

CurrTech Integrations

Philosophy of Mathematics

Project Narrative

CurrTech Integrations philosophy program 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 score using rubrics.
- Focus on training in the construction and use of tiered instruction and assessment for all learners. The milestone assessments blueprint requires at least three score points on each standard that are written using level assessments model.
- The goal of both the milestones and the higher level questions in instruction is based upon the research that learners should be challenged by using items “slightly too difficult”.
- The identifying and mapping of items into daily spiral reviews and milestones assures increased retention and increased access to a broader range of higher level questions.
- True understanding is demonstrated when learners can do and explain. The extended constructed response items in all milestones, enrichments, tiered instruction and assessment require explanation and application of concepts.

Educators have struggled to meet the needs of all students in the mathematics classroom. Educators have tried several models of instruction based on students who complete a unit and still couldn't perform and by students who were ready to move on.

These models include:

- Acceleration- students move on to the next content area or grade level/course.
- Cooperative learning- students work as teams often relying on those that are able to teach those who are less able.
- Drill and practice- students who complete their work are given more work at the same level.

Although each model offers some benefits, none of these models change the level of expectation to challenge talented students at a level that extends their development. Current designs have resulted in a description that America's Mathematics curriculum is, "A mile wide and an inch deep". (TIMMS) ***The goal of Mathematics Enrichments is to provide academically talented students with an appropriately rigorous and challenging program of study that moves students from where they are to higher levels of performance.*** Challenging assessments that demand application of essential understandings are now within the reach of able learners as a regular component of the educator's instructional program.

To educators:

The following list of questions and answers are provided to support your implementation of these materials.

1. What makes CurrTech Integrations Enrichments in Mathematics uniquely valuable to my students?

Mathematics enrichments are designed by using a checklist that includes the following elements in the design of the enrichment questions:

- 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, but they frequently assess two or more standards or benchmarks in a single problem.
- G. Enrichments ask students to apply their mathematical knowledge to academic and real life situations.
- H. Using scoring tools assures that the students have provided evidence of understanding and are able to use their mathematical knowledge.

2. How can I use the CurrTech Integrations Enrichments in Mathematics in my classroom?

Instructionally, mathematics enrichments help teachers provide opportunities for students to extend, refine and use their knowledge in each content area of mathematics.

Mathematics enrichments offer teachers several models for use in the classroom. It is important that any model chosen must support “**regular practice**” over the course of the year. Students need the benefit of practice over time to internalize the full range of problem solving strategies and thinking skills that will be mastered in working with the **CTI Enrichments**.

The enrichment problems may be used in the following formats:

- A. **One-A-Day-** in this model teachers provide students daily practice in applying mathematics strategies to challenging questions. In this model the enrichments work as formative activities to help students work through more challenging problems in a **whole class, small group or individual setting**. This model places problems before students that include regular practice in problem solving, communication, representation and all aspects of mathematics. Excited by the challenge of more difficult problems, students gain experience and skill in covering personal pathways to support a range of possible solutions. In this design problems may focus on mathematics that may or may not be related to today’s lesson. The teacher selects problems that fit with the time available and extends concepts previously introduced.

- B. Once-A-Week Clusters**– in this model teacher’s clusters the problems for the week to form a focused look at challenge problems. This model offers students the chance to develop and refine their problem solving strategies in a controlled practice that may be used as either a formative (chance to teach and learn) or a summative (to see if students can use and extend what they know) assessment of student skills. Teachers using this model will select from mathematical content cluster topics that have been taught earlier or are currently under study. The weekly clusters enable teachers to raise the expectations for academically talented learners by focusing them on a targeted opportunity to practice problem solving. Students in this model learn strategies and reapply them to build clear solution pathways. A cluster approach gives teachers a chance to compare/contrast problems and to discuss strategies that can be applied to solve a variety of problems. Students become metacognitive problem solvers who can use a variety of strategies to think through to an effective solution.
- C. Integrated Use** – in this model the teacher would, after experience with the enrichments, select and integrate selected enrichments to focus on skills being developed in the regular instructional program. Although this may seem a logical first use, it is advised that this model will require a careful curriculum match between the local instructional sequence and the specific content focus of the enrichments. Therefore, it is recommended that you start with Models A or B in your first year of implementation. As you and your students continue to gain understanding of the characteristics of the problems, you may start to integrate enrichment problems into daily lessons. The benefit of this design is that it offers academically challenged students alternatives to drill and practice on low level problems. Another related product by CurrTech Integrations is their Grade Level Bank of Tiered Instruction and Assessment. These banks of items per grade are designed to include tiered assessments of instruction that build student’s understanding from the basic algorithmic level to independent performance on multi-tasked performance assessments.

3. How is the material formatted and how does it support my use?

Associated with one of the five major strands of mathematics, each Enrichment is numbered. The responses and the scoring tool designation appear on a separate sheet by number. These items may be reproduced for use in your room in a variety of ways. By copying the items onto paper or card stock, you may use them individually or as small sets- Model A, B or C provide regular practice in the kinds of problem solving, representation, reasoning and communication skills that are common in state and national assessments but are often unavailable in textbooks. Enrichments are available in digital format which allows teachers to use items with the latest technology.

Math Enrichments are organized around 5 strands of mathematics for all grades. Similar to the organization found in the NCTM 2000 standards, Math Enrichments encompass the 5 major content areas and the 5 process standards (problem solving, communication, reasoning, connections and representations). Teachers have frequently had difficulty identifying problems that focus on the process standards in textbooks and support materials.

Major Content Strands

- 1) Number and Operation
- 2) Geometry and Measurement
- 3) Statistics
- 4) Probability
- 5) Patterns, Functions and Algebra

4. Where are the scoring tools and how do they operate in the program?

The scoring tools are in the appendix at the back of your enrichment book. These tools are generic and may be reproduced for repeated use by students in your room. Each enrichment task recommends a specific tool that supports that item. The scoring tools are a required element in evaluating student performance. Students should be familiar with the expectations built into the tools. These tools are similar to generic scoring tools that are used to evaluate performance in many state and local assessments.

The role of scoring tools is to clarify expectations early on in the instructional process and to enable the teachers and students to know if those expectations have been met in the final evaluation of the student work. Clear targets improve students' ability to perform and to discuss their progress toward the target.

5. How can I use CurrTech Integrations Enrichments which include rubrics?

A rubric is a scoring guide for evaluation of student work that includes specific performance criteria in a continuum of leveled description from low to high. CurrTech Integrations scoring guides clarify specific performance expectations and provide goals for student achievement. As rubrics define what performance students should do to demonstrate mastery of the mathematics standards, students learn the criteria for achievement levels through their use. Rubrics help learners to look at themselves in positive ways while continuing to take steps toward improving performance. Each student is provided feedback on his/her performance in a developmental continuum.

In the continual improvement model, teachers need to supply quality feedback about what students are learning, what they can do to improve and whether their mastery level is in line with expectations. Rubrics are tools to achieve this end. Teachers can determine mathematical error patterns and student strengths and specific next steps in the continuum of improvement of skills and processes. With practice, students are eventually able to self-assess what is required to move from their present scoring level to his/her performance. Rubrics are a fantastic way to develop mathematical metacognitions.

6. What rubrics are used to score student performance?

The CurrTech Integrations rubrics are written in appropriate language for instruction in intermediate grades, middle school, or high school. They are not written at specific grade level/course so that district educators can adapt and select the rubric that best fits their students. CurrTech Integrations rubrics are written for the purpose of increasing students' problem solving abilities in three skill areas: **problem solving, communication, reasoning and representation.**

Problem Solving is what a student does when there is not a clear path to a solution. Problem solving requires choosing a strategy to reach a conclusion/solution.

Communication is the part of problem solving where a student is required to explain “how” they solve a problem using the language of mathematics. **Reasoning** is the area of explaining and defending “why” a student chooses to solve a problem using a selected strategy. **Representation** is the area of correctly “showing one’s work.” This last area might include creating and using graphs, models and drawings.

To develop these areas CurrTech Integrations uses two types of rubrics: **analytic and holistic**. Analytic rubrics include discrete criteria and specific traits. There is a score for each trait. Analytic rubrics lend themselves to formative evaluations of student development. The holistic rubrics include clusters of descriptors for a concluding or cumulative performance for a summative evaluation.

In the **analytic** rubric there are separate and discrete descriptive criteria for a development area, such as communication. Specific characteristics to be evaluated are in separate columns with a range of score points. The four levels represent a range of performances from strongest to weakest. Separating the descriptors allows the teacher or student to look at the individual characteristics to be evaluated. The responses are viewed in a part-to-whole relationship, hence the term, “analytic.” The teacher and student must select the relevant score point that best matches the characteristic of the response. The benefits of this format are that it permits an evaluation of each characteristic of the response and asks the evaluator to analyze the response for strengths and weaknesses. This type of rubric is best suited to an analysis of the student’s work. As each component is considered separately, the analytic rubric format lends itself to formative evaluations of student work that can be used to guide the student to improve specific aspects of his or her work.

The **holistic** rubric clusters descriptive criteria for one development area, such as communication, around a range of score points, four through one, representing a range of performances from strongest to weakest. Clustering the descriptors enables the user to look at a response as a whole, hence the term holistic.

The teacher or student using this rubric must select the score point that **completely** matches the overall response. All criteria of a given score point must be met to earn that score point. This allows the evaluator to look at the total or integrated response.

This type of rubric is best suited to offering a single score response to a student's work. As all criteria are considered as a group, this formative lends itself to a summative assessment of student work on a given task.

7. Recommended Sequence for Introducing Rubrics to Students

When solving a problem, students' responses need to include communication of "how" a problem was solved, "why" a specific strategy was selected and representation that supports the conclusion. This Enrichment Module includes rubrics or tools to assist students in creating responses to an open-ended problem that includes communication, reasoning, and representation.

Analytic rubrics are generally considered to be the easiest of rubrics for students to use. Teachers are reminded to introduce the rubrics with caution and to teach students how to use these tools. These tools are usually used to diagnose student errors in solving problems and are formative in design. If students struggle with all aspects of solving open-ended problems then it is recommended that they be instructed in the separate components of a response, beginning with the communication rubric. If students are adept at communicating and representing their responses, but struggle with reasoning, then it is appropriate to use the reasoning rubric to diagnose their error patterns and instruct them on the criteria necessary to successfully explain "why" they chose a specific strategy.

When students are comfortable with the analytic rubrics or if they have had experience in the use of rubrics it is then appropriate to use the holistic form. When students are comfortable with the criteria that are specified in levels three and four of the analytic rubric it is time to assess them holistically on their responses. The holistic rubrics are used when working on responses to communicate, reason, and to represent answers. These tools are designed as summative tools to assess the total student response. They are generally more difficult to use and hold student responses to a higher level.

Students must meet all the descriptive criteria of the response point in order to earn the score at that level. If students score lower levels of the rubric (one or two) the teacher may use the analytic form of the rubric to diagnose the error pattern and assist them in refining their skills.

8. General Guidelines to Introduce Students to Rubrics

1. Introduce the concept of rubrics to students emphasizing that rubrics provide a guide of what is expected in a problem solving response. Use an analogy to help explain how rubrics are used. Explain the rationale of how the rubrics can be used as a target for continual improvement, and that they can serve as a checklist to proof student work.
2. Using the overhead master of a rubric, present the rubric, reading each item aloud and underlining key vocabulary words. Discuss vocabulary words in each line making sure students understand their meanings.
3. Explain the differences between each level on the rubric. Emphasize the use of words such as, “all, most, some, few or none” or “completely, mostly and partly” and their relationship to a 4, 3, 2, 1 score.
4. Present a practice problem and brainstorm together how to solve it. Once students have chosen a solution, work through it with them emphasizing the use of the scoring guide to help write the solution. Check the student work and guide the responses. Place key mathematical terms on the board and tell students to use them in their written explanations.
5. Present another practice problem and have students read their responses listing all the math terms they use. Create a list of reminders of what to do based on the discussions of the student responses. Create a list of problem solving procedures from this discussion. An example follows:
 - Read the problem and decide how to solve it.
 - Read the problem a second time rethinking the solution and what will be needed to solve it.
 - Organize what needs to be done using the rubric as a checklist.
 - Solve the problem.
 - Use the rubric to check the response.

6. Have the students score their own responses using the rubric. Have students discuss how they could improve their response or score.
7. Present several more practice problems having students work in cooperative groups using the rubric to guide their answers. Using the rubric, have the groups exchange papers to score another group's work. Discuss the rationale for their scores.
8. Utilize student papers from the anchor sets to illustrate the differences between a 4, 3, 2, or 1 score.
9. Have students individually solve a problem using the rubric. Give each student feedback on their answer using the rubric. Guide students in what their next steps should be to improve their scores.
10. Continue to practice solving open-ended problems using rubrics. Encourage students to improve; they will increase their skills with practice.

Scoring Tools:

Problem Solving in Mathematics Holistic Rubric*

Problem Solving in Mathematics Analytic Rubric**

Communication in Mathematics Holistic Rubric*

Communication in Mathematics Analytic Rubric**

Representation in Mathematics Holistic Rubric*

Representation in Mathematics Analytic Rubric**

Reasoning in Mathematics Holistic Rubric*

* Although an exemplary response may suggest the use of a holistic tool which focuses on the student's response as an integrated whole, you may substitute other scoring tools to refocus students on other aspects of their response.

** The analytic tools provide feed back on each trait on a continuum of performance.

9. Where can I find a set of definitions for key mathematical terms?

In the appendix you will find a simple list of terms and definitions that can be used to support mathematical instruction or assessment.