CurrTech Integrations

Tiered Instruction and Assessments

Numbers and Operations
Patterns, Functions and Algebra
Geometry
Measurement
Data Analysis
Probability

Axiom 1 – "The primary goal of quality curriculum design is to develop and deepen student understanding" - Carol Ann Tomlinson, Jay McTighe, ASCD 2006

CurrTech Integrations
Philosophy of Mathematics

Project Narrative

CurrTech Integrations philosophy is based on the research of Jay McTighe and Grant Wiggins: Understanding By Design, Renzulli and Reis: Schoolwide Enrichment Model and Jay McTighe and Carolyn Tomlison: Integrating Differentiated Instruction and UbD. The key ideas from the research have been aligned with CurrTech's Differentiated Mathematics Program (CDMP).

These key ideas are:

- Focus the curriculum on the "big ideas" through the use of milestone assessment.
- Include type 1, 2, and 3 Renzulli experiences within the CDMP program design of Enrichments, Performance Tasks and Tiered Instruction and Assessment. The milestone assessments contain at least 3 extended response items that are scored using rubrics.
- Focus on training in the construction and use of tiered instruction and assessments for all learners. The milestone assessments blueprint requires at least three score points on each standard that are written using levels of assessments.
- Based upon the research that learners should be challenged by using items "slightly too difficult" which is the goal of both the milestones and tiered instruction and assessments.
- That daily spiral reviews assures increased retention and access to a broader range of higher level questions.
- That true understanding is demonstrated when learners can do and explain. The extended constructed response items in milestones, enrichments, and tiered instruction and assessments require learners to explanation and apply mathematics concepts.

CurrTech Integrations

Tiered Instruction and Assessments
In a
Standards – Based World

How do we meet the needs of *individual* students within the context of NCLB and *standards-based* education? Consider the following three scenarios and what they imply for curriculum, instruction, and assessment in mathematics in a standards-based world.

#1 *Susan James, a 4th grade teacher goes to her principal to request that three students be moved up to the next grade for mathematics instruction. She explains, "We're starting a new unit on fractions. Some of my kids don't even know their addition facts, while these three students have already completed the fraction chapter on their own. I'm running out of ways to challenge them in my room. I need help!"*

#2 *Thelma Washington is the mother of a bright 8-year old in grade 3 at State Elementary. She has come to school to see her daughter's teacher to request a more challenging math book. Her daughter, Shana, gets A's on every math test and is bored. The teacher says he'll look into it, but doubts that the district will approve a change.*

#3 *The Assistant Superintendent of Instruction attends two meetings during the same day with parents. The first involves a group of middle school parents who have come to the District Office to request a math pull-out program or a "gifted" teacher to prepare their able children for early SAT testing required for entrance into a summer Gifted and Tallented Enrichment program. The second meeting is with a parent of a student with diagnosed learning difficulties who demands that his daughter be placed in the regular math program rather than working with the resources teacher (which the school recommends).*

These familiar scenarios raise significant issues for educators. While teachers of Mathematics have always encountered students with differing levels of mathematical understanding and skill (and the concerns of their parents), the present focus on content standards implies particular kinds of responses. In this introduction, we will review the strengths and weaknesses of current differentiation models and introduce you to a standards-based model for providing differentiation in mathematics.

Key Assumptions

CurrTech Integration's differentiation model (Tiered Instruction and Assessments) is grounded by three key assumptions regarding a standards-based mathematics program.

Assumption #1 - Content standards and benchmarks should guide instruction and assessment in mathematics.

Content standards and benchmarks define what students should come to know and be able to do in mathematics. Ideally, standards and benchmarks provide the structure for a coherent mathematic program. However, in reality, we have found that some standards documents are presented in a form that complicates their use. Whether working from state or district-level documents, standards can cause problems for teachers if they are too broadly or vaguely stated. The following example illustrates this problem.

Students will solve "real world" problems using mathematics.

Standards such as this one fail to specify what should be taught as well as how it should be assessed. In cases such as this, there is a need to "unpack" standards and benchmarks to more sharply define what students should know and be able to do, and to identify acceptable evidence of meeting the standard. For example, the second grade benchmark below clarifies the standard in terms of content (addition and subtraction) and process (using appropriate operation in the context of problem solving).

STANDARD – Students will solve a real world problem by choosing an appropriate operation and justifying the use of addition or subtraction.

In standards-based education, the "rubber meets the road" with the assessment. We have found that the most effective way to operationalize a content standard is in terms of the type of assessment evidence needed to show that students have met it. In this case, the assessment task asks students to use basic operations in the context of solving a "real world" problem.
A second problem with standards occurs when they are too narrow. An example of a narrow standard is presented below:

Students will find the mean, median, and mode. (Level I, II)

When standards and benchmarks are defined this narrowly, they can encourage teaching mathematics as a set of discrete facts and skills and assessing mathematical knowledge through decontextualized test "items". Such narrowly defined standards and benchmarks need to be clustered to support more meaningful learning experiences and more "authentic" assessments. For example, the following seventh grade benchmark identifies a larger purpose for statistics, while the companion assessment makes it clear that students are expected to apply and explain (not simply define and calculate).

Grade 7 – The student will use measures of central tendency (mean, median, mode, range, and standard deviation) to describe and interpret a set of data.

Grade 7 – Assessment – Level IV

Mary really wants to earn and “A” in English for the marking period. After 4 tests her average in English is 88%, and there is one more test before the marking period ends. If Mary’s teacher decides to base the average grade on the median rather than the mean, how will that affect Mary’s ability to achieve an “A” (90%) for the quarter? Develop a set of grades for Mary’s situation and explain the effect of changing Mary’s grade based on the median as opposed to the mean. Show your work and explain your reasoning.

Assumption #2 - A fundamental goal of differentiated instruction is to develop and deepen students’ understanding of the core mathematical concepts and processes contained in content standards. (NCTM 2000)

Analysis of student achievement in mathematics from the National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS) reveal that relatively few students demonstrate a deep understanding of core mathematical ideas and processes.

A classic illustration of this problem occurred on a NAEP assessment. The following test question was presented to eighth grade students:

> "How many buses does the army need to transport 1,128 soldiers if each bus holds 36 soldiers?" Nearly one third of the 8th graders responded with, "31, remainder 12."

While the students who selected this answer presumably know their math facts as well as the division algorithm, their application of this knowledge was inappropriate. In fact, one could question whether they really understand division, given the response. What is revealed instead is a mindless "plug-in" of the numbers, without consideration of the requirements of the situation.

The response to the NAEP bus problem raises a fundamental question for all mathematics standards – what would we accept as evidence that students truly understand the key mathematical ideas, not just the math facts contained in the standards? Howard Gardner addresses this question in his book, The Unschooled Mind, “The test of understanding involves neither repetition of information learned nor the performance of practices mastered. Rather it involves the appropriate application of concepts and principles to question or problems that are newly posed.” (Gardner, 1991). Similarly, Wiggins and McTighe (1998) underscore the importance of anchoring assessment tasks in novel contexts in order to determine genuine understanding. (Level IV or V)

Assumption #3 - On-going mathematics assessments are needed to reveal the degree of student knowledge and understanding in order to guide instruction.

A fundamental principle of sound assessment applies in this regard. In order to make valid inferences about student learning, multiple sources of assessment data are needed. A single score from an annual standardized test is insufficient to provide the necessary evidence that students understand and have mastered the knowledge and skills called for by the standards.

Instead of relying on "one-shot" testing, more robust assessment evidence, collected over time, is needed to inform instruction. The use of multiple formats (such as focused observation, selected response (Level I, II), constructed response (Level II, III), "authentic" performance tasks (Level V), and portfolio collection(s) enables us to better gauge the level of student skill and understanding to determine what instruction and differentiation is needed to improve student performance.

CurrTech Integrations believes that on-going assessments should be viewed as a continuum, including *diagnostic* (to check student readiness and identify misconceptions), *formative* (to inform teaching and learning along the way) and *summative* (to evaluate achievement at the conclusion of a learning segment). Through the use of on-going assessments, teachers are able to determine the *need* for differentiation based on a diagnosis of student skill levels. In addition, the results of on-going assessments inform the *nature* of the instruction needed to move students to deeper levels of understanding.

What are some current models used in mathematics differentiation?

Three approaches to differentiation – acceleration, enrichment, and remediation – are commonly seen in mathematics classrooms to accommodate different achievement levels and learning rates. Each approach has strengths and limitations.

Acceleration

Given the sequential nature of mathematics curricula, acceleration offers an appropriate means of accommodating students who have mastered the basics and quickly learn new material. Acceleration in mathematics is typically accomplished through regrouping (within and across classrooms) or via individually paced programs where students work independently through a sequenced text, a self pacing program on a computer or set of materials at a faster rate than students of the same age.

While a viable option for addressing the needs of more advanced students, acceleration poses two potential problems. The first is a practical matter. Students who move ahead more rapidly through the mathematics curriculum may “hit the ceiling”, especially at the transition schooling levels. For example, without careful coordination across the grades, an accelerated fifth grader who has completed the sixth grade math book may discover that the middle school schedule cannot accommodate his or her continued progress. Likewise, accelerated high school students may complete all of the available mathematics courses by their junior year.

A second potential problem with acceleration is rooted in the use of a textbook series as the primary resource. If differentiation equates to marching through textbooks at a more rapid rate, there is a very real danger that advanced students will merely “cover” more topics, rather than developing a *deeper understanding* of core mathematical ideas and processes. Given the characterization of current mathematics textbooks as providing “a mile wide, inch deep” treatment of mathematics, acceleration may, in fact, contribute to the problem of “skimming the surface” learning.

Enrichment

Enrichment offers an alternative approach to differentiation for mathematically advanced students. Students involved in enrichment groups, typically explore topics or conduct mathematical investigations **outside** of the regular mathematics curriculum. (Students are sometimes given choices among enrichment activities.) Here are two examples of enrichment activities: a group of "gifted" fourth graders explore tessellations; three high school students conduct statistical analysis on stock-market trends.

Mathematical enrichments are often challenging for able learners. However, in a standards-based context, such activities are often **disconnected** from the content specified in the standards and benchmarks. At its worst, mathematics enrichment translates into a random potpourri of commercially packaged enrichment materials and kits employed to mollify the faster learners and their concerned parents. Although well intentioned, such efforts rarely contribute to a deepening understanding of the key mathematical ideas within a coherent framework of standards.

CurrTech Enrichments are standards - based and connect to grade level/course standards through an appropriate rigorous and challenging program of study that moves students from where they are to higher levels of performance. The items are designed to increase the students understanding of standards.

A. All enrichments are designed to provide evidence of understanding the standards and benchmarks in each strand of mathematics. Enrichments focus on essential and enduring understandings in each identified mathematical strand.

B. Enrichments provide questions that require problem solving, application of strategies and require students to connect concepts and processes.

C. Problems may include more than one solution and/or have more than one best right answer. This helps students to move beyond the lower level problems often featured in mathematics drills.

D. Enrichments require that students show their work and/or explain their solutions; students are automatically reflecting on their work at a metacognitive level and are building their mathematics communication skills.

E. Mathematics enrichments include solutions and required scoring tools that identify the characteristics of the acceptable range of responses.

F. Mathematics enrichments are organized by major mathematical strands because they frequently assess two or more standards or benchmarks in a single question.

G. Enrichments ask students to apply their mathematical knowledge to academic and real life situations.

H. Using scoring tools assures that students have provided appropriate evidence of understanding and of mathematical processes.

Remediation

Remediation provides a second chance to students who have not been successful in learning the proscribed content in the time allowed. Students receive additional instruction and another chance to show evidence of achievement. Remediation is provided in a wide range of forms and formats from subgroups within the classroom to pullouts during and outside of the regular school day. Although remediation may employ alternative methods of instruction based on learning styles, student interests, or grouping strategies**,** it most often relies on reteaching using a “drill and practice” approach.

Despite its benefits, remediation has disadvantages. The remedial emphasis of practicing low-level, decontextualized skills may prevent lower achieving students from recognizing the more meaningful application of mathematics. When students are separated from the rest of the class in pullout groups, they are denied access to the reasoning that occurs when other students tackle more challenging problems and explain their strategies. Finally, the reliance on repeated practice may reinforce the erroneous belief that students can not be involved in “real world” problem solving until they master all of the basic facts and skills.

The shortcomings of the current approaches highlight the need for a differentiation model that meets the needs of all learners in the context of standards-based education. The following section examines CurrTech CDMP standards-based design to accommodate learners at different levels of understanding.

When does learning occur?

- Learning happens when a task is a little to difficult for a learner and scaffolding is provided to help students span the difficulty.
- Learning occurs through a progression of appropriately scaffolded tasks at degrees of difficulty just beyond a particular students’ reach.
- Motivation to learn is decreased when tasks are consistently too difficult or too easy for a learner (Csikszentmihalyi, Rathunde, & Whalen, 1993; Howard, 1994; Jensen, 1998; National Research Council, 2000; Vygotsky, 1962, 1978).
- In a five year longitudinal study of adolescents, students whose skills were under challenged by tasks demonstrated low involvement in learning activities and lessening of concentration. Students whose skills were inadequate for the level of challenge required by tasks demonstrated both low achievement and diminished sense of self-worth. The researchers concluded that teachers who were effective in developing student talent created tasks commensurate with student skills (Csikszentmihalyi et al., 1993).

What are Tiered Instruction and Assessments?

The differentiated model presented in this introduction is based on a continuum of problem types, with each level requiring a greater degree of understanding of the same mathematical idea or process. The model, based on five "tiered levels," extends the works of Cooney (1992), Romberg (1986), and Mills (1998) on leveled assessments in mathematics.

Research suggests that most teachers believe it is desirable to attend to learner variance as they teach. This is the case across grades and subjects and among teachers of all experiential levels. Research also suggests to us that few teachers in fact translate that ideal into classroom practice.

Three key features distinguish the CDMP tiered model of differentiation. It provides:

1. **For standards-referenced differentiation** – The key mathematical ideas and skills contained in the **same** standards and benchmarks form the basis for differentiation. The five levels provide increasing challenge based on the complexity and novelty of the problem context. As students progress along the continuum, deeper levels of mathematical understanding are required. Thus, the use of tiered levels guide's differentiation of instruction and assessment toward deeper levels of understanding of the key mathematical ideas and processes contained in the content standards.

What is Understanding?

- Understanding is demonstrated when learners can both explain and apply (Level III – V).

- Both drills and authentic application are necessary in the field and classroom. Students need to master the basics, and skill drills support that need. But, learners also need a chance to use their knowledge and skills, in other words, to "do" the subject (Level III – V).

- When students can apply knowledge and skill appropriately to a new situation and can effectively explain how and why, we have the evidence to "convict" them of understanding.

Focus on student's understanding and application of knowledge.

- Knowledge learned at the level of rote memory rarely transfers (Level I & II).

- Learning with understanding is more likely to promote transfer than simply memorizing information from a text or lecture. (Level III – V)

- Experts seek to develop an understanding of problems which often includes thinking in terms of core concepts or big ideas (Level III – V)

2. **A framework for on-going assessment** – Any robust approach to differentiation must be informed by a diagnosis of current levels of knowledge and skills. Therefore, on-going assessments are required to identify skill gaps and misconceptions, and guide appropriate instruction toward deeper levels of understanding. On-going assessments also enable teachers to determine when students are ready for more challenging experiences. CDMP continuum provides teachers with the on-going assessments for each standard and benchmark.

3. **For multiple entry points** – CDMP differentiation model accommodates learners at a variety of skill levels. The model addresses Tomlinson's call for, "… a way of thinking about teaching and learning that advocates beginning where individuals are rather than with a prescribed plan of action, which ignores students readiness...." (Tomlinson, 1999). The CDMP continuum of problems allows students to enter according to their level of knowledge and skill. For example, in levels one and two, the problems are highly scaffold to support students in learning to apply basic ideas in a structured context. Levels four and five present more advanced students with greater challenges requiring deeper levels of understanding of core mathematical ideas and processes (rather than simply moving them along faster or to unrelated topics).

Studies of Student Achievement

Newmann, Bryk and Nagoka (2001) investigated 24 restructured schools at the elementary, middle, and high school levels to study the effects of authentic pedagogy and assessment approaches in mathematics.

- Students with high levels of authentic pedagogy and assessment were helped substantially whether they were high or low achieving students.

- Another significant finding was that the inequalities between high and low performing students were greatly decreased when normally low performing students were taught and assessed using these strategies.

How can I use CurrTech Integrations Tiered Instruction and Assessments?

A "unit test" or "milestone" provides teachers with evidence to help answer these important questions:

- Did the students learn it?
- To what extent does the student understand?
- How might I adjust my teaching to be more effective for learners with varying needs?

Teachers often ask these most important questions:

- What do I do now to help those students who do not understand specific benchmarks?
- What do I do now to challenge those students who have demonstrated excellent understanding of specific benchmarks?
- What do I do now with those students whose performance is okay but their understanding of specific benchmarks is not deep enough?

CDMP differentiation program is designed to help teachers accommodate learners at a variety of skill levels. CDMP program is designed to take students from where they are (readiness) to where they need to be. The CDMP continuum of problems is organized by content standards and by benchmarks within each content standard. Level one and two problems are highly scaffold to support understanding of basic ideas related to the benchmark. Level III asks learners to show their work and explain a process or procedure. While Level IV challenges students to apply the benchmark(s) used in an academic prompt. Level V (performance tasks) challenges students to apply concepts and benchmarks in an authentic application.

These levels provide teachers an opportunity to focus the entire class on a benchmark while breaking the class into learning groups based on where they are. Teachers using CDMP programs are able to pull the class back together at the end of class for a ticket-out on the benchmark for today or for a summary class discussion on today's benchmark.

Recommendations on how to begin:

- Teachers usually work with the group that is at level I or II.
- Teachers usually assign groups to a level III type problem before increasing the level of difficulty.
- Teachers use level IV problems often with students who have demonstrated excellent understanding of concepts/benchmarks.
- Teachers use level V authentic tasks with the whole group, usually four tasks each year.