THE RESEARCH FOUNDATION FOR

Accelerated Math
Accelerated Math was the first progress-monitoring tool reviewed by the National Center on Response to Intervention to be highly rated as a mastery measurement tool. Its high marks confirm what teachers nationwide have said all along—Accelerated Math is truly in a class by itself.

MathFacts in a Flash is highly rated as a progress-monitoring mastery measurement tool by the National Center on Response to Intervention.

STAR Math is highly rated for screening and progress monitoring by the National Center on Response to Intervention.

Accelerated Math and STAR Math meet all criteria for scientifically based progress-monitoring tools set by the National Center on Student Progress Monitoring.

Accelerated Math has earned the top rating for Prevention and Intervention at all grade levels by the National Dropout Prevention Center.
Contents
Introduction ...........................................................................................................................................................1
Why Math Practice Is Essential ..........................................................................................................................3
Characteristics of Effective Mathematics Instruction ..........................................................................................6
Research Basis for Accelerated Math ..................................................................................................................12
High-Quality Progress Monitoring and Mastery Measurement .........................................................................18
Overview of Accelerated Math ..........................................................................................................................21

Appendices
Appendix A: Sample Practice Assignment .........................................................................................................27
Appendix B: Sample Extended Response Objective ..........................................................................................28
Appendix C: Key Reports .......................................................................................................................................29
  Accelerated Math Status of the Class Report ....................................................................................................30
  Accelerated Math Practice TOPS Report ..........................................................................................................32
  Accelerated Math Diagnostic Report ................................................................................................................33
References ...........................................................................................................................................................34
Acknowledgements ...............................................................................................................................................38

Table
Table 1: Accelerated Math Software and AM Best Practices Accomplish Key Components of Effective Instruction ........................................................................................................................................6

Figures
Figure 1: Accelerated Math Classroom ..................................................................................................................9
Figure 2: Accelerated Math Renaissance Home Connect Screen—Tests ................................................................10
Figure 3: STAR Math Reports Higher Increases for Students Using Accelerated Math ................................................13
Figure 4: Students Using Accelerated Math Outpace District Average on NALT ...................................................13
Figure 5: Accelerated Math Achievement Gains by Subgroup .............................................................................14
Figure 6: Students Make Greater Math Gains With Accelerated Math Best Practices (High Implementation) ..............................................................................................................................................15
Figure 7: Accelerated Math and Accelerated Reader Yield Higher Gains in Student Achievement per Dollar ............................................................................................................................................16
Figure 8: NCRTI Progress Monitoring Mastery Measure Tools Chart—Accelerated Math ......................................18
Figure 9: Renaissance Place Dashboard Math Screen ............................................................................................19
Figure 10: Accelerated Math Cycle Overview ........................................................................................................23
Figure 11: Accelerated Math Renaissance Home Connect Screen—Practice & Exercises ....................................25
Introduction

“Practice makes perfect.” It is quite likely that either you have said these words to someone grappling to learn a new skill, or that, at some point, these very words have been said to you. Although this phrase has become quite commonplace, the truth behind it must not be taken lightly.

Research shows that practicing a new skill is what makes the difference in whether that skill is truly learned. This rings true whether one is playing a sport, a musical instrument, or a board game, but it is especially true of mathematics. Time spent intensively practicing a skill—not initial ability—is the single most important shared characteristic of mathematicians as well as world-class chess players and musicians (Coyle, 2009; Ericsson, Charness, Feltovich, & Hoffman, 2006). As cognitive scientist Dan Willingham notes, “It is virtually impossible to become proficient at a mental task without extended practice” (2009, p. 81).

Even so, according to the National Mathematics Advisory Panel—commonly called the National Math Panel (NMP) (2008b), “Few curricula in the United States provide sufficient practice to ensure fast and efficient solving of basic fact combinations and execution of the standard algorithms” (p. 26).

Accelerated Math provides high-quality student practice and progress monitoring

Renaissance Learning’s Accelerated Math is a computerized tool for efficient progress monitoring and management of students’ personalized daily math practice for grades 1–12 within a formative assessment process. In diagnostic mode, Accelerated Math helps teachers analyze individual skills deficiencies and fill in gaps in learning progressions as well as increase student practice of specific standards-linked skills. As described by the National Math Panel, Accelerated Math is a “mathematics program with assessment of skill level, tailoring of the instruction to match skill level, individual pacing and goal setting, ample practice, and immediate feedback to student and teacher on performance” (2008a, p. 160). Accelerated Math meets five critical criteria identified by the Formative Assessment for Teachers and Students (FAST) State Collaborative on Assessment and Student Standards (SCASS) for effective formative assessment: “(1) learning progressions, (2) learning goals and criteria for success, (3) descriptive feedback, (4) self- and peer-assessment, and (5) collaboration” (McManus, 2008, pp. 4–5).

As a technology-enhanced, continuous progress-monitoring system (Ysseldyke & Burns, 2009; Ysseldyke & McLeod, 2007), this powerful software can be used for practice progress monitoring—the monitoring of progress by measuring performance of underlying tasks, such as math problems, that contribute to growth in math skills or benchmarks. Practice progress monitoring also provides a good continuous check on the effectiveness of classroom instruction, a way to identify students struggling with math skills, and a means to measure each student's progress toward personal goals.
Accelerated Math can be used successfully as the essential student practice component of existing classroom mathematics curricula for grades 1–12 (Ysseldyke & Betts, 2010; Ysseldyke & Bolt, 2007), supplying libraries of math problems from first grade math to calculus, algebra, geometry, and probability and statistics, as well as libraries aligned to various state standards, national guidelines, and textbook series.

The Accelerated Math software

• Creates personalized practice and exercise assignments, tests, and diagnostic tests
• Scores assignments and tests automatically and records results in a grade book
• Provides informative reports to help educators differentiate instruction and monitor progress
• Motivates students with immediate feedback via reports printed after assignments or tests are completed
• Includes research-based Accelerated Math Best Practices to ensure fidelity of implementation, including recommendations for optimal growth and appropriate goal-setting practices, delivered to educators via professional development offerings

The foundation of Accelerated Math
This paper takes a closer look at why Accelerated Math was created and how it provides students with valuable math practice by examining five topics:

• Why math practice is essential
• Characteristics of effective mathematics instruction
• Research basis of Accelerated Math
• High-quality progress monitoring and mastery measurement
• How Accelerated Math works
**Why Math Practice Is Essential**

Mathematics proficiency is of critical importance, both to succeed academically and ultimately for success in life. Experts, including the National Research Council (2001), agree that proficiency is described as “five interrelated strands of knowledge, skills, abilities, and beliefs that allow for mathematics manipulation and achievement across all mathematical domains”: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (Steedly, Dragoo, Arefeh, & Luke, 2008, p. 10). For students to learn successfully, these interconnected strands must work together. “For example, as a student gains conceptual understanding, computational procedures are remembered better and used more flexibly to solve problems. In turn, as a procedure becomes more automatic, the student is enabled to think about other aspects of a problem and to tackle new kinds of problems, which leads to understanding” (National Research Council, 2002, p. 17).

Students are capable of learning mathematics, but it does not just happen—it takes time, effort, and practice (Willingham, 2009–10). Practice is an essential part of learning and is often what makes the difference between successfully learning a skill or not. Practice is a non-negotiable part of the learning process: “It is intuitively obvious that practice is necessary for learning knowledge of any type. It's not surprising then that research indicated that practice significantly enhances learning….The effect of practice on learning can be substantial” (Marzano, Gaddy, & Dean, 2000, p. 66).

Brain research has uncovered the reason practice is universally important for learning. Simply put, practice helps build neurological connections, evidenced by increased white matter in the brain, which is the result of a process called myelination. These connections help people solve higher order problems faster and more efficiently, using less area of the brain and with less overall brain activity. Once a skill is taught, repeated practice alters the neurons in a part of the brain specific to that skill, so a skill can be performed more automatically, seemingly without thought (Coyle, 2009; Hill & Schneider, 2006). “Practice allows students to achieve automaticity of basic skills—the fast, accurate, and effortless processing of content information—which frees up working memory for more complex aspects of problem solving” (National Mathematics Advisory Panel, 2008b, p. 30; Sousa, 2006).

But all forms of practice are not inherently equal in their effectiveness. Research shows that to be effective in building a skill, practice must be personalized and coupled with instruction. Personalized practice means practice matched to student ability so students are challenged but not frustrated. It also means the practice must be accountable. Teachers and students must receive frequent feedback, and teachers must intervene as necessary to assure students are successful at high levels (Coyle, 2009; Ericsson, Kampe, & Tesch-Römer, 1993; National Council of Teachers of Mathematics [NCTM], 2007). “Assessment…involves both teacher and students in reciprocal activity to move learning forward within a community of practice” (Heritage, 2010, p.8).

Although experts in education, psychology, and neurology all agree practice is an essential part of learning, the National Math Panel (2009b) has found that, in general, math curricula do not include sufficient opportunities for students to practice and receive feedback on what has been instructed. This is where Accelerated Math comes in.
Accelerated Math works with any curriculum
In addition to being confirmed by several leading math experts (see box, previous page), the scope and sequence of the Accelerated Math learning objectives parallels recommendations found in the National Council of Teachers of Mathematics (NCTM) 2006 Curriculum Focal Points, the National Mathematics Advisory Panel 2008 final report, and the 2010 Common Core State Standards for Mathematics. Thus, Accelerated Math is an excellent means for providing and monitoring student math practice no matter what curriculum is being used in the classroom. Teachers can deliver instruction using the textbook in use, and then have students use Accelerated Math to practice what they have learned. A recent Ysseldyke and Betts (2010) study compared students using specific textbook curricula—both traditional and reform—with and without Accelerated Math. Results showed students using Accelerated Math outperformed their peers (see box at right).

Accelerated Math helps teachers find time for essential student math practice
Effective, personalized practice requires continuous daily—even hourly—instruction, practice, and assessment within a formative assessment process. Accelerated Math software and Accelerated Math Best Practices facilitate student practice and provides teachers with information to monitor student progress, adjust instruction and curriculum, and inform feedback for students.

Academic learning time (ALT)—the amount of time students spend on actual learning activities—has long been identified as a critical contributor to academic growth (Batsche, 2007; Berliner, 1991; Gettinger & Stoiber, 1999; Karweit, 1982). An important, but often underemphasized aspect of ALT is time for practice of learned skills—which is as important as explicit instruction (Szadokierski & Burns, 2008). Since ALT is the time when most learning actually takes place, increasing ALT is a powerful tool for improving academic results (Aronson, Zimmerman, & Carlos, 1998; Berliner, 1978; Smith, 1998). Four components distinguish ALT from simple measures of classroom time or “time on task”:

1. Students are actually engaged with the material
2. The material is at the proper level of challenge—i.e. in their Zone of Proximal Development (ZPD)\(^1\)
3. Students experience a high rate of success
4. Both the student and teacher receive regular feedback about performance

The challenge is that in order to increase ALT it is necessary to directly measure and manage it, which is exceedingly difficult, especially in diverse classroom where learners are working at many different levels at the same time. Accelerated Math overcomes this difficulty, and increases learning time, by focusing on each of the four components of ALT:

\(^1\) A student’s ZPD is an appropriate level of difficulty—neither too easy nor too hard—where the student is challenged without being frustrated.
• Actual engagement: Personalized problem sets engage students as well as provide an immediate and direct measurement of how much instructional time each student actually devoted to the work.

• Challenge level: Assessment via the STAR Math assessment and ongoing measurement of results from Accelerated Math ensure that each assignment is tailored to each student’s individualized ZPD, which is continuously recalculated as the student progresses.

• Success: Personalized assignments are generated at a level calculated for 85–90% success rates and are automatically monitored.

• Feedback: Assignment results are provided to students instantly. Teachers also receive concise, real-time reports so they know each student is progressing satisfactorily and can intervene promptly when necessary.

Accelerated Math provides differentiated student practice within each student’s individual ZPD, the difficulty level that is neither too difficult and thus frustrating nor so easy that no new knowledge and skills are learned. In order to customize student practice, the teacher determines each student’s initial placement in Accelerated Math using either results from a reliable and valid, standardized math assessment, such as STAR Math, and/or an Accelerated Math Diagnostic Test. Based on these results, students begin personalized practice/test cycles through mastery and review of each needed objective. In mastery measurement systems, students work through a hierarchical sequence of skills and demonstrate mastery of each before proceeding to the next skill (www.rti4success.org).

Research also shows that in order to develop competence in skills, students need to adapt or “shape” them as they are learning them. Appropriately challenging personalized practice with feedback is the primary means of doing this. According to Marzano et al. (2000):

During this shaping phase, learners modify the way they use the skill, become aware of potential problem areas as well as variations in how the skill can be used, and learn to use the skill in different situations. The importance of this shaping phase cannot be overstated, yet this crucial stage of learning is often not given the necessary time and attention. Skipping or shortchanging this stage of learning can result in students’ internalizing errors that are difficult to correct. It can also mean that students will not gain the conceptual understanding that is essential to truly mastering a skill or process. (p. 67)

With Accelerated Math, student math practice and subsequent technology-enhanced teacher monitoring of that practice can take place daily and provide literally continuous data to show how each student is progressing, long before progress can be measured by other methods such as weekly or monthly progress monitoring. This is much more useful to inform and adapt instruction and student practice than waiting for mid-year or end-of-year scores when it is too late to make changes that could impact a student’s growth.

---

2 STAR Math is a reliable, valid, and efficient, computer-adaptive assessment of general math achievement. (For more information on STAR Math, see box, p. 24.)
Characteristics of Effective Math Instruction

Teachers employ a bevy of instructional practices in their classrooms. The origins of these practices vary from those learned in teacher training to those passed from teacher to teacher to those developed from scratch by innovative educators. Much research has been done to determine which practices have the greatest impact on student achievement. Providing students with time for appropriately challenging math practice, ensuring students receive feedback on this practice, setting goals with students, and frequently monitoring students’ progress toward goals are all components of effective instruction and supported by extensive research (Christenson & Ysseldyke, 1989; Ysseldyke & Christenson, 1987). The left-hand column of Table 1 shows a list of critical evidence-based instructional practices summarized by Christenson and Ysseldyke (2002) from multiple literature syntheses (e.g., Christenson, Ysseldyke, & Thurlow, 1989; Gettinger & Stoiber, 1999).

Accelerated Math facilitates effective mathematics instruction

Daily progress-monitoring assessments like Accelerated Math are ideal within a formative assessment process because they inform instruction, provide immediate performance feedback, help monitor progress, and increase student motivation. As noted by Stiggins (2005), these assessments are for learning rather than of learning. This means the goal of the assessment is to enhance learning and inform instruction, not just to demonstrate what has been learned or to assign a grade. However, this cannot be done without interaction between teacher and student using information provided by the assessment. “Only by keeping a very close eye on emerging learning through formative assessment can teachers be prospective, determining what is within the students’ reach, and providing them experiences to support and extend learning” (Heritage, 2010, p. 8).

At the heart of all instructional practices is, of course, the teacher; the challenge for many schools is ensuring educators have enough time during the school day to carry out these important instructional tasks. Accelerated Math software and AM Best Practices accomplish the key practices identified in Table 1 while managing the day-to-day administrative tasks of a mathematics classroom, such as creating and scoring assignments and recording results, so that the teacher's time is freed to do what a teacher does best—teach.

Table 1: Accelerated Math Software and AM Best Practices Accomplish Key Components of Effective Instruction

<table>
<thead>
<tr>
<th>Research-Based Instructional Practice</th>
<th>What Accelerated Math Does</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional match</td>
<td>Student placement for work in Accelerated Math is determined using results of a reliable and valid math assessment, such as STAR Math, and/or an Accelerated Math Diagnostic Test. Teacher progress monitoring of student work on Accelerated Math assignments informs instruction and intervention.</td>
</tr>
<tr>
<td>Instructional expectations</td>
<td>Accelerated Math Best Practices recommend involving students in goal-setting practices, including setting scientifically based goals for students based on growth norms using the STAR Math Goal Setting Wizard. Informative reports and immediate feedback keep students apprised of their progress toward goals.</td>
</tr>
<tr>
<td>Classroom environment</td>
<td>Accelerated Math excels at classroom management, completing administrative tasks and providing progress-monitoring information to help the teacher do what a teacher does best—teach. Classroom routines revolve around student access to the teacher for additional instruction or intervention as needed. Students in the Accelerated Math classroom take responsibility for their learning and follow teacher-provided routines so that time is used wisely.</td>
</tr>
<tr>
<td>Research-Based Instructional Practice</td>
<td>What Accelerated Math Does</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Accelerated Math Best Practices recommend that routines be clearly communicated to students so they know what is expected of them. Accelerated Math facilitates teacher modeling and think-alouds during teacher-to-student interaction, so the students can hear and see the teacher’s thought processes while solving a problem. Likewise, student verbalization can be used to check students’ understanding of what the teacher demonstrated or provide insight into a student’s thinking.</td>
</tr>
<tr>
<td>Cognitive emphasis</td>
<td>Accelerated Math facilitates teacher modeling and student think-alouds during individual and small-group conferencing. Because student work is completed on paper, teachers can track misconceptions and patterns in errors that occur in students’ problem-solving processes.</td>
</tr>
<tr>
<td>Motivational strategies</td>
<td>Using Accelerated Math, teachers motivate students by providing opportunities for successful math practice. Accelerated Math keeps track of the number of objectives mastered, percent correct, completion of a library, and so forth, all of which can be used for goal setting to help motivate students to practice more. Peer-learning strategies also motivate students as they work together to find the answer to a problem, discuss problem-solving techniques, ask each other for assistance, and so forth. Accessing Accelerated Math through Renaissance Home Connect establishes communication between school and home, which can be very motivating for students (for more information about Renaissance Home Connect, see pp. 8, 25).</td>
</tr>
<tr>
<td>Relevant practice</td>
<td>Accelerated Math helps teachers find time—even in diverse classrooms where students are working at many different levels—for academic learning time (ALT) by focusing on student engagement, appropriate level of challenge, student success, and timely feedback. Accelerated Math assignments are personalized and tailored to each student based on achievement.</td>
</tr>
<tr>
<td>Informed feedback</td>
<td>Informative reports are generated as students complete assignments, including corrective information about items answered incorrectly. Accelerated Math routines include the recommendation for students to rework missed problems on paper and submit them to the teacher for additional instruction or intervention as needed.</td>
</tr>
<tr>
<td>Academic engaged time</td>
<td>The Accelerated Math classroom is structured so that students are always using time productively, working on assignments or tests, submitting work to be scored, or conferring with the teacher for additional instruction and intervention as needed or with other students for peer-learning opportunities. Student routines and expectations are clearly communicated in the Accelerated Math classroom, so students always know where their efforts should be focused, and if they need guidance, the teacher, as well as classroom signage, is available to provide direction.</td>
</tr>
<tr>
<td>Adaptive instruction</td>
<td>Through a specific practice, test, and review cycle (see p. 23), students are provided with multiple opportunities to practice and master an objective as well as ensure mastery over time through incremental review. Each subsequent practice assignment generated in Accelerated Math is based a student’s prior work.</td>
</tr>
<tr>
<td>Student understanding</td>
<td>Accelerated Math Best Practices recommend teachers explicitly explain student expectations and routines, as well as display directions around the classroom, so that students know what is to be done when.</td>
</tr>
</tbody>
</table>

The Accelerated Math software could have been designed to be a computer-based tool for students to use to receive instruction from and do math work directly on, but instead Accelerated Math was purposefully not created this way. Accelerated Math intentionally puts the teacher—not the computer—at the center of instruction. The computer generates students’ assignments, but all student work is completed on paper, so students can examine their work should they answer any items incorrectly or show their work to the teacher when seeking assistance. The computer also generates immediate feedback. For students this is provided via the TOPS Report, which allows students to track their progress, see how many objectives they have mastered toward individualized goals, and receive information about problems answered incorrectly (for more information about key Accelerated Math reports, see p. 29). The teacher uses information from Accelerated Math to monitor students’ growth and provide differentiated instruction as needed.

When students need help, Accelerated Math routines call for the teacher and student to confer for individualized help and additional instruction. These conferences facilitate the use of instructional practices shown by research to be most effective, such as teacher modeling of problem-solving strategies, using verbalization (Gersten et al., 2009), or thinking aloud, about procedures, symbols, and decision making (Jayanthi, Gersten, & Baker, 2008), including both correct and incorrect behaviors (Montague, 2004), as well as student verbalization, or think-alouds (NCTM, 2007), which help to build understanding while providing the teacher with an opportunity to diagnose misconceptions (Gersten et al., 2009).

In order for math instruction to be effective, students need to be motivated. Accelerated Math fosters student motivation in many ways, including providing opportunities for successful math practice at the right level of challenge, which is a positive, reinforcing experience. As students learn that math can be fun, both the amount of practice and the motivation to practice increase.

As students successfully complete Accelerated Math assignments and tests, the software keeps track of the number of objectives mastered, percent correct, completion of a library, and so forth, which can be used to set goals and, in turn, encourage students to continue to practice. Black and Wiliam (1998) found that students respond more favorably when they can establish their own goals and are presented with “a meaningful, interesting, and reasonably demanding challenge” (p. 24).

The Accelerated Math software incorporates social interaction and peer-learning strategies, both of which help to maintain student motivation. Figure 1 is the typical organization of an Accelerated Math classroom. Its design highlights the program’s focus on student-to-teacher and student-to-student interaction. For example, the teacher may use information from Accelerated Math—such as the Status of the Class Report (for more information, see p. 26)—to gather several students struggling with similar objectives for small-group instruction or other activities. In these small groups, students can discuss problem-solving strategies, help each other problem solve, and share ideas.
Parental involvement—connecting school to home—is a very motivating social factor for students. Accelerated Math establishes open communication with the Renaissance Home Connect website, which parents can access to view details of their child’s completed math work, and students can use for additional math practice at home (see Figure 2, next page; for more information, see p. 25). Renaissance Home Connect also allows students to have email results sent to parents and other caregivers upon completion of an Accelerated Math test.

CHARACTERISTICS OF EFFECTIVE MATHEMATICS INSTRUCTION

- **Personalized practice assignments** keep students motivated and challenged.
- **Cooperative learning** techniques allow students to help each other succeed.
- **Automatic scoring** frees teachers from record-keeping tasks.
- **Differentiated instruction** ensures success for every student.

Figure 1: Accelerated Math Classroom
CHARACTERISTICS OF EFFECTIVE MATHEMATICS INSTRUCTION

Figure 2: Accelerated Math Renaissance Home Connect Screen—Tests

Fidelity of implementation
Effective instruction can only take place if tools used to support it are implemented with fidelity. Accelerated Math Best Practices is a formative assessment process based on evidence-based classroom strategies for ensuring that guided independent math practice accompanies direct instruction, using the data and management features of Accelerated Math to accelerate math growth throughout the classroom and across grade and achievement levels. High implementation of Accelerated Math promotes both personalized goal setting and appropriate, personalized practice (e.g., Nunnery & Ross, 2007; Ysseldyke & Bolt, 2007).

To ensure students benefit from Accelerated Math to the greatest extent possible, AM Best Practices include techniques for differentiating instruction, increasing and verifying academic engaged time (AET) for math skills practice, interpreting performance data, and monitoring the application of skills during student practice. These recommendations are taught in a flexible series of in-person or web-delivered professional development sessions and underscore the critical role the teacher plays in the effective use of Accelerated Math:

1. **Math practice time**—Teachers ensure students have an appropriate amount of time for guided independent mathematics practice. Renaissance Learning recommends working toward the goal of 40 minutes of math practice with Accelerated Math per day, which will indicate that students are on pace and are mastering an average of four objectives per week.
2. **Math success**—Teachers ensure students are highly successful math learners, with an average percent correct of 75% or above on practice assignments and 85% or above on tests.

3. **Appropriate math objectives**—Teachers ensure students are practicing math objectives appropriate to their age and achievement level.

4. **Progress monitoring**—Teachers obtain information for progress monitoring from three sources: daily, from direct teacher observation and conferences with each student (e.g., Status of the Class, TOPS reports); daily and weekly, from completion of student work in the software (e.g., Diagnostic Report); and periodically, 3–10 times per year, from a reliable and valid math assessment such as STAR Math.

5. **Personalized goals**—Teachers motivate students by ensuring they are working toward personalized quality (average percent correct) and quantity (number of objectives mastered) goals.

6. **Personalized instruction**—Teachers use information from progress monitoring and goal setting to assess, inform, and tailor personalized instruction for each student.
Research Basis for Accelerated Math

Renaissance Learning’s trusted Accelerated Math software has been impacting student mathematics learning and providing a way for teachers to measure mastery of math skills for more than 10 years. As described by the National Math Panel, Accelerated Math is a “mathematics program with assessment of skill level, tailoring of the instruction to match skill level, individual pacing and goal setting, ample practice, and immediate feedback to student and teacher on performance” (2008a, p. 160). Accelerated Math software and AM Best Practices facilitate formative assessment defined as “a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students’ achievement of intended instructional outcomes” (McManus, 2010, p. 3).

The software continues to receive accolades about its reliability and validity from key federal groups. Most recently, the National Center on Response to Intervention (2009a) found Accelerated Math to be the first progress-monitoring mastery measurement tool to meet all quality standards (see p. 18), and in 2007, the National Center on Student Progress Monitoring determined the software met all criteria for a scientifically based progress-monitoring tool.

The large evidence base supporting Accelerated Math consists of a number of experimental and quasi-experimental research studies—generally considered by the research community to provide the strongest evidence of effectiveness and to be consistent with the definition of scientifically based research—including 75 independent studies and 17 articles that have been published in peer-reviewed journals. A selection of this research is highlighted below.

Positive impact on student achievement

Independent research has found that Accelerated Math improves student achievement with various populations. Classrooms following Renaissance Learning’s recommended Accelerated Math Best Practices make even greater gains.

A study by Burns, Klingbeil, and Ysseldyke (2010) of 360 elementary schools in Florida, Minnesota, New York, and Texas found that schools using Accelerated Math had more students scoring in the proficient or higher categories of their respective state mathematics tests, after controlling for state reading test performance as a covariate. The researchers also found a positive effect related to the amount of time schools used Accelerated Math; those using the program 5 years or more outperformed both those schools using it less and not at all. Moreover, the findings indicated no racial achievement gap among schools using Accelerated Math, whereas there was a gap among control schools. In other words, Accelerated Math schools with a majority ethnic minority population performed similarly to Accelerated Math schools with a majority white population.

In a 2009 study by Lambert and Algozzine, teachers in grades 2–5 at three elementary schools in Oklahoma implemented Accelerated Math as a progress monitoring and mastery measure tool in 36 classrooms randomly assigned to either the treatment or control group. Students were tested with STAR Math at the beginning of the study for placement into Accelerated Math, then mid-year and at the end of the year to measure growth. STAR Math results showed that the growth rate of the treatment group was significantly higher than that of the control group (see Figure 3). In order to further evaluate the program’s effectiveness, treatment classes were categorized into either high- or low-implementation groups based on the level of implementation achieved. The researchers found that the growth of the high-implementation group was significantly higher than that of the low-implementation group.
RESEARCH BASIS FOR ACCELERATED MATH

Ysseldyke and Tardrew (2007) found that students in grades 3–10 were able to increase their achievement while using Accelerated Math, with gains from 7 to 18 percentile points higher than comparison students. Teachers were able to monitor individual progress and personalize instruction for many types of students.

A retrospective, longitudinal study (Nunnery & Ross, 2007) compared student achievement as measured by the Texas Learning Index and the Texas Assessment of Academic Skills between students using Renaissance Learning progress-monitoring tools and matched controls. Researchers found statistically significant, positive effects of Accelerated Reader/Accelerated Math software and Best Practices on reading and mathematics achievement for elementary students, and on mathematics achievement for middle school students. Students in high-implementation schools scored higher than comparison schools or low-implementation schools.

Ysseldyke, Spicuzza, Kosciolek, and Boys (2003) examined the impact of Accelerated Math on student achievement in math and classroom behaviors related to overall student achievement. Students in fourth and fifth grade from a large, urban Midwestern school district participated, with a treatment group of students who used Accelerated Math (n=157) and a control group of students who did not use Accelerated Math (n=61). Data for a district-wide comparison group (n=6,385) were also collected. All groups used the Everyday Mathematics textbook curriculum (McGraw-Hill). The study results indicated that control students (who did not use Accelerated Math) gained an average of 2.56 normal curve equivalents (NCEs) on the Northwest Achievement Levels Test (NALT), while treatment students (who did use Accelerated Math) gained 6.58 NCEs (see Figure 4). Classroom behavior observations indicated that the use of Accelerated Math resulted in increased time spent on classroom activities, which the researchers identified as contributing to positive academic outcomes.

**Figure 3: STAR Math Reports Higher Increases for Students Using Accelerated Math**

<table>
<thead>
<tr>
<th>NCE Gains</th>
<th>Accelerated Math Classroom</th>
<th>Control Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.14</td>
<td></td>
<td>2.45</td>
</tr>
</tbody>
</table>

**Figure 4: Students Using Accelerated Math Outpace District Average on NALT**

<table>
<thead>
<tr>
<th>NCE Gains</th>
<th>Entire District</th>
<th>Accelerated Math Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.56</td>
<td></td>
<td>6.58</td>
</tr>
</tbody>
</table>

Normal curve equivalents are a way of representing percentile scores so that they can be accurately averaged and compared with each other. Since NCEs are derived from percentiles, they measure growth in comparison to national norms. Positive NCE gains mean student achievement grew at a faster rate than national averages. An NCE gain of zero represents the national average.
Zumwalt (2001) conducted a 25-week study of 350 eighth-grade pre-algebra students in six schools in Idaho. Ninety-four students received traditional instruction, 162 were instructed using Accelerated Math, and 94 students used computer-aided instruction software from either Jostens Learning Corporation or Computer Curriculum Corporation (CCC). Students using Accelerated Math significantly outperformed students using Jostens, CCC, or traditional instruction on the Iowa Test of Basic Skills. Lower performing students, in particular, benefited more from Accelerated Math.

Effective with various student populations
Studies have shown progress with students using Accelerated Math in Title I classrooms (e.g., Brem, 2003; Ysseldyke, Tardrew, Betts, Thill, & Hannigan, 2004), in free and reduced-price lunch programs, and in special education, as well as with students with learning disabilities, at-risk or with low-achievement, and learning English as a second language (e.g., Ysseldyke & Tardrew, 2007, see Figure 5; see also Spicuzza et al., 2001; Teelucksingh, Ysseldyke, Spicuzza, & Ginsburg-Block, 2001).

Figure 5: Accelerated Math Achievement Gains by Subgroup

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>LD</th>
<th>GT</th>
<th>FRL</th>
<th>Title 1</th>
<th>ELL</th>
<th>LA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentile Rank Gain</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>14</td>
<td>15</td>
<td>18</td>
</tr>
</tbody>
</table>

Springer, Pugalee, and Algozzine (2007) conducted a randomized experiment with 28 at-risk high school students who did not pass the Arizona Instrument to Measure Standards test. The control group participated in the school’s typical math classroom, and the experimental group used Accelerated Math. Afterwards, more students (57%) in the experimental condition were able to pass the state test than those in the control condition (14%).

Another study (Ysseldyke, Spicuzza, Kosciolek, Teelucksingh, et al., 2003) examined the effect of Accelerated Math on overall student achievement for students in a large urban district composed of approximately 75% minority students and 67% of students receiving free or reduced-price lunch. Researchers assigned students
to use Accelerated Math with their regular curriculum or to continue using only their curriculum. The researchers found that students at all ability levels who used Accelerated Math demonstrated accelerated rates of performance compared to national norms after being below national norms before participating in the Accelerated Math classroom. Gains ranged from 3.4 to 10.8 NCEs on the Northwest Achievement Levels Test, and gains were similar on the STAR Math assessment.

Greater gains with high implementation

Studies have also shown that higher levels of implementation of the Accelerated Math software positively influences achievement. Renaissance Learning offers teachers a variety of professional development opportunities to learn Accelerated Math Best Practices, which are research-based recommendations meant to ensure fidelity of implementation so that students benefit from the software to the greatest extent possible. Students in classrooms with teachers who use the software according to AM Best Practices have been able to achieve greater scores on standardized tests than other students (e.g., Brem, 2003; Lemkuil, Ysseldyke, Spicuzza, & Ginsburg-Block, 2000).

For example, researchers examined the impact of Accelerated Math in a quasi-experimental study (Ysseldyke & Bolt, 2007). Approximately 2,000 students from more than 100 classrooms in elementary and middle schools across the United States, including several in large cities, participated in the study. The researchers discovered that students whose teachers used Accelerated Math as intended demonstrated greater gains on two standardized tests, TerraNova and STAR Math, than students with limited or no implementation (see Figure 6).

Figure 6: Students Make Greater Math Gains With Accelerated Math Best Practices (High Implementation)

In order to examine the issues of variability, implementation integrity, and sustainability when implementing a progress-monitoring program, a subsequent investigation by Bolt, Ysseldyke, and Patterson (2010) followed some of the same schools, teachers (including the prior-year’s control group), and students for a second year as they attempted to implement Accelerated Math school-wide. The researchers also investigated the relationship between implementation of Accelerated Math and positive student outcomes. Bolt et al. found significant variability in intensity of implementation across all three levels investigated in the study (student, teacher, and school); however, individual teacher implementation remained stable across the two years of the study. The researchers also found that teachers who implemented Accelerated Math with greater fidelity had students who experienced higher math gains on standardized assessments; likewise, this relationship between use of Accelerated Math and achievement was significant at the student level.
In a study of the effectiveness of both Accelerated Math and Accelerated Reader by Holmes, Brown, and Algozzine (2006), results from the Criterion-Referenced Competency Tests indicated that students in two high-implementing schools outperformed students in two low-implementing comparison schools overall (effect size (ES)=0.65), and in math (ES=0.75), reading (ES=0.50), and language arts (ES=0.71). Teachers in all schools expressed positive attitudes toward Accelerated Math and Accelerated Reader.

**Can be used with any curriculum**

As mentioned previously, Accelerated Math works with many different curricula to provide the essential practice students need to improve math achievement. Ysseldyke and Betts (2010) found students using Accelerated Math with the following curricula outperformed peers who used only the curriculum: enVision Math, Everyday Mathematics, Holt McDougal, Macmillan/McGraw-Hill, and Saxon Math. In 2007, Ysseldyke and Bolt demonstrated that Accelerated Math was successfully used with more than 10 different curricula, including Everyday Mathematics (McGraw-Hill), Harcourt Math, Houghton Mifflin Math Central, and Prentice Hall Transition Mathematics. Several studies have shown Accelerated Math is effective when used with Everyday Math (Spicuzza et al., 2001; Ysseldyke, Spicuzza, Kosciolek, & Boys, 2003; Ysseldyke, Spicuzza, Kosciolek, Teelucksingh, et al., 2003).

**Cost-effective**

Teacher time and school resources are often limited, so using a cost-effective tool is key to success. In 2007 and 2008, Yeh's comparisons of gains in student achievement suggested that Accelerated Math and Accelerated Reader, which he defined as “rapid assessment systems,” were several times more effective at raising student achievement than other methods: twice as effective as high quality preschool, 3 times as effective as class size reduction, 4 times as effective as a 10% increase in per pupil expenditure, 6 times as effective as increased accountability, 6 times as effective as voucher programs, 32 times as effective as raising teacher quality, and 64 times as effective as charter schools. Achievement gains per dollar from rapid assessment were 5 times the gains that accrue through Comprehensive School Reform, 45 times the gains from accountability testing, 124 times the gains from class size reduction, 152 times the gains from a 10% increase in preexisting patterns of educational expenditures, 765 times the gains from high quality preschool, 1,007 times the gains from raising teacher quality, 1,907 times the gains from voucher programs, and 18,223 times the gains from charter schools (see Figure 7).

**Figure 7: Accelerated Math and Accelerated Reader Yield Higher Gains in Student Achievement per Dollar**
Aligned with the National Mathematics Advisory Panel recommendations
Accelerated Math helps educators meet recommendations in the National Math Panel's final report (2008b) by

- Presenting “a focused, coherent progression of mathematics learning, with an emphasis on proficiency with key topics” (pp. xvi, 20–22)
- Supplying “sufficient and appropriate practice” that fosters “computational proficiency with whole number operations….fluency with the standard algorithms…. [and] a solid understanding of core concepts” (pp. xix, 26–29)
- Focusing on effort rather than ability, which “increases [student] engagement in mathematics learning [and] improves mathematics outcomes” (pp. xx, 31–32)
- Promoting “regular use of formative assessment,” which “improves… students’ learning” (pp. xxiii, 46–48)
- Providing “tools that inform teachers about specific ways of using formative assessment information to provide differentiated instruction” (pp. 46–48)
High-Quality Progress Monitoring and Mastery Measurement

Accelerated Math is a standardized, reliable, valid, efficient, and cost-effective continuous progress-monitoring system. The program is one of several Renaissance Learning tools the U.S. Department of Education’s National Center on Response to Intervention (NCRTI) and other experts have deemed to meet the highest scientific standards of quality, making it a perfect fit for screening and progress monitoring.

As the authority on Response to Intervention (RTI), the NCRTI promotes RTI practice and has established a standard process to evaluate the scientific rigor of tools and interventions that can be used for RTI. Periodic reviews are conducted by Technical Review Committees made up of national experts who together have developed rigorous evidence standards to guide the process.

In 2009, Accelerated Math was the first progress-monitoring tool to be highly rated as a mastery measure by the NCRTI, and it remains the only product to receive top marks in every category (see Figure 8). No other assessment can provide automated progress monitoring at the skill mastery level.

Figure 8: NCRTI Progress Monitoring Mastery Measure Tools Chart—Accelerated Math

The NCRTI defines progress monitoring as “repeated measurement of academic performance to inform instruction of individual students in general and special education. It is conducted at least monthly to: (a) estimate rates of improvement, (b) identify students who are not demonstrating adequate progress and/or (c) compare the efficacy of different forms of instruction to design more effective individualized instruction.” The two forms of progress monitoring are: General Outcome (reflects overall competence) and Mastery Measure (monitors a student’s successive mastery of a hierarchy of objectives).

In 2007, the National Center on Student Progress Monitoring—the predecessor to the NCRTI—determined that Accelerated Math met all criteria for scientifically based progress-monitoring tools.

Using Accelerated Math for Response to Intervention

Accelerated Math can be thought of as an assessment for daily practice monitoring, meaning it is designed to provide feedback regarding either student completion of important tasks known to improve achievement outcomes (such math problem solving) or student comprehension of direct instruction. Ideally, daily practice monitoring can provide estimates of academic engaged time (AET). Assessments at this level provide the majority of the information necessary to inform instruction and personalize student practice to improve performance. The only practical way to administer daily assessments and benefit from all the data they generate is through integrated assessment technology (Renaissance Learning, 2009a).

Only technology can make differentiated instruction a reality, by processing performance data on which to base differentiated assignments, helping the teacher make those assignments, and automatically generating a flow of data to the teacher, the student, and the parent that makes it easy to tell that individual goals are being met.
Differentiated instruction.

A key guiding principle of response to intervention is differentiated instruction—not just for students receiving intervention, but at all tiers, with personalized goal setting that allows teachers to accurately monitor students’ growth in a timely manner and make changes to instruction as necessary. Differentiated instruction in RTI should not be limited to students formally designated to receive interventions—it should apply within the core (Tier 1) classroom as well. It is true that differentiated instruction is difficult—because it inherently implies setting, and monitoring, individual goals. Only technology can make it a reality, by processing performance data on which to base differentiated assignments, helping the teacher make those assignments, and automatically generating a flow of data to the teacher, the student, and the parent that makes it easy to tell that individual goals are being met.

To ensure students begin working in Accelerated Math at the right level of challenge, teachers may have students take an Accelerated Math Diagnostic Test, a STAR Math assessment, or both. The personalized math practice that Accelerated Math generates allows for the ultimate in differentiation at all tiers. The software automatically creates assignments geared directly to students’ individual achievement levels and focused on objectives each student is ready to learn, which is engaging and motivating for students. Accelerated Math also frees up the teacher’s time to work with any students who may be experiencing difficulties. Because the software automatically scores students’ assignments, the teacher can immediately and effectively act upon data from the program and ensure students are making progress toward goals.

Academic learning time (ALT).

As mentioned earlier (p. 4), the amount of time students spend on learning activities, including practicing skills they have just been taught, is vital to student achievement. Accelerated Math Best Practices call for students to use class time productively and include routines to ensure students always know what they are to do next. And the software uses technology to save class time for the teacher and student by automating assignments and record keeping. Accelerated Math also helps the teacher track students’ ALT by using math objectives to estimate how much time students have spent working math problems keyed to personalized objectives. Measuring ALT is also a way to tangibly monitor fidelity of implementation (i.e. using a program as it was intended), which helps to ensure students benefit from Accelerated Math to the greatest extent possible. The Renaissance Learning Dashboard assists educators with tracking various Accelerated Math metrics, including engaged time (see Figure 9).
Explanation of psychometric standards
Standardization.
The Accelerated Math software conforms closely to the most widely accepted principles of assessment and mathematics. Assignments are developed, administered, and scored with standardized assessment procedures and fixed parameters to ensure fairness and consistency, which means the information they provide is comparable over time and from student to student. Using a tightly controlled process, algorithms are used to generate multiple-choice questions for math problems. Each multiple-choice item has an unequivocally correct answer. Each free-response item also has an unequivocally correct answer, but students can choose the solution strategy they deem appropriate.

Reliability and validity.
The U.S. Department of Education’s National Center on Response to Intervention (2009a) and National Center on Student Progress Monitoring (2007) reviews of Accelerated Math confirm its reliability and validity.

Reliability is the extent to which scores from an assessment are consistent across repeated administrations of the same or similar assessments to the same group or population. The more reliable assessment scores are, the more they are free from errors of measurement; however, in educational assessment it is important to keep in mind that some degree of measurement error is inevitable. The internal reliability of Accelerated Math assignment scores has been documented to be in the moderate range for assessments with a small number of items.

Validity is the degree to which an assessment measures what it claims to measure. Evidence of assessment validity is often indirect and incremental, consisting of a variety of data that, taken together, are consistent with the theory that the assessment measures the intended construct. Accelerated Math assignments are valid because the objectives in the assignments are tied directly to common math curriculum and textbook problem types, expert recommendations, and various state standards.

Efficiency and ease of use.
In addition to being reliable and valid, the multiple-choice assignments of Accelerated Math are efficient and easy to use. Results from Accelerated Math assignments provide a high degree of useful information while consuming relatively few teacher resources, such as time that would otherwise be spent scoring math assignments by hand.

Multiple-choice questions are seen as a way of enhancing opportunities for rapid feedback to students as well as saving staff time. Computers enable more flexibility in the delivery of multiple-choice questions as well as automate and speed up grading and the collection of test results (Nicol, 2007). As noted by Stiggins (2005):

> [Multiple-choice] tests are efficient in that we can administer large numbers of multiple-choice or true/false test items per unit of testing time. Thus, they permit us to sample widely and draw relatively confident generalizations from the content sampled. For this reason, when the target is knowledge mastery, [multiple-choice] formats fit nicely into the resource realities of most classrooms. (p. 70)
Overview of Accelerated Math

Accelerated Math software personalizes student math practice and helps teachers generate assignments/tests, monitor progress, and motivate students to succeed. Teachers use progress-monitoring information provided by Accelerated Math to do what they do best—provide individualized, differentiated instruction to each student.

Content development

The Accelerated Math libraries were first published in 1998, with a scope and sequence based on commonalities between the 1989 National Council of Teachers of Mathematics (NCTM) standards, leading publisher textbooks, National Assessment of Educational Progress (NAEP) editions, and math editor teaching experience from the 1990s. A great deal has occurred in U.S. education since 1998, and much professional thought has gone into what is important in mathematics. For the 2008 Accelerated Math content revision, Renaissance Learning (2009b) took into account all of the landmark changes and created a new scope and sequence for the Accelerated Math Second-Edition Libraries for Grades 1 through 8, Algebra 1, and Geometry that incorporated:

- National Mathematics Advisory Panel (2008a) essential concepts and skills, and other recommendations
- Math curricular profiles of Singapore and other top-performing countries
- Alignments with model state standards
- Content reviews by the Northwest Regional Educational Laboratory, mathematics educators, mathematicians, and university researchers (see box on p. 3 for list of math experts)
- Research on effective development of algorithm-generated dynamic items

Then, in 2009, after the prerelease of the Committee on Early Childhood Mathematics and National Research Council’s report, Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity, it became clear there was a resounding call for greater emphasis on early numeracy in mathematics. The NCTM Curriculum Focal Points had already identified foundational prekindergarten and kindergarten skills, and Renaissance Learning developed the Accelerated Math Early Numeracy Library with objectives to meet the needs of early or struggling math learners.

How Accelerated Math works

Accelerated Math assignments are individually generated and printed for each student. After students work math assignments on paper, they record and submit their responses using a scan card and AccelScan scanner, a hand-held Renaissance Responder, or a portable NEO 2 laptop. The software automatically scores each assignment and shares immediate feedback via informative reports for the teacher and students.
Accelerated Math Enterprise provides access to all Accelerated Math content libraries, additional progress-monitoring tools (e.g., the Dashboard, see p. 19), data hosting, professional development, online training materials, expert support, and automatic software upgrades and updates.

There are four types of assignments in Accelerated Math:

- **Practice assignments** (for an example, see Appendix A, p. 27) consist of multiple-choice questions, include teacher-assigned and Ready to Work objectives, and are designed to give students an opportunity to practice math concepts that have been previously taught.

- **Exercise assignments** consist of multiple-choice or free-response questions, include any objective specified by the teacher, and are designed to be used to supplement daily lessons or to provide more practice on specific objectives after a lesson or intervention.

- **Tests** consist of multiple-choice or free-response questions, include Ready to Test objectives, and are designed to allow students to demonstrate mastery of an objective.

- **Diagnostic tests** consist of multiple-choice or free-response questions, include any objectives specified by the teacher, and are designed to test students on any objective, even those not recently practiced. Teachers can use a diagnostic test to place incoming students in Accelerated Math or to allow students to master objectives directly when they have previous knowledge of certain objectives.

A typical Accelerated Math implementation includes the following steps:

1. Based on students’ scores from a STAR Math assessment and/or an Accelerated Math Diagnostic Test, or using professional judgment, the teacher assigns each student objectives in the Assignment Book.
2. The teacher provides instruction on the designated objectives.
3. Using Accelerated Math, the teacher prints personalized practice or exercise assignments based on the objectives assigned to each student.
4. Students complete the printed assignments and record their answers on Accelerated Math scan cards, in the NEO 2 or Renaissance Responder, or from home using Renaissance Home Connect (see p. 25).
5. For each student, Accelerated Math immediately scores the assignment, prints a TOPS Report summarizing performance, and prints the next practice assignment based on that performance.
6. If a student’s TOPS Report indicates a problem was missed, the student reworks the problem.
7. All students meet individually with the teacher to discuss TOPS Report results and any corrections if applicable, and if needed, the teacher provides additional instruction or intervention.
8. The teacher prints a test for any students that meet the practice mastery criteria for an objective.
9. After students complete the printed tests, they record answers either on scan cards or in the NEO 2 or Renaissance Responder.
10. The Accelerated Math software scores the tests, and again the teacher discusses the TOPS Report and any corrections with each student.
11. Objectives are mastered when students meet specific criteria. To maintain mastery, objectives are reviewed on practice assignments after two weeks.
12. Using the various reports provided by Accelerated Math, the teacher monitors progress daily, weekly, and at greater intervals (e.g., monthly, marking period) to differentiate instruction and provide intervention as needed.

---

4 Ready to Work objectives are those that students have encountered on at least one practice or exercise assignment or diagnostic test without mastering.

5 Ready to Test objectives are those for which the student has successfully practiced, so he or she is ready to test for mastery on these objectives.
Students follow various pathways for mastering objectives while using Accelerated Math (see Figure 10). Upon completion of an assignment, the student continues on a path based on whether or not he or she was successful. If a student continues to be unsuccessful, the teacher receives a notification to intervene (both on reports printed from the program and in the software's assignment book), and following teacher intervention, the student must attempt to master the objective again by practicing and testing. Once an objective is practiced, tested, and mastered, it is reviewed on practice assignments after two weeks. If the student is unsuccessful upon review, the objective status changes to intervene and the student repeats the practice, test, and review cycle.

Figure 10: Accelerated Math Cycle Overview
Assignment content.

Assignments generated by Accelerated Math include math problems derived from specific topics or skills, called Objectives. Objectives are assigned to students based on their math achievement level and mastery of prerequisite objectives. The objectives available depend on the library of objectives in use. Libraries, or sets of objectives, are available that are designed to align with specific grade levels, various contents areas (e.g., algebra), state standards, national guidelines, and textbook series. Educators can use STAR Math (see box), an Accelerated Math Diagnostic Test, and/or their professional judgment to begin a student’s work in an appropriate Accelerated Math library.

Accelerated Math uses an extensive set of algorithms to generate multiple-choice questions with randomized variables specific to assigned objectives. The algorithms are templates or models for creating math problems that are tightly controlled to produce questions appropriate for a single, specific objective. As a result, problems generated by the algorithms are comparable in difficulty, as are any two assignments or tests with the same objective(s). This allows for students testing on the same objective(s) to receive different versions of an assignment or test and educators to generate multiple alternate forms of an assignment or test if needed.

For example, in the Grade 1 Library, an objective for addition is limited to using numbers up to 12. An algorithm may start with a problem such as 2 + 3. It will then generate additional math problems with numbers up to 12, randomly selected and substituted for 2 and 3. As a result, the algorithm may produce 8 + 1, 4 + 7, or similar problems. Some of these will be selected and administered to the student, depending on the number of math problems specified by the teacher or software.

In addition to multiple-choice questions, Accelerated Math includes Extended Response Libraries for grades 3 through calculus (for an example, see Appendix B, p. 28). These questions are static questions that require written responses. They include problem-solving questions, proofs, reasoning, applications, and gathering and using data. Extended-response questions can be solved using more than one strategy and require higher order thinking skills for completion. Educators score these questions using an answer key and rubric and enter scores for three criteria into the Accelerated Math software. These problem types are especially helpful in assisting the educator with diagnosing misconceptions or facilitating group discussions. Teachers can have students, individually or as a group, verbalize their reasoning, thought processes, and strategies used to solve the problem (Gersten et al., 2009).

STAR Math—used for screening, progress-monitoring, and diagnostic assessment—is a reliable, valid, and efficient, computer-adaptive assessment of general math achievement for grades 1–12. STAR Math provides nationally norm-referenced math scores and criterion-referenced evaluations of skill levels. A STAR Math assessment can be completed without teacher assistance in less than 15 minutes and repeated as often as weekly for progress monitoring. STAR Math scores are highly correlated with traditional standardized tests, and results from STAR Math can be used to help place students in an appropriate Accelerated Math library to begin working.

STAR Math uses an item bank of more than 1,900 items and computer-adaptive technology to tailor each student’s test to his or her abilities, reducing testing time and increasing reliability. The difficulty level of each item administered in STAR Math is determined according to a student’s responses, resulting in personalized growth information. If a question is answered incorrectly, the next question will be easier. If a question is answered correctly, the next will be more difficult.

STAR Math is highly rated for screening and progress monitoring by the U.S. Department of Education’s National Center on Response to Intervention (2009b, 2009c).

To learn more, see a separate publication from Renaissance Learning, The Foundation of the STAR Assessments, available online from http://doc.renlearn.com/KMNet/R001480701GCFBB9.pdf

For students struggling with mathematics, the power of Accelerated Math, MathFacts in a Flash, and STAR Math combine in Accelerated Math for Intervention, a dynamic, evidence-based math intervention for grades 3–12 that provides diagnostic tools to help teachers identify both students’ strengths and critical skills deficiencies. For more information, visit www.renlearn.com/ami

---

6 A prerequisite objective is an objective that provides practice with the prerequisite skills needed to become proficient with the requisite objective.
Submitting assignments.

Renaissance Learning offers several ways for students to submit answers to Accelerated Math assignments. Students complete assignments and tests on paper and can record answers onto an AccelScan scan card, which is fed into the AccelScan scanner. The scanner, using Intelligent Mark Recognition technology, recognizes students’ answers quickly and accurately. Scan cards can be reused for multiple assignments for the same student, reducing paper waste. Students are typically excited to scan their own cards and motivated by receiving immediate results.

Answers from Accelerated Math assignments or tests may also be entered into the NEO 2 portable laptop or the Renaissance Responder, an interactive remote-response handheld device. A benefit to using these tools is that students can score assignments and tests while seated at their desks, which can aid classroom management by limiting student movement around the classroom.

Accelerated Math Enterprise includes the Renaissance Home Connect website, an online tool that helps connect parents to what is happening at school and extend student math practice beyond the classroom (see Figure 11). Parents can use Renaissance Home Connect to monitor their child’s work in Accelerated Math, including Ready to Test and mastered objectives, progress toward goals, results of practice and exercise assignments and tests, as well as to encourage additional student practice at home. Students may score and reprint current assignments, receive immediate feedback via a TOPS Report upon scoring an assignment, and print new practice assignments. (Students are not able to complete tests or master objectives; these activities require a monitored classroom environment.) Students may use Renaissance Home Connect at home, during study time, in a library, as part of before- and after-school programs, with tutoring programs, and in other venues with Internet access. In addition, students may choose up to six family members to receive emails with results when Accelerated Math tests are completed.

Figure 11: Accelerated Math Renaissance Home Connect Screen—Practice & Exercises

---

---

Teachers have the option to disable the scoring function if desired.
Key reports

Accelerated Math offers various levels of progress monitoring, including daily, weekly, and periodic monitoring as well as student-, classroom-, grade-, school-, and district-level monitoring. Assignments can be administered daily, weekly, or at larger intervals (e.g., tests and diagnostic tests). Each assignment that a student completes is automatically scored, and the results are recorded in the Accelerated Math grade book. Accelerated Math can generate reports for individuals, classes, grades, schools, and entire districts as well as provide the progress-monitoring data necessary for modifying instruction. (For examples of some of the key Accelerated Math reports discussed below, see Appendix C, p. 29.)

The Status of the Class Report (see p. 30) provides critical daily information about all students so that the teacher can personalize instruction as needed. The report indicates whether students are working on assignments, need new assignments or objectives assigned, or need intervention on specific objectives. The teacher can also see which students are struggling on similar objectives, so they can be grouped together for additional assistance.

A TOPS Report (p. 32) prints each time a student completes an assignment and includes the student’s score, a list of objectives included in the assignment, and a summary of that student’s work for the class marking period and school year. For multiple-choice assignments, the report also shows which problem(s) the student answered incorrectly along with the student’s answer and the correct answer.

The Diagnostic Report (p. 33) provides an overview of student and class progress. The report includes diagnostic codes, the average grade level for mastered objectives, the number of objectives mastered through diagnostic tests and tests, an estimate of engaged time, the average number of objectives mastered per week, and average scores for different types of assignments.

The Goal History Report provides the mastery goals for each student, the number of objectives mastered, the percent of goal, and the test percent correct by marking period. Teachers can customize the report to specify which classes or students to include.

The Student Record Report provides a record of each student’s progress, including which objectives are active, which are marked “Intervene,” and which have been mastered. The report also provides student scores (percent correct) and milestone dates for each objective. Teachers can customize this report to select which students to include, the report date range, and whether to display all or a maximum number of objectives.
Appendix A: Sample Practice Assignment

C. Payne
Grade 8
Renaissance School

Practice
Accelerated Math™: Monday, January 5, 2009, 9:24 AM

Form Number 3050

Objectives: (4 of 4 listed)
66. Identify a cross section of a 3-dimensional shape
67. Determine a measure of length, weight or mass, or capacity or volume using proportions
44. <Review> Determine a linear equation in two variables that represents a table of values
57. <Review> WP: Solve a distance-rate-time problem that involves unit conversions

1. Which two-dimensional shape could be the result of a plane slicing vertically through this hemisphere?

2. Which two-dimensional shape could be created by a plane slicing horizontally through this cube?

3. The volume of molten metal needed to fill a cylindrical mold is proportional to the square of the radius of the mold. A mold with a radius of 2 cm requires 128 mL of molten metal. How much molten metal would be needed to fill a mold with the same height and a radius of 3 cm?
   [A] 576 mL  [B] 96 mL  [C] 192 mL  [D] 288 mL

4. A dressmaker buys flannel fabric by the yard. A purchase of \(7 \frac{1}{4}\) yards of flannel costs $58. How many yards of flannel would the dressmaker be able to buy for $37?
   [A] \(5 \frac{2}{7}\) yd  [B] \(2 \frac{5}{8}\) yd  [C] \(4 \frac{5}{8}\) yd

5. Which equation generates the values in the table?
   \[
   \begin{array}{c|c|c|c|c|c}
   x & -2 & -1 & 0 & 1 & 2 \\
   y & -2 & -5 & -8 & -11 & -14 \\
   \end{array}
   \]
   [A] \(y = -3x - 8\)  [B] \(y = -3x - 16\)  [C] \(y = -2\)
Appendix B: Sample Extended Response Objective

Extended Response Objective
Accelerated Math™ . Friday, July 17, 2009, 10:24:27 AM
29. Decimals, round, compare

T. Aaron
Grade 5
East Elementary School
Form Number 38

1. Kyra’s class is playing MATH BINGO. Kyra’s teacher gives clues to numbers need to be in a row, in a column, or in a diagonal. Below is her teacher.

<table>
<thead>
<tr>
<th>B</th>
<th>I</th>
<th>N</th>
<th>G</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>4.5</td>
<td>1.5</td>
<td>2.9</td>
<td>0.7</td>
</tr>
<tr>
<td>5.5</td>
<td>5.2</td>
<td>4.7</td>
<td>2.5</td>
<td>7.5</td>
</tr>
<tr>
<td>2.2</td>
<td>1.3</td>
<td>2.9</td>
<td>6.1</td>
<td>3.6</td>
</tr>
<tr>
<td>1.9</td>
<td>3.7</td>
<td>3.2</td>
<td>3.0</td>
<td>1.4</td>
</tr>
<tr>
<td>5.8</td>
<td>3.4</td>
<td>8.0</td>
<td>4.4</td>
<td>2.6</td>
</tr>
</tbody>
</table>

CLUES
In column B, the number closest to 6.
In column I, the number closest to 4.
In column N, the number closest to 3.
In column G, the number closest to 2.
In column O, the number closest to 1.

a. Circle the numbers in Kyra’s card that correspond to the clues. Did Kyra’s card make a BINGO?

b. Make new clues for each column to get 5 numbers either across or diagonally. Exchange your game with a partner and play MATH BINGO.

c. Using clues that are not related to rounding, make clues for each row. Exchange your game with a partner and see if you each get BINGO.
Appendix C: Key Reports

On the following pages are sample key reports\(^8\) for use with Accelerated Math:

- Accelerated Math Status of the Class Report
- Accelerated Math Practice TOPS Report
- Accelerated Math Diagnostic Report

The complete menu of reports available for Accelerated Math is found in a separate publication from Renaissance Learning, *Key Report Samples*, available online from http://doc.renlearn.com/KMNET/R003563228GE7E80.pdf

\(^8\) Reports are regularly reviewed and may vary from those shown as enhancements are made.
**Class: Math 4A**  
Teacher: Adams, Marcie

**Group Name: Class**

**Assignment Status**

<table>
<thead>
<tr>
<th>Student</th>
<th>Type</th>
<th>Objectives</th>
<th>Practice Date</th>
<th>Exercise Date</th>
<th>Test Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, Marcus</td>
<td>Intervene (2)</td>
<td>2</td>
<td>03/11/11</td>
<td></td>
<td>03/11/11</td>
</tr>
<tr>
<td>Bell, Timothy</td>
<td>Intervene (2)</td>
<td>1</td>
<td>03/14/11</td>
<td></td>
<td>03/14/11</td>
</tr>
<tr>
<td>Bollig, Brandon</td>
<td>Intervene (2)</td>
<td>1</td>
<td>03/11/11</td>
<td></td>
<td>03/14/11</td>
</tr>
<tr>
<td>Chang, Michelle</td>
<td>Intervene (2)</td>
<td>0</td>
<td>03/11/11</td>
<td>03/11/11</td>
<td>03/14/11</td>
</tr>
<tr>
<td>Gonzales, Maria</td>
<td>Intervene (2)</td>
<td>3</td>
<td>03/11/11</td>
<td>03/11/11</td>
<td>03/14/11</td>
</tr>
<tr>
<td>Halden, Susan</td>
<td>Intervene (2)</td>
<td>1</td>
<td>03/11/11</td>
<td>03/11/11</td>
<td>03/14/11</td>
</tr>
<tr>
<td>O'Neil, Sarah</td>
<td>Assign Obj</td>
<td>0</td>
<td>03/14/11</td>
<td></td>
<td>03/11/11</td>
</tr>
<tr>
<td>Richmond, Angela</td>
<td>Assign Obj</td>
<td>0</td>
<td>03/14/11</td>
<td></td>
<td>03/14/11</td>
</tr>
<tr>
<td>Rodrigues, Carlos</td>
<td>Assign Obj</td>
<td>4</td>
<td>03/14/11</td>
<td></td>
<td>03/14/11</td>
</tr>
<tr>
<td>Stone, Lisa</td>
<td>Assign Obj</td>
<td>0</td>
<td>03/11/11</td>
<td></td>
<td>03/11/11</td>
</tr>
<tr>
<td>Tyler, Lawrence</td>
<td>Print Assignment</td>
<td>3</td>
<td>03/11/11</td>
<td></td>
<td>03/14/11</td>
</tr>
<tr>
<td>White, Jacob</td>
<td>Print Assignment</td>
<td>0</td>
<td>03/14/11</td>
<td></td>
<td>03/14/11</td>
</tr>
</tbody>
</table>

**Intervention Needed**

<table>
<thead>
<tr>
<th>Student</th>
<th>Assignment Type</th>
<th>Objectives</th>
<th>Library Objective Code</th>
<th>Overall Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bollig, Brandon</td>
<td>Practice</td>
<td>90. Generate a table of paired numbers based on a rule</td>
<td>DMG4-090</td>
<td>11 / 18 (61%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>91. Determine a rule that relates two variables</td>
<td>DMG4-091</td>
<td>12 / 18 (67%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>96. Convert between customary units of weight using whole numbers</td>
<td>DMG4-096</td>
<td>6 / 10 (60%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>97. Convert between metric units of capacity using whole numbers</td>
<td>DMG4-097</td>
<td>5 / 10 (50%)</td>
</tr>
</tbody>
</table>

*Diagnostic Test*
## Status of the Class Report

Printed Monday, March 14, 2011 3:50:44 PM

**School: Oakwood Elementary School**

**Class: Math 4A**
Teacher: Adams, Marcie

**Group Name: Class**

### Objectives Causing Difficulties
Minimum Students: 3

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Assignment Type</th>
<th>Student</th>
<th>Library Objective Code</th>
<th>Overall Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>112.</td>
<td>Practice</td>
<td>Chang, Michelle</td>
<td>DMG4 -112</td>
<td>8 / 12 (67%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>Stone, Lisa</td>
<td>DMG4 -112</td>
<td>7 / 12 (58%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>Tyler, Lawrence</td>
<td>DMG4 -112</td>
<td>5 / 10 (50%)</td>
</tr>
<tr>
<td>114.</td>
<td>Practice</td>
<td>Richmond, Angela</td>
<td>DMG4 -114</td>
<td>6 / 10 (60%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>Rodrigues, Carlos</td>
<td>DMG4 -114</td>
<td>6 / 10 (60%)</td>
</tr>
<tr>
<td></td>
<td>Practice</td>
<td>White, Jacob</td>
<td>DMG4 -114</td>
<td>5 / 12 (42%)</td>
</tr>
</tbody>
</table>

### Outstanding Assignments

<table>
<thead>
<tr>
<th>Student</th>
<th>School Days Since Last Work Printed</th>
<th>Practice</th>
<th>Exercise</th>
<th>Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, Marcus</td>
<td>Today</td>
<td>1</td>
<td>2431</td>
<td>1-18</td>
</tr>
<tr>
<td>Bell, Timothy</td>
<td>Today</td>
<td>2541</td>
<td>2487</td>
<td>1-8</td>
</tr>
<tr>
<td>Bollig, Brandon</td>
<td>Today</td>
<td>2541</td>
<td>2487</td>
<td>1-8</td>
</tr>
<tr>
<td>Chang, Michelle</td>
<td>Today</td>
<td>2441</td>
<td>2493</td>
<td>17-32</td>
</tr>
<tr>
<td>Gonzales, Maria</td>
<td>Today</td>
<td>2509</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halden, Susan</td>
<td>Today</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O’Neil, Sarah</td>
<td>Today</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Richmond, Angela</td>
<td>Today</td>
<td>2501</td>
<td>2466</td>
<td>1-20</td>
</tr>
<tr>
<td>Rodrigues, Carlos</td>
<td>Today</td>
<td>2476</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone, Lisa</td>
<td>Today</td>
<td>2448</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tyler, Lawrence</td>
<td>Today</td>
<td>2448</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, Jacob</td>
<td>Today</td>
<td>2448</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Diagnostic Test

The teacher needs to print an assignment for Lawrence.
APPENDIX C: KEY REPORTS

Practice TOPS Report for Brandon Bollig
Printed Friday, March 11, 2011 10:45:20 AM

School: Oakwood Elementary School
Class: Math 4A

Number Correct: 16 / 20 (80%)

Incorrect Responses (4)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Original Answer</th>
<th>Correct Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>90.</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>90.</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>91.</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>91.</td>
<td>B</td>
<td>A</td>
</tr>
</tbody>
</table>

Objectives on this Practice (5)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Results</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>89.</td>
<td>6 / 6 100%</td>
<td>9 / 12 75%</td>
</tr>
<tr>
<td>90.</td>
<td>4 / 6 67%</td>
<td>9 / 18 50%</td>
</tr>
<tr>
<td>91.</td>
<td>4 / 6 67%</td>
<td>9 / 18 50%</td>
</tr>
<tr>
<td>39.</td>
<td>1 / 1 100%</td>
<td>4 / 4 100%</td>
</tr>
<tr>
<td>40.</td>
<td>1 / 1 100%</td>
<td>4 / 4 100%</td>
</tr>
</tbody>
</table>

Overall Progress

<table>
<thead>
<tr>
<th>Average Percent Correct</th>
<th>Objective Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice %: 67%</td>
<td>Ready to Test: 1</td>
</tr>
<tr>
<td>Test %: 70%</td>
<td>Goal for Marking Period: 32</td>
</tr>
<tr>
<td>Review %: 73%</td>
<td>Total Mastered this Marking Period: 21 (66% of Goal)</td>
</tr>
<tr>
<td></td>
<td>Total Mastered This Year: 93</td>
</tr>
</tbody>
</table>

Teacher Comments:
Brandon is having problems with these objectives. Brandon will make corrections and share with his teacher before he continues.

Parent Comments:
The goal for Practice is 75%. Brandon is not meeting this goal; he may be having trouble with new concepts.

The Accelerated Math TOPS Report prints after each assignment is scored, giving immediate feedback to students.

Form: 2541
Problems: 1-20
Printed: 3/11/11 10:02:31 AM
Completed: 3/11/11 10:45:08 AM

*Includes Exercise Results
Includes Diagnostic Test Results
Includes Review Objectives

Brandon is having trouble with new concepts. Brandon's score suggests he may be having trouble retaining concepts.

The goal for Review is 80%.
This report helps to carefully monitor students' progress towards mastery of math objectives.

### Class: Math 4A
Teacher: Adams, Marcie

#### Group Name: Class

<table>
<thead>
<tr>
<th>Student</th>
<th>Diagnostic Codes</th>
<th>Practice</th>
<th>Exercise</th>
<th>Regular Test</th>
<th>Diagnostic Test</th>
<th>Total Tests</th>
<th>Review</th>
<th>Engaged Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, Marcus</td>
<td>I, P, T, R</td>
<td>92</td>
<td>94</td>
<td>93</td>
<td>94</td>
<td>94</td>
<td>95</td>
<td>40</td>
</tr>
<tr>
<td>Bell, Timothy</td>
<td></td>
<td>80</td>
<td>77</td>
<td>85</td>
<td>82</td>
<td>84</td>
<td>83</td>
<td>29</td>
</tr>
<tr>
<td>Bollig, Brandon</td>
<td>I, P, T, R</td>
<td>64</td>
<td>69</td>
<td>67</td>
<td>72</td>
<td>70</td>
<td>73</td>
<td>28</td>
</tr>
<tr>
<td>Chang, Michelle</td>
<td></td>
<td>85</td>
<td>87</td>
<td>88</td>
<td>87</td>
<td>88</td>
<td>90</td>
<td>33</td>
</tr>
<tr>
<td>Gonzales, Maria</td>
<td></td>
<td>91</td>
<td>88</td>
<td>91</td>
<td>89</td>
<td>90</td>
<td>91</td>
<td>38</td>
</tr>
<tr>
<td>Halden, Susan</td>
<td>I, P, T, R</td>
<td>73</td>
<td>67</td>
<td>74</td>
<td>75</td>
<td>75</td>
<td>77</td>
<td>28</td>
</tr>
<tr>
<td>O’Neill, Sarah</td>
<td></td>
<td>95</td>
<td>96</td>
<td>95</td>
<td>96</td>
<td>96</td>
<td>97</td>
<td>44</td>
</tr>
<tr>
<td>Richmond, Angela</td>
<td></td>
<td>83</td>
<td>86</td>
<td>86</td>
<td>84</td>
<td>85</td>
<td>84</td>
<td>30</td>
</tr>
<tr>
<td>Rodrigues, Carlos</td>
<td></td>
<td>84</td>
<td>81</td>
<td>87</td>
<td>85</td>
<td>86</td>
<td>88</td>
<td>34</td>
</tr>
<tr>
<td>Stone, Lisa</td>
<td></td>
<td>89</td>
<td>87</td>
<td>88</td>
<td>86</td>
<td>87</td>
<td>90</td>
<td>35</td>
</tr>
<tr>
<td>Tyler, Lawrence</td>
<td></td>
<td>81</td>
<td>76</td>
<td>85</td>
<td>84</td>
<td>85</td>
<td>80</td>
<td>31</td>
</tr>
<tr>
<td>White, Jacob</td>
<td></td>
<td>86</td>
<td>89</td>
<td>90</td>
<td>88</td>
<td>89</td>
<td>88</td>
<td>30</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>83</td>
<td>83</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>33</td>
</tr>
</tbody>
</table>

#### Key Indicators of Successful Math Practice
- Average Percent Correct on Practice
- Average Percent Correct on Review
- Average Number of Objectives Mastered Per Week (4)

#### Brandon
Brandon may be having problems retaining previously learned concepts. Goal is 80%.

#### Susan
Susan seems to be struggling with new concepts. Goal is 75%.

#### Group Summary

<table>
<thead>
<tr>
<th>Diagnostic Code Summary</th>
<th>Number of Students</th>
<th>% of Students</th>
<th>Diagnostic Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>17</td>
<td>Teacher intervention needed (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Practice percentage lower than 80% (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Teacher intervention needed (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>Regular Test score lower than 80% (7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Students At Risk: 2 of 12 (17%)

<table>
<thead>
<tr>
<th>Objectives Mastered</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Tests</td>
<td>223</td>
</tr>
<tr>
<td>Diagnostic Tests</td>
<td>95</td>
</tr>
<tr>
<td>All Tests</td>
<td>318</td>
</tr>
</tbody>
</table>

#### Brandon’s Progress
- Average Number Per Week: 4.0
- Regular Test: 27
- Diagnostic Test: 5
- Total Tests: 32
- Average Objective Level: 4.5

#### Susan’s Progress
- Average Number Per Week: 3.3
- Regular Test: 19
- Diagnostic Test: 7
- Total Tests: 26
- Average Objective Level: 4.3
References


Acknowledgments

Renaissance Learning sincerely thanks the following individuals for sharing their expertise in consultation on our mathematics tools.

**Sybilla Beckmann, Ph.D.** is a professor of mathematics at the University of Georgia. She is especially interested in helping college faculty learn to teach mathematics content courses for elementary and middle grades teachers and has developed three courses for prospective elementary school teachers at the University of Georgia. She has written a book for such courses, *Mathematics for Elementary Teachers*, published by Addison-Wesley, now in a second edition. Beckmann was a member of the writing team for the NCTM's *Curriculum Focal Points for Prekindergarten Through Grade 8 Mathematics* and has worked on the development of several state mathematics standards.

**Richard Bisk, Ph.D.** is chair and professor of mathematics at Worcester State College in Massachusetts, where he teaches mathematical modeling, linear algebra, number theory, and mathematics for elementary teachers. He has worked with K–12 teachers and students for 15 years and has taught and developed numerous professional development courses that focus on improving teacher understanding of mathematics, including the Singapore Math Project, which was developed in conjunction with the Massachusetts Department of Education. Bisk also presented testimony before the National Math Panel in September 2006 regarding the need to improve preservice elementary teacher knowledge of the mathematics they teach. And he assisted in the development of Massachusetts’s new guidelines for the mathematical preparation of elementary teachers.

**Thomas P. Hogan, Ph.D.** is a professor of psychology and a Distinguished University Fellow at the University of Scranton. He has more than 40 years of experience conducting reviews of mathematics curricular content, principally in connection with the preparation of a wide variety of educational tests, including the Stanford Diagnostic Mathematics Test, Stanford Modern Mathematics Test, and the Metropolitan Achievement Test. Hogan has published articles in the *Journal for Research in Mathematics Education* and *Mathematical Thinking and Learning*, and has authored two textbooks and more than 100 scholarly publications in the areas of measurement and evaluation. He has also served as consultant to a wide variety of school systems, states, and other organizations on matters of educational assessment, program evaluation, and research design.

**R. James Milgram, Ph.D.** is a professor of mathematics at Stanford University. His work in mathematics education includes consulting with several states on math standards, including California. Milgram has given lectures around the world and is a member of numerous boards and committees, including the National Board of Education Sciences, created by the Education Sciences Reform Act of 2002 “to advise and consult with the Director of the Institute of Education Sciences (IES) on agency policies,” and the Human Capital Committee of the NASA Advisory Council, which “provides the NASA Administrator with counsel and advice on programs and issues of importance to the Agency.” Milgram is author of “An Evaluation of CMP,” “A Preliminary Analysis of SAT-I Mathematics Data for IMP Schools in California,” and “Outcomes Analysis for Core Plus Students at Andover High School: One Year Later.” Each of these papers identifies serious shortcomings in popular mathematics programs.
Sharif M. Shakrani, Ph.D., is co-director of the Education Policy Center at Michigan State University and a professor of measurement and quantitative methods in the Department of Counseling, Educational Psychology and Special Education. Before coming to Michigan State University, Dr. Shakrani served 8 years as the deputy executive director of the National Assessment Governing Board in the U.S. Department of Education. He was responsible for technical and policy direction for the National Assessment of Educational Programs (NAEP). He has also worked for the National Center for Education Statistics in the U.S. Department of Education where he guided the design and analysis of federal educational assessments. In his work in the Michigan Department of Education, Dr. Shakrani was responsible for K–12 general curriculum and assessment and was instrumental in revising the Michigan Educational Assessment Program (MEAP).

Amanda M. VanDerHeyden, Ph.D., is a private consultant and researcher, living in Fairhope, Alabama, who has previously held faculty positions and has worked as a researcher, consultant, and national trainer in a number of school districts. In 2006, Dr. VanDerHeyden was named to a National Center for Learning Disabilities advisory panel to provide guidance related to RTI and the diagnosis of specific learning disability. She is associate editor of Assessment for Effective Intervention, serves on the editorial boards of several journals including School Psychology Quarterly and Journal of School Psychology, and has recently co-authored Essentials of Response to Intervention (with Dr. Matthew Burns). Dr. VanDerHeyden received the 2006 Lightner Witmer Early Career Contributions Award from the APA for her scholarship on early intervention, RTI, and models of data-based decision making. She serves as research advisor to iSTEEP, has published measures of early numeracy for preschool and kindergarten children, and currently directs research projects in early numeracy with preschool/kindergarten children as well as evaluation of Tier 2 mathematics intervention.
Acknowledgements

Renaissance Learning sincerely thanks the following individuals for sharing their expertise in consultation on our mathematics tools. (To learn more, please see the detailed Acknowledgements section inside.)

Sybilla Beckmann, Ph.D., is a professor of mathematics at the University of Georgia.

Richard Bisk, Ph.D., is chair and professor of mathematics at Worcester State College in Massachusetts.

Thomas P. Hogan, Ph.D., is a professor of psychology and a Distinguished University Fellow at the University of Scranton.

R. James Milgram, Ph.D., is a professor of mathematics at Stanford University.

Sharif M. Shkrani, Ph.D., is co-director of the Education Policy Center at Michigan State University and a professor of measurement and quantitative methods in the Department of Counseling, Educational Psychology and Special Education.

Amanda M. VanDerHeyden, Ph.D., is a private consultant and researcher living in Fairhope, Alabama.