# Understanding in Junior High Math: Can a Change in How We Assess Make a Difference?

*by Fonda Vadnais*

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## Abstract

Conceptual understanding in mathematics at the middle grades is lacking in many Alberta students. Research suggests that by making connections with previous learning and using repeated formative assessment with descriptive feedback, teachers may be able to positively impact conceptual understanding. This paper examines one school's journey over three years, specific to ways that teachers changed the way they assessed, how they used formative assessment, and how they reported student achievement in junior high math. Grade 9 Provincial Achievement Tests results were compared over the first two years of implementation of the new Alberta math curriculum, the first year with previous, more traditional assessment practices, and the second year after initiating the change in assessment practices. A target group was followed over a four year period as well, tracking year end performances on grade 6 and 9 Provincial Achievement Tests and grade 7 and 8 divisionally developed final exams.

## Introduction

A math assessment project was designed by a group of teachers across a school division, allowing for each site to implement the plan in ways that would accommodate their unique context of teaching staff, administrative decisions and community support. This is an account of the journey taken by one school with a population of approximately 300 grades 7 through 12 students. The focus of the project implementation and data collection was grades 7 to 9 taught by two full time math teachers.

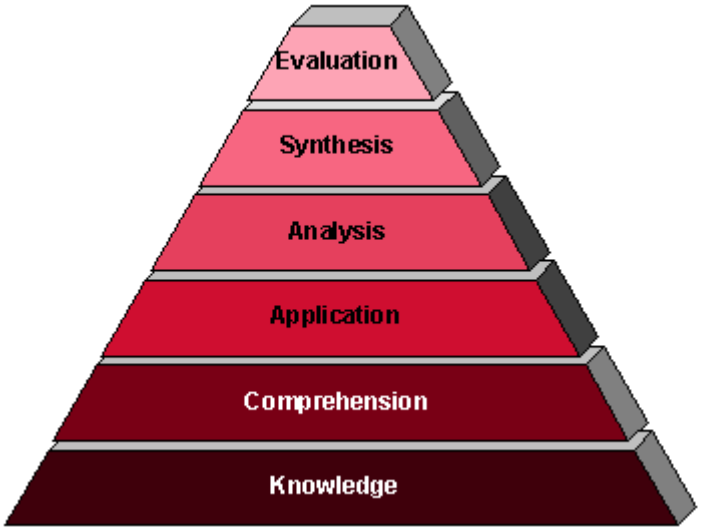
### *The Plan*

In order to look differently at the math curriculum, teachers first developed a long-range plan that did not rely on the chronology of a textbook or curriculum document. Rather, the plan grouped outcomes with conceptual connections to allow for logical sequential growth. Weekly assessments were introduced and performance tasks assessing multiple outcomes were designed.

'Flex weeks' were scheduled to allow students to catch up or get back on track if they were falling behind; these flexible times also allowed teachers to review or re-teach an outcomes that assessments indicated were particularly difficult for students. Having common classes scheduled at the same time at provided some team teaching opportunities or temporary class reassignment during these weeks. Classes for the two participating math teachers were scheduled at the same time, allowing the opportunity for differentiated instruction by splitting the students into two groups: those who needed to be challenged with some higher end problem solving situations and those who needed to revisit the concept from a different perspective. After

an assessment during this re-assigned time, students would return to their regularly assigned math classes. Students from both groups indicated their appreciation for the chancer to work with other students at the same conceptual level and for the opportunity to challenge their levels of understanding.

**Formative assessments**. Strategies to evaluate student achievement must be designed so that they are fair, just and equitable, motivating, and instil confidence in students' abilities to learn and to succeed. In addition, learning assessments must test a variety of types and levels of skills. Bloom's taxonomy offers a model that divides learning into three domains, one of which is the cognitive domain. This domain further categorizes cognitive levels, progressing from the lowest level of thinking—simple recall—to the highest, evaluating information.

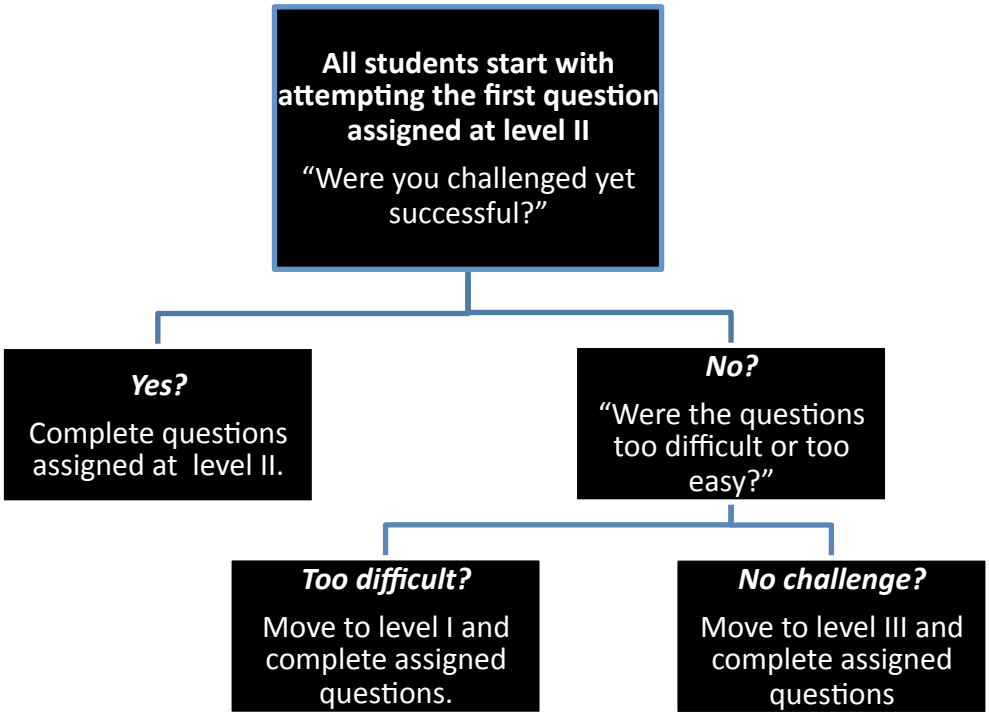



In this AISI project, common formative assessments referred to as *check-ups*, were based on Bloom's three levels of understanding. This ensured that students' achievement of all curricular outcomes demonstrated a continuum of understanding. Type I questions addressed basic details and processes that are relatively easy for most students. Type II questions assessed more complex ideas and processes. Type III questions required students to make inferences or applications that go beyond what was taught in the class, taking the specific outcome to the next grade level or requiring students to combine the knowledge of more than one grade level outcomes to solve a problem (Marzano, 2006).

Another factor linking assessment to student achievement is frequency (Marzano, 2006). However, with the time constraints of a school year, how often can a single outcome be assessed? Marzano's research indicates that the largest increase in percentile point gain, when compared to the number of assessments, was five repeated assessments on any given outcome. Accordingly, three to five versions of check-ups were developed for each outcome; further formative assessments were given in the forms of performance tasks, exit passes, senteo activities and strand exams.

In-class learning tasks also incorporated Bloom's model. Practice questions were denoted as Level I, II, or III to ensure that students were engaged in meaningful work that challenged but did not overwhelm or frustrate them. Students chose, sometimes with guidance,

the level at which they would work; these would change based on a student's understanding of the concept being taught. All students working on levels II or III worked independently, in pairs, or in small groups. All students working at level I sat at a table with a teacher and work at various levels of independence. The following flow chart was provided for the students to determine the level at which they should be working on any given day.




All check-ups incorporated descriptive feedback in the form of a nine point master scale that moved teachers from simple percentage feedback to explanatory comments or probing questions. A mark was given in the form of a proficiency level letter from the mastery scale After each of these formative assessments, students made corrections, tracked their performance, set personal goals and made notes on what to remember for the next time the same outcome was assessed. These personalized tracking sheets provided students a visual representation of their progress, as well as a place to record their own personal learning goals and define their success in terms of their own learning as opposed to a normative comparison.

**Reporting process.** Student achievement was reported in two ways. Monthly progress reports included letters representing performance on the mastery scale. Each specific outcome that had been covered was included on these reports. After four assessments of the same specific outcome, the grading software Pinnacle determined the grade that best reflected a student's learning over time; mean, mode, or learning trend. The software used alternate calculation methods so that a grade was determined for each student based on personal growth.

Four times over the course of the year, student achievement was reported through a school wide report card. Again, the Pinnacle grading software was used to report on the eight general outcomes of the junior high math curriculum; number, patterns, variables and equations, measurement, 3D and 2D shapes, transformations, data analysis, and chance and uncertainty.

Marks from the specific outcomes were averaged to determine the general outcomes, but no overall math mark was reported.

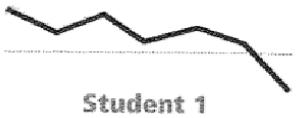
Year-end grades were assigned through a process of negotiation during which the student and teacher used all assessment tools to come to agreement. In this process, students were responsible for providing evidence of their learning. To provide such evidence, they could use their marked final exam, marked strand exams, as well as the full year's tracking sheets and corresponding check-ups.

### *Implementation and Education*

The implementation of the assessment project was sequential and reflected the Ministry math *curriculum* implementation schedule the province. Sharing the rationale that this method of assessment was in the best interest of students provided the opportunity for teachers to reaffirm their beliefs about assessment.

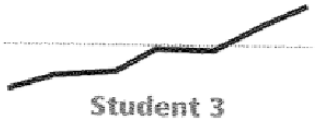
**Educating stakeholders.** Two of the most commonly asked questions from students and parents throughout this assessment project were *Why assess things over and over?* and *Why are marks based on outcomes rather than content?* Anne Davies' (2000) research reinforced our practice of repeated formative assessment. She describes three students who take a course in how to pack a parachute:

Student number one initially scored very high, but his scores dropped as the end of the course approaches. With the class average represented by the horizontal line, the student's grades might look like this.




Student number two demonstrates erratic achievement: sometimes he does very well, sometimes not. The teacher has a hard time predicting from day to day how he will do.


Relative to the rest of the class, student number three did very poorly for the first two-thirds of the course but lately has figured out how to successfully pack a parachute.



We might now reflect on which student we would want packing our parachute: the one with an initial apparent success in the skill? The one with the best average of all attempts at packing your parachute? Or, the one who took longer to perfect the skill, but whose learning trend over time indicated a more skilled parachute packer?

Another question often posed by parents of students in this project was *Why outcome based reporting rather than an overall math mark?* Most parents, when asked what a mark of 75% indicated to them, responded that they assumed it meant that their child was performing at 75% on all the topics or outcomes. When shown the following table, most parents agreed that outcome based reporting really was a better way to communicate math achievement in math.

| Student A | Student B | Student C |
|---|---|---|
| Fractions – 75% | Fractions – 40% | Fractions – 95% |
| Percentages – 75% | Percentages – 85% | Percentages – 40% |
| Decimals – 75% | Decimals – 100% | Decimals – 90% |
| **Report Card Mark - 75%** | **Report Card Mark - 75%** | **Report Card Mark - 75%** |

**Results**

A small group of 16 students participated in this form of assessment for two years. Their baseline data was the grade 6 Provincial Achievement Test and a divisional grade 7 final exam. This target group was assessed in the more traditional method for grades 6 and 7, and with repeated formative assessment and descriptive feedback for grades 8 and 9.

One performance comparison was between the grade 7 and grade 8 divisional final exams. Both of these exams were developed by the same group of divisional teachers using the same blueprinting methods, so some comparison is possible. After one year participating in this AISI assessment project, the class average increased 7%. The percentage of students who achieved the standard of excellence on the grade 8 final exam increased 6 % over the grade 7 final exam, and the percentage of students who achieved acceptable standard went up 19 %. Eleven out of the sixteen students in the target group increased their final exam performance, some by as much as 15%.

Across Alberta, performances on Provincial Achievement Tests in math tend to drop from grade 6 to grade 9. However, when comparing this target group's performance on grade 6 and 9 Provincial Achievement Tests, the class average remained constant and the percentage of students who were below acceptable standard decreased.

| Target Group Final Exam Results | 2008 *(Gr. 6 PAT)* | 2009 | 2010 | 2011 *(Gr. 9 PAT)* |
|---|---|---|---|---|
| Class Average | 62% | 54% | 61% | 62% |
| Standard of Excellence | 31% | 13% | 19% | 19% |
| Acceptable Standard | 63% | 50% | 69% | 69% |
| Below Acceptable Standard | 37% | 50% | 31% | 31% |

## Conclusion

While conceptual understanding in junior high math among students at this school still requires attention, celebration is surely in order if we compare student achievement prior to and after the assessment intervention. It is exciting to anticipate the extent to which student achievement may continue when grade nine math students have had the benefit of three full years of this type of assessment. If similar improvement is seen again on school wide Provincial Achievement Test results, one would be hard pressed to argue against this approach to assessment.

In order for this type of approach to be successful, teachers, parents and students must shift away from the belief in assessment as a sorting tool. Rather, assessment must be viewed as a strategy to enhance student learning and to teach students to learn about how they learn. Furthermore, it is important to identify and celebrate all students who demonstrate conceptual attainment and mastery regardless of the chronology or timeline of their learning. Administering summative assessments while the teacher is still teaching and the student is still learning is unhelpful, if not harmful, to students becoming curious, risk-taking learners who integrate mistakes in productive ways. This project demonstrated that it is possible, and acceptable, for students to excel, and be celebrated, or for students to fail and continue learning.

## References

Alberta Education. (2007). *Mathematics kindergarten to grade 9 program of studies*. Edmonton: Author.

Black, P., Harrison, C., Lee, C., Marshall, B. & Wiliam, D. (2004). *Assessment for learning: Putting it into practice*. New York, NY: McGraw-Hill 115 International.

Black, P. & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education*, 5(1), 7-75.

Davies, A. (2000). *Making classroom assessment work*. Merville, BC: Connections Publishing.

Marzano, R. J. (2006). *Classroom assessment and grading that work.* Alexandria, VA: ASCD.

O'Connor, K. (2007). *A Repair Kit for Grading: 15 Fixes for Broken Grades.* Portland, OR: Educational Testing Service.

Sadler, R. (1998). *Formative assessment and the design of instructional systems.* Retrieved August 1, 2009 from www.uts.ualberta.ca/documents/FormativeAssmt_InstrSci.pdf

Stiggins, R. J. (2001). *Student –involved classroom assessment*, 3rd ed. Upper Saddle River, NJ: Merrill/Prentice Hall.

Wiggins, G. (2007). *Formative classroom assessment: Theory into practice.* New York: Teachers College Press.