Assessment Strategies in Mathematics Classrooms

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Research Recommendations for Assessment

- “An assessment system designed to help steer the instruction system must give good information about direction as well as distance to travel. A system that keeps telling us we are not there yet is like a kid in the back seat whining ‘are we there yet’” (Daro, Mosher, & Corcoran, 2011, p.51)

- Assessment should enhance student’s learning, provide helpful feedback to the student and the teacher (AMTE)

- Assessment should be aligned to standards and include mathematical practices such as justifying, modeling, attention to precision (Fennell, Kobett, & Wray, 2017)

- Should include a cycle of formative assessment and feedback (several times), then summative assessment (Wiliam & Leahy, 2015)

- Formative assessment increases speed and amount of student learning (Wiliam & Leahy, 2015)
Assess the student work example on a scale of 0-10. What led you to choose the score you did?

What elements were present that you gave credit?

What elements were missing that you would like to see in an exemplary response?
Student Work Sample 1

Student work samples distributed in session.
Holistic Scoring Guides (Rubrics)

- Samples are given a single overall score
- Give teachers an overall assessment of the topic rather than specific strengths and weaknesses
- More suitable for summative than formative assessment
- Can make scoring large numbers of projects easier
- Better when all samples are scored by the same teacher
<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| 10 | **Exemplary**  
   Answer is correct  
   Thinking is appropriate, sophisticated, and clearly communicated  
   Attention to precision is present |
| 8  | **Proficient**  
   Answer is correct  
   Minor omissions or incorrect use of symbols, units, etc... that do not indicate misunderstanding of the major content |
| 6  | **Approaching Expectations**  
   Answer is reasonable  
   Some understanding is shown, but there is an error that indicate possible misconceptions |
| 4  | **Progressing**  
   Some attempt was made, and some parts are connected to the problem  
   Multiple significant errors exist that indicate possible misconceptions |
| 2  | Some attempt was made, but the attempt seems disconnected from the problem |
| 0  | No attempt was made |
Analytic Scoring Guides (Rubrics)

- Different criteria are considered when scoring the response
- Responses may score high in one area and low in another
- Different criteria may hold different weights
  - Weights tell students what we value
- Cells of the rubric should clearly indicate the level of performance that falls within that designation
- Suitable for formative assessment because they give the student and teacher detailed feedback
- Are less ambiguous and subjective than holistic scoring guides
<table>
<thead>
<tr>
<th>4 points</th>
<th>3 points</th>
<th>2 points</th>
<th>1 point</th>
<th>0 points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solution</strong></td>
<td></td>
<td>Solution is completely correct and clear. It is appropriately labeled.</td>
<td>Solution is correct, or a close approximation, but has minor errors in labeling or is not clear.</td>
<td>Solution is incorrect, or it is unclear where the solution appears.</td>
</tr>
<tr>
<td><strong>Strategy</strong></td>
<td>Strategy is completely appropriate for the problem, is well-conceived, and has no obvious errors.</td>
<td>Strategy is appropriate for the problem, but has a minor error that does not suggest a misconception, but rather a calculation error.</td>
<td>Strategy is mostly appropriate for problem, but has a significant error that suggests a misconception may exist. Alternatively, multiple minor errors, as noted under 3 points, exist.</td>
<td>Strategy is not appropriate for problem and suggests a major misconception exists, but some meaningful attempt was made. Alternatively, multiple significant errors exist, or strategy is unclear.</td>
</tr>
<tr>
<td><strong>Notation</strong></td>
<td><strong>Explanation</strong></td>
<td>There are no errors in notation involving concepts discussed in class. Ex: Equals sign usage, accurate mathematical vocabulary, units expressed carefully.</td>
<td>One or two errors appear, such as those listed under 2 points.</td>
<td>Three or more errors appear, or one major error that suggests significant misconception.</td>
</tr>
</tbody>
</table>
Student Work Sample 2

Student work samples distributed in session.
Student Work Sample 3

Student work samples distributed in session.
Student Work Sample 4

Student work samples distributed in session.
Other Rubrics I Like

(Stutzman & Race, 2016)
Answer + Explanation + Information + Organization = Understanding

(Vazquez, 2008)
## Exemplars® Classic 3-Level Math Rubric

<table>
<thead>
<tr>
<th>Level</th>
<th>Understanding</th>
<th>Strategies, Reasoning, Procedures</th>
<th>Communication</th>
</tr>
</thead>
</table>
| Novice | - There is no solution, or the solution has no relationship to the task.  
- Inappropriate concepts are applied and/or procedures are used.  
- The solution addresses none of the mathematical components presented in the task. | - No evidence of a strategy or procedure, or uses a strategy that does not help solve the problem.  
- No evidence of mathematical reasoning.  
- There were so many errors in mathematical procedures that the problem could not be solved. | - There is no explanation of the solution, the explanation cannot be understood or it is unrelated to the problem.  
- There is no use or inappropriate use of mathematical representations (e.g., figures, diagrams, graphs, tables, etc.).  
- There is no use, or mostly inappropriate use, of mathematical terminology and notation. |
| Apprentice | - The solution is not complete indicating that parts of the problem are not understood.  
- The solution addresses some, but not all of the mathematical components presented in the task. | - Uses a strategy that is partially useful, leading some way toward a solution, but not to a full solution of the problem.  
- Some evidence of mathematical reasoning.  
- Could not completely carry out mathematical procedures.  
- Some parts may be correct, but a correct answer is not achieved. | - There is an incomplete explanation; it may not be clearly presented.  
- There is some use of appropriate mathematical representation.  
- There is some use of mathematical terminology and notation appropriate of the problem. |
| Practitioner | - The solution shows that the Student has a broad understanding of the problem and the major concepts necessary for its solution.  
- The solution addresses all of the mathematical components presented in the task. | - Uses a strategy that leads to a solution of the problem.  
- Uses effective mathematical reasoning.  
- Mathematical procedures used.  
- All parts are correct and a correct answer is achieved. | - There is a clear explanation.  
- There is appropriate use of accurate mathematical representation.  
- There is effective use of mathematical terminology and notation. |
| Expert | - The solution shows a deep understanding of the problem including the ability to identify the appropriate mathematical concepts and the information necessary for its solution.  
- The solution completely addresses all mathematical components presented in the task.  
- The solution puts to use the underlying mathematical concepts upon which the task is designed. | - Uses a very efficient and sophisticated strategy leading directly to a solution.  
- Employs refined and complex reasoning.  
- Applies procedures accurately to correctly solve the problem and verify the results.  
- Verifies solution and/or evaluates the reasonableness of the solution.  
- Makes mathematically relevant observations and/or connections. | - There is a clear, effective explanation detailing how the problem is solved. All of the steps are included so that the reader does not need to infer how and why decisions were made.  
- Mathematical representation is actively used as a means of communicating ideas related to the solution of the problem.  
- There is precise and appropriate use of mathematical terminology and notation. |

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### Other Rubrics I Like

(Adapted from Ontario Teachers Federation, 2018)

**Level 1**

**I Need to Make This a Goal!**

This is hard, I need some help to understand more.

<table>
<thead>
<tr>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding Traditions Around the World was challenging for you, but don’t worry we will review this topic again. Look over your work and remember to put in a big effort.</td>
</tr>
</tbody>
</table>

**Example Comment:**

*Remember to provide more examples on your comparison chart.*

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**Level 2**

**I’m Moving in the Right Direction!**

I know some things about but I still have lots of questions.

<table>
<thead>
<tr>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>You understand some things about Traditions Around the World. You’re moving in the right direction but you still need a little help from your teacher and a bit more practice.</td>
</tr>
</tbody>
</table>

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**Level 3**

**I’m Right on Track!**

I feel like I know a lot about .

<table>
<thead>
<tr>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>You show considerable understanding of Traditions Around the World. For the most part, you’re working independently.</td>
</tr>
</tbody>
</table>

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**Level 4**

**Wow! My Work is Impressive!**

is easy to understand and I like to challenge myself.

<table>
<thead>
<tr>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>You have a thorough understanding of Traditions Around the World. The concepts come to you easily and you put in the effort to go above and beyond what is expected.</td>
</tr>
</tbody>
</table>
Alternative Assessment Methods for Younger Students (or older)

(Van de Walle, Karp, & Bay-Williams, 2016)

<table>
<thead>
<tr>
<th>Topic: Mental Computation Adding 2-digit numbers</th>
<th>Not There Yet</th>
<th>On Target</th>
<th>Above and Beyond</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Names</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lalie</td>
<td></td>
<td>✓ 3-18-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pete</td>
<td>✓ 3-20-09</td>
<td>✓ 3-24-09</td>
<td></td>
<td>Difficulty with problems requiring regrouping</td>
</tr>
<tr>
<td>Sid</td>
<td></td>
<td></td>
<td>✓ + 3-20-09</td>
<td>Flexible approaches used</td>
</tr>
<tr>
<td>Lakeshia</td>
<td>✓</td>
<td></td>
<td></td>
<td>Counts by tens, then adds ones</td>
</tr>
<tr>
<td>George</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pam</td>
<td>✓</td>
<td></td>
<td></td>
<td>Beginning to add the group of tens first</td>
</tr>
<tr>
<td>Maria</td>
<td></td>
<td>✓ 3-24-09</td>
<td></td>
<td>Using a posted hundreds chart</td>
</tr>
</tbody>
</table>
Alternative Assessment Methods for Younger Students (or older)

(Van de Walle, Karp, & Bay-Williams, 2016)
Using with Standards-Based Grading

- Grades reflect student mastery of set standards
- Use is quickly increasing in elementary, middle and high schools
- Mastery can increase throughout the semester
- Encourages growth mindset in students (future teachers)
- Encourages students to find and understand their areas of need and work to fill that gap
- Students have responded very positively
- Increased visits during office hours, more focused questions
Ongoing Research

- Currently using 10-point analytic rubric in 3 sections of MATH 1420
  - 99% Standards-based grading
- Plan to analyze student mastery and student satisfaction with the course
References

Thank you!

Questions?
Feedback?
Suggestions?

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