don't see as a separate content area that they study, but it's part of, you know, every...content area that they study in school, whether they're in graphs, in social studies or, you know, looking at stories and how math is even in some of their stories in reading.

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Gilbert Valdez: Technology in Assessment

Gilbert Valdez, Ph.D.

Director
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and Codirector of the North Central
Eisenhower Mathematics and
Science Consortium (NCEMSC)

VIDEO TRANSCRIPT:

Well, the value of technology is to add productivity to learning. If you think about what the tractor did for farming, this is what technology can do for learning. And it's become a necessary productivity tool for the future. If you look at 21st century skills, they're going to be requiring the use of technology very effectively. And some of the things that we most should be testing are those abilities to find, evaluate, and package in a different way, more meaningful according to the audience, that knowledge. And not necessarily looking for what did somebody say before, was the, because then there'd be no right answer, or more often, nobody has ever answered that particular question because the knowledge is new.

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Gilbert Valdez: Learning and Assessment

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Eisenhower Mathematics and
Science Consortium (NCEMSC)

VIDEO TRANSCRIPT:

I think states need to recognize that learning is about big concepts and something that has meaning for a lifetime, not something that you memorize on Thursday and regurgitate back on Friday. What we're talking about is using assessments that test big ideas... and big understanding...rather than having students design test, rather that allow students to guess which answer is least wrong through test-taking skills, and not having any knowledge of content.

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Gilbert Valdez: Summative Versus Formative Assessment

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Eisenhower Mathematics and
Science Consortium (NCEMSC)

VIDEO TRANSCRIPT:

Well, I think you have to understand that the two tests have two different, purposes and, and intents. ...high-stake's testing purpose is to prove that students have some knowledge over a given amount of time. Formative assessment is intended to improve learning, and it's used to determine how you go about changing teaching and teaching strategies so that the learning is improved and made more efficient and more effective.

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Matt Jewell: Teachers Can Make Learning Relevant to Students' Lives

Matt Jewell

English Language Learner Teacher
Madison elementary School
Wheaton, Illinois

VIDEO TRANSCRIPT:

It's important that students are—that I'm also thinking about how to make everyday situations kind of chances to show them mathematical concepts. There was a student who was given, an ELL student, that happened to be given, five dollars for lunch one summer, and she was telling the teacher that she had to buy lunch for three of her brothers and sisters with five dollars. So she was talking about this, and it kind of dawned on me that a lot of that is math sense. Will she know how to order so that, you know, maybe one large fry could be less expensive than getting the three smaller fries? Or, if she has drinks at home, she doesn't have to purchase a drink. We could help her to see and use kind of real-life scenarios where she would have to use kind of mathematical concepts and to help kind of in everyday living situations. So I think I have to continue to incorporate that into the math teaching. Instead of using story problems that are rather abstract and use names that are not connected at all to their real life, using their names in problems or using problems like trying to buy dinner with five dollars at McDonald's, that's a lot more applicable and I think...it will help them to see math as something that happens every day and not something that, you know, is very abstract, and sometimes that happens with what you see in some of the books.

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Matt Jewell: Mathematical Literacy

Matt Jewell

English Language Learner Teacher
Madison elementary School
Wheaton, Illinois

VIDEO TRANSCRIPT:

I think that the kids have to know terms, they have to know basic math terms that the district gives us for a particular grade level. It also...I think has to do with knowing what operations to use when they get to a math problem. A word problem can come and they need to know the language, but then they need to translate that into what operation to use. So that's important. Good number sense, too, I think is important for [a] mathematically literate person. Number sense means, you know, knowing operations, knowing estimation, knowing simple greater-than or less-than things. So for me, at my grade level, which varies depending on the ELL student's place, it could be a first-grader or a fifth-grader, they need to understand more and more, just kind of, a good number sense, which is important. Place value, I think is critical to understand, you know, what ones and tens and hundreds and thousands are. So, to me, a mathematically literate person understands those concepts and then can use those kinds of words, that language, or those concepts, in problem solving, to do operations that they need to.

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Barbara Campbell: Helping Students Understand the Practicality of Mathematics

Barbara Campbell

Veteran Teacher

VIDEO transcript:

I think manipulatives is the way it has to be, and that goes back, I mean that's another classic. ...I remember math classes that I took... as a student and it was hands-on for me. But then if I just rely on a textbook and then let the children look at pictures, it's not good enough. They've got to get their hands on it; they've got to have fun with it. They've got to see what that means and manipulate it.

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Barbara Campbell: Parents as a Resource in the Classroom

Barbara Campbell

Veteran Teacher

VIDEO TRANSCRIPT:

I really believe that one of my best resources in my room are my parents. And if I'm fortunate, I have been fortunate to have parents who are in the corporate world and they can come back and say this is real and you need to learn this, and this is why. And ...just kind of share their expertise, and generally they love what they do. So when they come in, it really motivates the children. And they say, oh, this is so-and-so's father or mother, wow, that's neat. I've got to do this.

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