Formative Assessment Activities:

Can They Do the Math?

A Resource Guide for Middle School Mathematics Teachers

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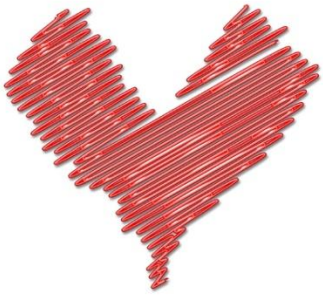

This project is lovingly dedicated to Paul, Emily, Daniel, and Timothy. They helped me figure out what I really wanted to be "when I grew up" and gave me the love and support I needed to become a teacher.

I would also like to acknowledge and thank Diane Lancaster for showing up in my driveway one June day. I wouldn't have started this journey or been able to complete it without her!

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Introduction

As a Middle School Math teacher, I discovered that I use formative assessments frequently in my classes in order to inform my teaching and provide feedback to my students. This resource guide will be a helpful tool for teachers, and not just in the mathematics classroom. The primary goal is to provide middle school mathematics teachers with formative mathematic assessment activities and ideas on how to use and integrate them into their daily teaching practices.

A secondary goal is to provide students with the opportunity to express their knowledge and showcase their critical thinking skills in an alternative assessment format.

Why should teachers use formative assessment?

Public education in the United States today is largely motivated by standardized testing. Students' knowledge is evaluated on a yearly basis using a multiple-choice and open-response testing format, and the efficacy of the teachers is evaluated based on the results of those tests. Teachers in the classroom have freedom with the types of assessments they use; but in my experience, I found that mathematics teachers seem to use multiple-choice tests more often than other types of assessments.

The exclusive use of standardized assessments in math can be problematic because multiple-choice assessments do not provide teachers with a well-rounded measure of a student's complete level of skill and ability. Bahr (2004) states that "traditional mathematics assessments tend to communicate that mathematics is an endeavor that involves determining a quick answer using a pre-existing, memorized method, thus failing to represent the true complexity of mathematics" (p. 33). This suggests that standardized assessments are not meeting the needs of teachers, and therefore alternative forms of assessment have a place in education in order to meet the needs of teachers for data they can use to inform their lessons.

Formative assessment (FA) is a method of assessment where students are given immediate feedback and furnished with ideas on how to improve what they are doing. The feedback must be useful to the student and according to Jenkins (2010) be "specific, accurate, timely, clear, focused upon the attainable and expressed in a way which will encourage a person to think" (p. 566) so they can modify what they are doing, make corrections, and improve their learning. Jenkins

also stated that “the effectiveness of [formative assessment] is reduced if students are not appropriately informed of what they are expected to demonstrate a knowledge of” (p. 567). In their research, Volante & Beckett (2011) stated that “formative strategies such as questioning techniques, feedback without grades, self-assessment, peer assessment, and formative use of summative assessments can double the speed of student learning” (p. 240). The use of FA in the classroom has also been shown to reduce the achievement gap because FA strategies benefit low achievers the most.

Formative mathematics assessments can provide teachers with new information regarding the problem-solving skills and abilities of their students, and in turn inform teachers’ instruction (Bryant, 1996). Formative assessment methods also give students the opportunity to showcase their skills and abilities in less traditional ways.

This project will be based on the five key principles of assessment in action as outlined by Clark (2008) with the activities adapted to address all of these principles, in order to encourage dialogue and feedback between student and teacher.

Five Key Principles of Assessment in Action*

1. Students must be able to understand clearly what they are trying to learn, and what is expected of them.
2. Students must be given feedback about the quality of their work and what they can do to make it better.
3. Students must be given advice about how to go about making improvements.
4. Students must be fully involved in deciding what needs to be done next.
5. Students must be aware of who can give them help if they need it.

*Clark, I. (2008). Assessment is for learning: Formative assessment and positive learning interactions. *Florida Journal of Educational Administration and Policy, 2*(1), 1-16.

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A Note to Teachers

As any teacher does, a math teacher experiences all levels of student abilities and understanding of the content being taught in any given lesson in the classroom. But math classes can move quickly from concept to concept, sometimes with little or no assessment until unit tests or chapter tests. This can leave a math teacher wondering if her students are learning the concepts being taught, and leave students wondering if they understand those concepts as well.

Formative Assessment can be used in the math classroom to assess immediate student comprehension and understanding of an entire lesson or just a small part of it, and in some cases give you a chance to provide immediate feedback to students. This Resource Guide contains a variety of Formative Assessment activities that can be used in math classrooms in order to determine exactly which students learned the lesson, which students are a little shaky, and which students require additional support. Formative Assessment provides the students and the teacher with immediate feedback which can be used quickly to inform and adjust the lesson in order to provide an optimum learning experience for students. The times indicated for each assessment are estimates. Times vary depending on class size, teacher efficiency, and student engagement.

The key to Formative Assessment is for teachers and students to learn from the information that is gathered and act on it. Formative Assessments should be used in all classrooms regardless of content. The Formative Assessment strategies and activities that are compiled in this resource guide are divided into two categories: those that are content-specific and those that have multiple uses. The multiple-use activities can be adapted for almost any mathematics standard as well as other content standards with only slight modifications or none whatsoever in some cases.

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Multiple-Use Activities

3-2-1 Exit Ticket

Overview: An Exit Ticket is a tool that can be used by a teacher as a post-assessment of how well the lesson went and what the students still don't understand.

Standard: Various – this is a multi-use strategy

Materials: 3-2-1 Exit Ticket (see example and Black-Line Master)

Time Needed: 25 minutes: 10 minutes to make and cut copies, and 15 minutes after class

Preparation: The teacher must make copies of the Black-Line Master

Instructions: At the end of a lesson, give each student a 3-2-1 Exit Ticket. The students write three responses to the sentence frames on the Exit Ticket as follows:

- 3 things I learned today….
- 2 things I found interesting….
- 1 question I still have….

The teacher collects the Exit Tickets as the students leave the classroom after the lesson. The teacher reviews the exit tickets and makes notes of what content may need to be reviewed or re-taught depending on the students' answers.

Variations:

Alternative sentence frames can be substituted on the exit ticket depending on what the teacher would like to know about the lesson and the students' level of comprehension. For example:

- 3 things I learned today….
- 2 ways I can apply this information….
- 1 thing I did not understand….

-OR-

- 3 things I can teach my classmate….
- 2 things I am really excited about….
- 1 thing I am still not sure of….

Examples:

3	**Things I Learned Today….**
2	**Things I Found Interesting….**
1	**Question I Still Have….**

3	**Things I Can Teach My Classmate….**
2	**Things I Am Really Excited About….**
1	**Thing I Am Still Not Sure Of….**

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A-B-C Summary

Overview: This is a quick, creative, fun assessment teachers can use to determine levels of comprehension of their students and allowing students to share their ideas with one another.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 10 minutes

Preparation: None

Instructions: At the end of a lesson, each student is assigned a different letter of the alphabet. Teachers can use their own discretion and leave letters out or duplicate letters for larger classes. Each student must select a word starting with that letter that is related to the topic being studied.

As a whole class, the students will share their words and the logic of why they chose them. The teacher can write the words on the board in alphabetical order to create a comprehensive list of words linked to the topic.

Note: In order to avoid certain letters of the alphabet or assign letters more creatively, teachers can use abstract choices. For example:

- The third letter of the student's last name
- The second letter of a parent's name
- Every letter in a mathematical sentence

Extension:

Students create a mini-poster (8-1/2x11 maximum) for their vocabulary word, including a definition and picture, for the classroom word wall.

Analogy Writing

Overview: Assess your students' understanding of concepts with analogies. Provide a prompt which will allow students to reflect on what they have learned.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 5 minutes

Preparation: None

Instructions: Periodically throughout your lessons, present students with an analogy prompt for a designated concept, principle, or process. Allow the students time to reflect and then have them read their analogies aloud to the rest of the class.

Sentence frame analogy prompts:

"The _____**(**concept**)**_____ **is like** _____
_____ **because** _____
_____
_____."

"The most important thing about_____**(concept)**_____
is _____
_____
because_____
_____
_____."

Classwork Trade

Overview: Students use peer assessment to assist each other in making sure their classwork is complete and correct before turning it in to the teacher.

Standard: Various – this is a multi-use strategy

Materials: Colored pencils

Time Needed: 10 minutes

Preparation: None

Instructions: At the end of a lesson, or shortly before, students find a partner and trade classwork (this can be a notebook, writing paper, worksheet, or anything else that has been assigned to be finished in class that day). The students read each other's work and check to make sure that all components are included. The students make notations using different colored pencils, provide positive feedback using accountable talk, and then return it. Each student adds anything that was missing before it is turned in to the teacher.

Create Your Own Test Questions

Overview: Students get excited when they help you with test questions because they feel like they have inside information! This fun formative assessment activity can be used to evaluate total student comprehension of the content and provide students with their own study guide.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 10-15 minutes

Preparation: None

Instructions: Teachers ask students to prepare math problems to help create a summative assessment of the content being taught. Students create any number of problems the teacher requires, modeled after their homework or class work, in order to create their own study guide. The students must solve the problems and return them to their teachers for evaluation.

Based on the quality of responses from the students, teachers may choose to use the problems for a quiz, an in-class game or contest, or to create a summative assessment. Regardless of how the student-generated problems are used, teachers should be sure to integrate them into the curriculum so students get a chance to see their work!

Fingers on Chest

Overview: For a quick assessment of how students feel they are comprehending a lesson, use this activity which allows students to keep their reflection private.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 5 minutes

Preparation: None

Instructions: Ask students to reflect on their level of comprehension of the lesson presented by placing fingers on their chests for only the teacher to see. Use a scale of one to four, with one being lowest level of understanding and four being highest. Teachers assess the student responses quickly and then decide whether to revisit the content or move forward.

Four Corners

Overview: After teaching a lesson, allow students to move to different corners of the room depending on their level of understanding of the lesson being taught. The students in each corner generate questions they have and report them to the class for discussion.

Standard: Various – this is a multi-use strategy

Materials: Labels for each corner

Time Needed: 10-15 minutes

Preparation: The teacher must establish this routine at the beginning of the year by teaching the students what each corner represents in their level of learning. The corners should be labeled, "Stop!" "Slow Down" "Keep Moving" and "Let Me Help". These labels can be left up all year long.

Instructions: Call for "Four Corners" in order to assess the level of student comprehension of a lesson. The students go to the corner of the room that best fits their level of understanding of the lesson.

Corner 1 "Stop!" – I am totally confused.
Corner 2 "Slow Down" – I understand some of it but couldn't pass a test today
Corner 3 "Keep Moving" – I'm getting it and I wish we wouldn't have too much homework about it.
Corner 4 "Let Me Help" – I understand it and could teach it to my friends.

Once students go to their corners, they have two minutes to generate questions with the other students in that corner about what they are learning. The questions are then asked to the class for clarification and discussion. The questions generally reflect the level of understanding from each corner, and the teacher can quickly address gaps and incorrect learning.

Homework Help Board

Overview: Start your class using this day-after-homework routine and use it as a quick assessment to determine whether students had difficulty with the homework. Teachers can assess student work immediately and reteach if necessary based on homework problems students write on the board.

Standard: Various – this is a multi-use strategy

Materials: White board, dry erase markers

Time Needed: 5-10 minutes during a warm-up activity

Preparation: None

Instructions: At the beginning of class, students review their homework and identify any problems that they didn't understand or caused them difficulty. The students write those problem numbers on the board. Students who had no difficulty and successfully completed the problem write the solution on the board for the class to see. If a student had a different approach to solving a problem, that student can add their solution to the board as well.

Once the solutions are on the board, the teacher uses questioning strategies in order to facilitate a student discussion. If all the problems have been solved correctly, the teacher moves on to the daily lesson or possibly asks one or two questions as verification that all students understood the concept. If problems were solved with different approaches, the teacher can review the various methods and ask the students to discuss them. If a problem noted on the board has no solution, the teacher can review that problem, suggest a first step, and provide scaffolding in order to reteach the concept to the class.

Variation: Use different pens for boys and girls. Boys do not always show their work, and girls use only the method taught to find solutions. Require boys to do the problems first and show all work. When the boys are finished, ask girls to provide alternative ways of solving the problems.

Homework Pathways

Overview: Allow students the opportunity to choose a "Homework Pathway." This will reduce student frustration and lessens the need to reteach students who have learned and practiced a concept incorrectly.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: None (this homework policy is established at the beginning of the year)

Preparation: The teacher must establish this homework policy at the beginning of the year.

Instructions: When homework is assigned, students can choose which pathway they should follow according to their individual level of understanding of the lesson.

Pathway 1: If students are confident after finishing their homework that most or all of their answers are correct and they understand the concepts, they generate three questions they feel the teacher should use on the summative assessment.

Pathway 2: If students completed their homework but are not certain they have all the questions right, they should try three to five more problems to see if they can figure it out with the additional practice.

Pathway 3: If students are frustrated and confused after attempting to do their homework, they should stop answering the questions and instead create a list of their own questions they can ask the teacher the next day to help them understand the concepts.

In-Class Check-Up

Overview: This activity is used the day before a test or quiz. The teacher can assess the comprehension of the students and provide them with guidance on what areas to concentrate on as they study.

Standard: Various – this is a multi-use strategy

Materials: Paper and pencil

Time Needed: 65-70 minutes: 20 minutes to prepare review problems and a worksheet, and 45-50 minutes in class

Preparation: The teacher must prepare 5-6 review problems for the students to complete in class and a review worksheet for the students to take home as homework. The teacher must also teach the students how to answer the review problems on notebook paper so the teacher can assess them quickly during the class.

Instructions: The teacher provides the students with 5-6 review problems on the board in preparation for a quiz or test the next day. As students work to complete them, they must write the answers down the left side of the paper in order for the teacher to be able to assess the answers quickly in class. Student work is shown on the right side of the paper. When students are finished with the review problems they raise their hand so the teacher can evaluate their work. The students will rework any problems that are incorrect.

If the problems are all correct, the students are given the review worksheet to begin in class and finish as homework. In this way the teacher can give the students immediate feedback on concepts they are having trouble with and guide them in what they need to study in order to be prepared for the quiz or test the next day. To ensure that every student's work gets checked, the teacher keeps a list of names to check off and monitor.

Learning Logs

Overview: Students use Learning Logs to help integrate content, process, and personal feelings. Learning Logs can also become a vehicle for exchange among parents, teachers, and students.

Standard: Various – this is a multi-use strategy

Materials: Notebook or composition book for each student

Time Needed: 5 minutes at the end of a class; additional time for assessment conferences

Preparation: None

Instructions: At the end of a lesson, students are given five minutes to reflect on their learning by writing in their Learning Log. Logs can include problem-solving entries, observations, questions about lectures, word problems they have created, predictions before a concept is taught, definitions of key vocabulary, justification of a solution to a problem, summaries of the day's lesson, comments about homework assignments, and reflection on the student's own understanding and the questions that may still exist.

The teacher can guide the students in their writing until they get used to it by asking open-ended questions:

- What did I do in class today?
- What did I learn?
- What did I find interesting?
- What questions do I have about what I learned?
- What was the point of today's lesson?
- What connections did I make to previous ideas and lessons?

These topics can help teachers identify strengths and weaknesses in their students' understanding of math content and address individual needs. Short assessment conferences are scheduled throughout a week or at the end of a unit to discuss the reflections and provide feedback to students. Teachers can also assess students in cooperative groups, thus reducing the time required for conferences.

Variation:

Students can write in their Learning Logs on a weekly basis, reflecting on what was learned during the week: what they found challenging, what their accomplishments were, and other thoughts and ideas regarding the week's lessons.

Alternative Sentence Stems: For students who need more support using the English language, teachers should provide sentence stems.

"Today in class, we learned about _____."

"In this lesson, I found _____ interesting."

"I am confused about _____ because_____."

"I can use what I learned in class today when I _____."

"I am proud that I understand how to _____."

Monday* Quizzes

Overview: Give a short pre-assessment to your students on Monday aimed at the learning targets of the week in order to differentiate instruction for the week. This is an excellent formative assessment strategy for a team of teachers.

Standard: Various – this is a multi-use strategy

Materials: White board or overhead projector, sticky notes

Time Needed: 65-70 minutes; 5-10 minutes on Monday (or the first class day of the week) during each class, and 60 minutes that same afternoon to review data and prepare lessons

Preparation: The teacher must create a short pre-assessment which will provide information about student knowledge of what will be taught that week.

Instructions: On Monday at the beginning of class, display the problems on the overhead projector or whiteboard and provide time for the students to solve them. Students record their answers on sticky notes with their names on them, which they give to the teacher. At the end of the day, the sticky notes are sorted into three categories: student clearly understands concept; student doesn't understand concept, or it remains unclear whether student understands concept. The teacher then creates three different learning activities based on each group of students. The students are grouped by ability and the teacher supports each group during the class.

Variation: A team of teachers can work together to lighten the workload. All teachers give the pre-assessment and review their data. After the review process, each teacher can design one learning activity so the work is shared. The students can remain in their classrooms with their own teacher. As an alternative, the students can be moved into different classrooms depending on ability, with one teacher taking each group. The teachers meet at the end of each day for review and problem-solving techniques to help the students in their room who are not mastering the content. In this case the teachers need to be able to work together and be organized so that each teacher has a list of the students they will be teaching in their classroom.

*First class day of the week

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Scale of 0 to 100

Overview: Using a scale of 0 to 100, students analyze their own level of comprehension before a content unit. Afterwards, the students re-evaluate and compare where they started and where they ended.

Standard: Various – this is a multi-use strategy

Materials: Chart paper or a large piece of butcher paper, 1x3 sticky notes in two colors

Time Needed: 30 minutes: 10 minutes of preparation, 5 minutes at the beginning of the unit, and 15 minutes at the end

Preparation: Teachers must make a chart which will be used as a bar graph with an x-axis going across the bottom and a y-axis going up the side. The x-axis should be labeled in tens starting at 0 and going up to 100. The paper can be labeled with the content title and should be left up in the classroom until the end of the unit.

Instructions: Before the beginning of the unit, teachers ask students to evaluate their level of knowledge of the content on a scale of 0 to 100. Students place their blank sticky note on the graph paper according to how much they think they know about the content (students do not put their names on the sticky notes).

- Placing it above the 0 shows no knowledge of the content whatsoever
- Placing it on the 100 shows complete knowledge with no teaching necessary

The sticky notes are placed above each other on the paper, creating a bar moving up from the number the students choose.

After the unit is finished, teachers revisit the graph and ask the students to re-evaluate their level of knowledge. The teachers give students a different-colored sticky note and they place it on the graph again, reflecting their new level of knowledge. The students and teachers can visually see the increase in the level of knowledge of the class as a whole.

Note: If teachers want specific information regarding individual students, the students write their names on the back of the sticky notes for privacy.

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Student Self-Report Note

Overview: Students attach a "Student Self-Report Note" to their homework or other assignment, reflecting on their own level of learning, and passing that information on to the teacher.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 20 minutes: 10 minutes to make and cut copies; 10 minutes to assess data

Preparation: Copies of "Student Self-Report Notes" must be made and cut (see example and Black-Line Master)

Instructions: Teachers hand out copies of the "Student Self-Report Note" to each student when an assignment is given. After completing the assignment, students check off a box on the note depending on their level of comprehension of the assignment, and explain their choice. Teachers collect the notes along with the assignment and assess the data. Teachers reteach as necessary.

Example:

Student Self-Report Note

While doing this assignment, I felt (check one):

[ ] confident that I knew how to do all the problems. I think I know the material well enough to teach others how to do the work.

[ ] like I knew how to do some of the problems but not all of them.
*Explain*_____

[ ] like I thought I knew how to do the problems when I started, but then I got confused and lost.
*Explain*_____

[ ] lost from the beginning. When the teacher was explaining how to do the problems, I did not understand.
*Explain*_____
_____

Think-Pair-Share

Overview: Students are given time to think individually about a lesson or concept, discuss it in pairs with a partner, and finally, share it with the teacher and class for a quick formative assessment.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 5 minutes

Preparation: None

Instructions: Whenever a quick formative assessment is necessary to evaluate student levels of comprehension, ask students to Think-Pair-Share. The students spend two minutes thinking individually about the lesson, writing a few notes for themselves if necessary. When time is up, students turn to a partner (someone next to, in front of, or behind them) and discuss their thoughts with each other. The teacher must ensure that all students have a partner. When the allotted pair discussion time is over, the students participate in a full-class discussion. The teacher listens and takes notes as necessary during the pairs and full-class discussions to assess the different student levels of comprehension. Teachers can use a spreadsheet with a learning scale (See example and Black-Line Master) to make notes of what level of understanding each student is at.

Note: While students are discussing the lesson in pairs, keep them on task by requiring them to report on what their partner said during the full-class discussion.

Example:

Classroom Checklist				
Student Name	1 (developing)	2 (approaches)	3 (meets)	4 (exceeds)

Three-Minute Pause

Overview: Provide students with a chance to reflect on their learning with a three-minute pause in the middle or at the end of lesson, and create a classroom dialogue based on their responses.

Standard: Various – this is a multi-use strategy

Materials: Paper and pencil

Time Needed: 5-10 minutes

Preparation: None

Instructions: In the middle or at the end of a lesson, the teacher will provide the students with a "Three-Minute Pause" during which they will reflect on the following statements:

- I changed my attitude about……
- I became more aware of……
- I was surprise about……
- I felt……
- I related to……
- I empathized with……

At the end of three minutes, the teacher will give the students two minutes to share their responses with a partner. When the students are finished talking to each other, the teacher will facilitate a short classroom discussion on the reflection of the lesson. The teacher may take notes to record student responses and anecdotes, and follow up with any students who need additional support.

Which Homework to Do?

Overview: Students determine which homework assignment they should do depending on a quick 4- or 5-problem assignment at the end of class. This will reduce student frustration and lessens the need to reteach students who have learned and practiced a concept incorrectly.

Standard: Various – this is a multi-use strategy

Materials: None

Time Needed: 15 minutes: 5 minutes to prepare four problems, and 10 minutes in class

Preparation: Teachers must prepare four or five problems from the lesson

Instructions: Students are given four or five problems to solve at towards the end of class. Homework assignments are determined by how many problems are solved correctly.

- 0-1 problems correct: Students in this group require additional support. Teachers reteach the concept to these students. They are then assigned additional homework problems to be done before the next class.
- 2-3 problems correct: Students in this group require additional practice. They are assigned additional homework problems to be done before the next class.
- 4-5 problems correct: Students in this group do not require additional practice. They will generate three questions that can be used on a summative assessment.

Content –Specific Activities

Before and After:
Mean, Median, Mode, and Range
Assessment

Overview: This pre- and post-assessment tool can be used to determine which Mean, Median, Mode, and Range content a teacher should review and which should be taught.

Standard: CCSS 6.SP.5c

Materials: "Mean, Median, Mode, and Range - Before and After" (see Black-line Master)

Time Needed: 20 minutes: 10 minutes to make and cut copies and 5 minutes at the beginning and end of the class

Preparation: The teacher must make copies of the Black-line Master

Instructions: As a pre-assessment in the beginning of class, the students will read five statements concerning Mean, Median, Mode, and Range and will either agree or disagree with each statement. When all the students have finished, the teacher will survey the class and gather information regarding the lesson. The teacher can then adjust the lesson to fit the needs of the class. After the lesson is taught, the students will do the post-assessment and re-evaluate the statements, reflecting on their new level of comprehension of Mean, Median, Mode, and Range.

If after the pre-assessment the teacher determines that all or almost all the students know the content, the teacher can review that material briefly and move on to the next lesson.

Example:

Before and After Mean, Median, Mode, and Range Assessment				
Name:_____Period:_____				
Before Lesson		**Statement**	**After Lesson**	
agree	disagree	The mode is the middle number of a data set.	agree	disagree
agree	disagree	The mode is the data point that is most frequent.	agree	disagree
agree	disagree	To find range, subtract the smallest data point from the largest data point.	agree	disagree
agree	disagree	To find mean, first add all the data points together and then divide by ten.	agree	disagree
agree	disagree	The median is the middle number of a data set.	agree	disagree

Circles on the Wall

Overview: This formative assessment gets students moving around the classroom, working in pairs to determine the sizes of different circles hung around the room.

Standard: CCSS 7.G.4

Materials: Paper, large compass or string for homemade compass, scissors, pencil, tape or push-pins; rulers, calculators, and 3x3 sticky notes for students.

Time Needed: 40 minutes: 20 minutes to measure, draw, and cut circles, and 20 minutes in class

Preparation: The teacher must measure, draw, and cut out 6-8 circles of different sizes out of butcher paper. The center of the circle should be marked with a dot. The circles are numbered and hung on the walls around the classroom as "stations."

Instructions: The students are divided into pairs (see *Math Meeting Buddies instructions and examples below, and Black-Line Master) and given a ruler, calculator, scratch paper, and sticky notes. The students write their names on the front of the sticky notes. The students choose any station to begin and move around the room, working together to determine the circumference of each circle. When students find the answer they write it on the back side of the sticky note and then stick the note on the circle so the answer doesn't show. The teacher circulates throughout the room, providing support and feedback where necessary.

Teachers can discuss the answers in class or evaluate the answers on the sticky notes after class, determining whether the students need additional support and reteaching. Feedback can be provided during the activity or at a later opportunity.

***Math Meeting Buddies**

Instructions: Students' names are written on each other's papers in the matching appointment space. For example, Annie and Jose are "Multiplication Buddies". Annie's name goes on Jose's paper in the "Multiplication" appointment space, and Jose's name goes on Annie's paper in the same space. When the teacher calls for "Multiplication Buddies," Annie and Jose pair up (See Example below).

In order for students to create their own pairings, they need ten minutes to mingle about the room meeting up with other students they'd like to work with who are available during the same appointment time. They make an "appointment" by writing their name on the other student's

paper. At the end of the allotted time, the teacher asks students which appointment spaces they haven't filled and pair up the remaining students as necessary. If a student is the odd person left without an appointment filled, that student can sign up with a pair to be a group of three.

In order to give students some choices, teachers can pair students for one or two appointments and allow the students to create the remaining appointments themselves. The teacher can also provide basic guidelines for the pairings depending on how they would like students paired up.

Guidelines:

In the beginning of the year, the teacher can advise the students that they can only have one person they already know. The other three appointments must be students they don't know.

Later in the year, when Meeting Buddies need to be refreshed, the teacher can advise that the students cannot make an appointment with someone they have already worked with on another Meeting Buddies Sheet.

Note: When using Meeting Buddies, absent students create unmatched partners. Quickly reassign students without buddies to each other or create a group of three.

Examples:

Name: Jose .	
Math Meeting Buddies	
Addition	**Subtraction**
Tom	Jessica
Multiplication	**Division**
Annie	Diego

Name: Annie .	
Math Meeting Buddies	
Addition	**Subtraction**
Marie	Becky
Multiplication	**Division**
Jose	Nathan

Combining Like Terms:
I Have the Answer: What's the Question?

Overview: This formative assessment gets students to think backwards through the steps of the Distributive Property.

Standard: CCSS 7.EE.1; 8,EE.7b

Materials: Sticky Notes

Time Needed: 10 minutes

Preparation: None

Instructions: The teacher writes four or five answers to Combining Like Terms problems on the board (for example, x + 2y = 12). Students create their own problems and write them with the corresponding solutions on sticky notes. The sticky notes are stuck to the classroom whiteboard underneath each of the answers they match. The teacher evaluates the sticky notes and chooses one or two to use as examples for the entire class.

Examples:

Answer: x + 2y = 12

Question: 4x + y + 2 = 14 + 3x – y

Answer: 3x + y = 17

Question: 5x – 2y – 4 = 2x – 3y + 13

Transformations of Coordinate Pairs Floor Grid

Overview: This assessment allows students to get out of their classroom to demonstrate knowledge of transformations of coordinate pairs.

Standard: CCSS 8.G.3, 8.G.1

Materials: Painters' Tape (blue masking tape), Coordinate Pairs cards (see "Black-Line Masters"), list of students for note-taking

Time Needed: 80 minutes: 30 minutes to prepare (taping the floor and cutting out coordinate pair cards), and 50 minutes for assessment.

Preparation: The teacher must have use of a multi-purpose room with a tiled floor. The tape is used to create a coordinate plane on the floor with an x- and y-axis. One long piece is placed going down the center of the room and then a second is placed perpendicular to it across the middle of the room. Small pieces of tape are numbered with positive and negative numbers and placed on the axes at every tile. This creates the coordinate plane.

Instructions:

1. The teacher gives each student a note card with a pair of coordinates written on it.
2. The teacher draws attention to the coordinate plane on the floor and asks the students to identify the y-axis, the x-axis, and the origin (0,0).
3. The teacher gives a signal and each student moves to their place on the coordinate plane determined by their given coordinate pair. The teacher takes notes on the students' abilities to find their place.
4. The teacher can manipulate the position of the students by asking them to trade cards.

After the students have found their initial positions, the teacher can assess their knowledge of:

1. Slope: request the students to move about the grid using different slopes (ex: right 2, up 1).
2. Rotation: request the students find a new position on the grid based on rotation around the origin.
3. Translation: request the students find a new position on the grid based on a specific transition (ex: down 3, left 1).
4. Reflection: request the students find a new position on the grid based on a reflection across an axis.

Example:

(1, 2)	(1, -3)
(1, 4)	(1, -1)
(2, -1)	(2, 6)
(0, 2)	(0, 5)
(2, 3)	(2, -4)

Unit Rate Tables

Overview: Teachers can use this formative assessment to assess student comprehension of unit rates using tables and ratios.

Standard: CCSS 7.RP.2a

Materials: Large tablet paper, tape or push-pins; sticky notes, scratch paper, and pencils for students

Time Needed: 40 minutes: 20 minutes to create tables, and 20 minutes in class

Preparation: The teacher must create 5-8 tables on the tablet paper on which the students will be able to leave answers (see Black-Line Masters for examples of tables). The tables are numbered and hung on the walls around the classroom as "stations."

Instructions: Students are divided into pairs (see Math Meeting Buddies Black-Line Master) and write their names on the front of sticky notes. Each pair chooses any station to begin with and moves from station to station, using their knowledge of proportions and ratios to determine unit rates and missing numbers in order to complete all the tables. Students write their answers on the backs of sticky notes and place them in the blank spaces in the tables. The teacher circulates throughout the room, providing support and feedback where necessary.

Teachers can discuss the answers in class or evaluate the answers on the sticky notes after class, determining whether the students need additional support and reteaching. Feedback can be provided during the activity or at a later opportunity.

Examples:

Complete the Table for Susie's Hike					
Distance (mi)	½				
Time (h)	¼	½	¾	1	2

Complete the Table for Juan's Race					
Distance (mi)		2			
Time (h)	¼	½	¾	1	2

How Far Does Brandon Go?					
Distance (mi)	8 ½				
Time (h)	½	1	1 ½	2	2 ½

How Much Does It Cost?					
# of Pounds	2	4	7	8	10 ½
Cost ($)		10			

Which Car Goes the Fastest?					
Car	A	B	C	D	E
Distance (mi)	20	15	80	45	40
Time (h)	½	¼	2	¾	½
Speed (mph)					

Examples:

Complete the Table for Words Per Minute					
Time (min)	1	2	10	15	20
Words Read			450		

How Much Does Marie Get Paid?					
Time (h)	2	2 ½	5	6 ½	9
Rate of Pay ($)	6.40				

How Much Batter to Make Muffins?					
Cups of Batter	2				
# of Muffins	5	10	25	35	100

Complete the Table for Cost of Gasoline					
# of Gallons	3	4	5	7	10
Cost ($)	9.45				

Which Peanuts Cost the Most?					
Peanuts	A	B	C	D	E
Peanuts (bags)	2	4	5	12	16
Cost ($)	3.00	5.60	8.00	14.40	32.00
Total Cost ($/bag)					

Using Individual Whiteboards

Overview

Individual whiteboards can be an extremely useful tool when formatively assessing students in the mathematics classroom. The activities outlined below are only a sampling of the many ways you can use them every day to inform your teaching. When using any of these individual whiteboard activities, the teacher can take notes as needed for assessment.

Activities

✴Show Me

Use whiteboards for quick assessments on any topic. Give the students a problem to solve and have them hold their whiteboards up with the answer. Teachers can quickly review all answers and provide support as needed.

✴Back-to-Back

Two students sit back to back, each with a whiteboard. The teacher writes a problem on the classroom whiteboard and the students work together to solve the problem. Without looking at each other's board, one student describes the first step to solving the problem and both students write it down. The other student describes the next step, and they both write it down. This is repeated until the problem is solved. The students can communicate verbally but cannot see each other's board until the problem is solved.

✴Partner Problem-Solving

Students work in pairs. They create their own content-related problem on their whiteboard and switch whiteboards with their partner. The partners must solve each other's problems. When the students are finished, the boards are returned and the students must check the solutions for accuracy. The teacher walks throughout the room, checking student work and providing support as necessary.

✴True or False

The teacher makes a math statement and students write a "T" or "F" response on their whiteboard. The teacher asks the students to hold the boards up and reviews all the answers in one glance.

Activities (continued)

✴One-Sentence Summary

Students write one sentence on their whiteboard to summarize the math lesson after it's finished for the teacher to read. Time permitting, students can read their sentence to the rest of the class.

✴Pass-the-Board

Students are divided into groups of four, and each student has their own whiteboard. A problem is written on the classroom board and the students copy it onto their own whiteboard. The students write the first step to solving the problem on their whiteboard. The boards are then rotated in the group clockwise so everyone has a new board with part of the problem solved. The students do the next step of the problem, pass the boards clockwise again, and solve another step. This is repeated until the problem is solved. A variation of this would be to have each student in the group solving a different problem.

✴Silent Classroom

Any questions, comments, or answers the students have must be written on the individual whiteboards and then held up so teacher can see them. The students can also indicate if they're having trouble with the content and need further explanation. This strategy can be used in pairs or teams, with a score-keeper and a prize at the end of the class for the team with the fewest instances of speaking.

Standards Matrix

Content Standards Addressed in this Project

	Common Core Mathematics Standards Matrix						
Activities	**6.SP.5c**	**7.RP.1**	**7.EE.1**	**7.G.4**	**8.EE.7b**	**8.G.2**	**8.G.3**
Before and After: Mean, Median, Mode, and Range	X						
Circles on the Wall				X			
Combining Like Terms: I Have the Answer – What's the Question?			X		X		
Transformations of Coordinate Pairs Floor Grid						X	X
Unit Rate Tables		X					

Common Core Mathematics Standards

✴ **6.SP.5c (Statistics and Probability)**

5. Summarize numerical data sets in relation to their context, such as by:

c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

✴ **7.RP.1 (Ratios and Proportional Relationships)**

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.*

✴ **7.EE.1 (Expressions and Equations)**

1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

✴ **7.G.4 (Geometry)**

4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.

✴ **8.EE.7b (Expressions and Equations)**

7. Solve linear equations in one variable.

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

✴ **8.G.2 (Geometry)**

2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

✴ **8.G.3 (Geometry)**

3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

Black-Line Masters

3-2-1 Exit Tickets

3	**Things I Learned Today….**
2	**Things I Found Interesting….**
1	**Question I Still Have….**

3	**Things I Learned Today….**
2	**Things I Found Interesting….**
1	**Question I Still Have….**

Student Self-Report Note

Student Self-Report Note

While doing this assignment, I felt (check one):

[ ] confident that I knew how to do all the problems. I think I know the material well enough to teach others how to do the work.

[ ] like I knew how to do some of the problems but not all of them.
*Explain*_____

[ ] like I thought I knew how to do the problems when I started, but then I got confused and lost.
*Explain*_____

[ ] lost from the beginning. When the teacher was explaining how to do the problems, I did not understand.
*Explain*_____
_____

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[ ] lost from the beginning. When the teacher was explaining how to do the problems, I did not understand.
*Explain*_____
_____

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*Explain*_____

[ ] like I thought I knew how to do the problems when I started, but then I got confused and lost.
*Explain*_____

[ ] lost from the beginning. When the teacher was explaining how to do the problems, I did not understand.
*Explain*_____
_____

Think-Pair-Share

Classroom Checklist

Classroom Checklist

Student Name	1 (developing)	2 (approaches)	3 (meets)	4 (exceeds)

Before and After:

Mean, Median, Mode, and Range

Assessment

+-x/+-x/+-x/+-x/+-x/+-x/+-x/

Before and After:
Mean, Median, Mode, and Range Assessment

Name:_____Period:_____

Before Lesson		Statement	After Lesson	
agree	disagree	The mode is the middle number of a data set.	agree	disagree
agree	disagree	The mode is the data point that is most frequent.	agree	disagree
agree	disagree	To find range, subtract the smallest data point from the largest data point.	agree	disagree
agree	disagree	To find mean, first add all the data points together and then divide by ten.	agree	disagree
agree	disagree	The median is the middle number of a data set.	agree	disagree

Before and After:
Mean, Median, Mode, and Range Assessment

Name:_____Period:_____

Before Lesson		Statement	After Lesson	
agree	disagree	The mode is the middle number of a data set.	agree	disagree
agree	disagree	The mode is the data point that is most frequent.	agree	disagree
agree	disagree	To find range, subtract the smallest data point from the largest data point.	agree	disagree
agree	disagree	To find mean, first add all the data points together and then divide by ten.	agree	disagree
agree	disagree	The median is the middle number of a data set.	agree	disagree

Math Meeting Buddies

+-x/+-x/+-x/+-x/+-x/+-x/+-x/

Name:_____	
Math Meeting Buddies	
Addition	**Subtraction**
Multiplication	**Division**

Coordinate Pairs Cards

+-x/+-x/+-x/+-x/+-x/+-x/+-x/

(1, 2)	(1, -3)
(1, 4)	(1, -1)
(2, -1)	(2, 6)
(0, 2)	(0, 5)
(2, 3)	(2, -4)

(3, 1)	(3, 6)
(3, -3)	(3, -5)
(4, 5)	(4, -3)
(4, 2)	(4, 0)
(0, -1)	(0, -6)

(-1, 2)	(-1, -3)
(-2, 5)	(-2, -2)
(-2, -4)	(-3, 0)
(-3, -5)	(-4, 1)
(-4, 6)	(5, 6)

(-3, 3)	(1, 4)
(-4, -3)	(2, 3)
(-5, -5)	(3, 6)
(-5, 4)	(4, 2)
(5, 2)	(0, 3)

Unit Rate Tables

Complete the Table for Susie's Hike					
Distance (mi)	½				
Time (h)	¼	½	¾	1	2

Complete the Table for Juan's Race					
Distance (mi)		2			
Time (h)	¼	½	¾	1	2

How Far Does Brandon Go?					
Distance (mi)	8 ½				
Time (h)	½	1	1 ½	2	2 ½

How Much Does It Cost?					
# of Pounds	2	4	7	8	10 ½
Cost ($)		10			

Which Car Goes the Fastest?					
Car	A	B	C	D	E
Distance (mi)	20	15	80	45	40
Time (h)	½	¼	2	¾	½
Speed (mph)					

Complete the Table for Words Per Minute					
Time (min)	1	2	10	15	20
Words Read			450		

How Much Does Marie Get Paid?					
Time (h)	2	2 ½	5	6 ½	9
Rate of Pay ($)	6.40				

How Much Batter to Make Muffins?					
Cups of Batter	2				
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Cost ($)	3.00	5.60	8.00	14.40	32.00
Total Cost ($/bag)					

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Annotations

Allsopp, D., Kyger, M., Lovin, L., Gerretson, H., Carson, K., & Ray, S. (2008). Mathematics dynamic assessment: Informal assessment that responds to the needs of struggling learners in mathematics. *Teaching Exceptional Children, 40*(3), 6-16.

The authors of this theoretical research article explored a method of informal assessment which provides teachers with information that can help identify what students do and do not understand about mathematical concepts and understandings as well as an in-depth evaluation process. The authors also explored ways for teachers to plan their instruction in order to address students' specific mathematical learning needs.

The authors examined Mathematics Dynamic Assessment (MDA), an informal assessment process which helps struggling learners by integrating four research-supported assessment practices: assessment of students' interests and experiences; concrete-representational-abstract assessment within authentic contexts; error pattern analyses; and flexible interviews. The authors explained in detail the methods used in each practice and described one teacher's experience using MDA. The authors included a discussion on the benefits of MDA and stated that a teacher can obtain a "deep level of information about students' mathematical understandings, resulting in a dynamic picture of what students know and do not know and possible reasons for their understandings and misunderstandings" (p. 10).

Teachers can implement these ideas directly into their classroom with some class time and effort. MDA is a positive informal assessment system that can give teachers additional information and in-depth looks into students' learning processes and levels of understanding.

Bahr, D. (2004). Creating mathematics performance assessments that address multiple student levels. *Australian Mathematics Teacher, 63*(1), 33-40.

The author of this theoretical research article discussed the need to improve mathematical assessments so that they include assessment of additional mathematical abilities such as problem solving, understanding, and critical thinking. The author also described her methods of teaching teachers to design mathematical performance assessments.

The author first argued that changes in assessment have not kept up with the expansion of curriculum and instruction. Previous mathematics curriculum consisted of students learning formulas and methods without any understanding of why or how those formulas work. Student understanding and comprehension of mathematical concepts needs to replace the tradition of decontextualized technical skills in mathematics, and the assessments need to be altered to better measure this new understanding. The author explained in detail the procedures he used when he instructs teachers how to design performance-based mathematical assessments including wording, standards, criteria for judging, and question development. The author included a table for teachers which can be used to determine numerical complexity as well as a rubric teachers can use as they assess their students' mathematical abilities.

Teachers can implement these ideas directly into their classroom as they create their own performance-based mathematical assessments. If teachers have the creative license to design their own assessments, the instructions are easy to follow and complete from start to finish.

Baughlin, J., Brod, E., & Page, D. (2002). Primary trait analysis: A tool for classroom-based assessment. *College Teaching, 50*(2), 75-80.

The authors of this theoretical article explained what Primary Trait Analysis (PTA) is and the benefits of its use by teachers in classrooms. The authors also provided detailed examples of PTA rubrics for assignments such as daily participation, oral presentations, journal writing, and chemistry labs.

The authors described PTA as a four-point scale or rubric which is an effective tool for classroom-based assessment and teacher/student communication. The use of a rubric in a classroom allows the teacher to tell the students the nature of the assignment, the expectations, and the learning outcomes. The authors gave further details of the benefits of using rubrics in the classroom and provided four4 examples of PTA scales which could be used in all disciplines for various assignments. The authors linked the rubric to letter grades and explained how an objective tool like a PTA scale can be helpful to teachers who are asked about their grading policies. The authors concluded that PTA is a tool that opens communication between teachers and students, provides transparency in the classroom, and makes grading procedures easier for teachers and clearer for students.

Some teachers are already using rubrics in their classroom to some degree. For those who are not, teachers can take advantage of the information in this article immediately to implement a rubric grading system.

Berry, J., & Nyman, M. (2002). Small-group assessment methods in mathematics. *International Journal of Mathematical Education in Science and Technology, 33*(5), 641-649. doi: 10.1080/00207390210144034

The authors of this empirical research study examined a method of assessment when a collaborative teaching method is used in a classroom in order to assess the problem-solving and thinking skills of students. The authors discussed positive and negative aspects of a team-oriented formal assessment method and include the students' reactions to this testing method.

The participants in this study were eight students from Alma College in Alma, Michigan, who were a part of an intensive, four-week spring term consisting of only one course. Students worked in four teams of two, and after the first week were given a formal assessment which they worked on cooperatively. Each team had their own room in which to take the test so they could discuss their answers easily, and the students submitted their responses as a team. The authors found that motivation of the students was increased by the collaborative, small-group environment because there was a sense of sharing ideas and cooperation. Teamwork also led to the opportunity to speak the language of mathematics routinely, and while disagreements among teammates were seen as a disadvantage of the assessment method, they usually led to more in-depth discussions. Students were able to balance their strengths and weaknesses with that of their partner and were more engaged because of the real-world approach.

This data can be used by teachers to help them make an informed decision regarding small-group work and small-group assessments in mathematics. Teachers must decide for themselves whether they can incorporate an unusual method like this into their own classrooms and routines to allow for a clearer picture of the students' critical thinking skills.

Bryant, B.R. (1996). Using alternative assessment techniques to plan and evaluate mathematics instruction. *LD Forum, 21*(2), 24-33.

The author of this theoretical research article discussed the need for teachers to focus on the assessment of mathematical skills in order to guide instructional planning. The author gave an overview of the purposes of assessments, described circumstances for using them, and then proceeded to describe different assessment strategies teachers can use depending on the information they are looking for.

The author first discussed three purposes of mathematical assessment: to compare students, to identify mastery, and to target strategies that students use to solve problems. The author suggested that teachers should always have these purposes in mind to help guide the instruction of the class, and teachers should also keep an assessment portfolio for each student in order to document progress over time. A variety of assessment strategies were presented by the author including tests, checklists and rating scales, graphs, interviews, word problem analysis, observations, and student self-reflections. These assessments were analyzed by the author, a specific purpose was described for each one, and the author gave suggestions on how and when they should be used. The author took into consideration both types of assessments, traditional and authentic.

Teachers can implement these ideas directly into their classroom in order to help guide their instruction. More emphasis is being placed on assessment "matching" the instruction, and this author has presented many ideas on how to use different assessments, when to use them, and how to gather and use the data from each one.

Callingham, R. (2008). Dialogue and feedback: Assessment in the primary mathematics classroom. *Australian Primary Mathematics Classroom, 13*(3), 18-21.

The author of this theoretical article discussed the need for a teacher to choose dialogue in the classroom that expands on a student's existing understanding, and the importance of the quality of learning as opposed to the need for assessment. The author also explained the need for feedback from the teacher as well as the student in order to inform future lessons.

The author set a simple recipe for successful teaching: dialogue and feedback, but acknowledged their difficulty in practice. The author explained that an activity must be engaging and establish a productive dialogue which allows the student to participate at their own level of learning. Consequently, there are two pieces of essential information a student needs to hear through feedback provided by the teacher: affirmation of what they can currently do and what they need to do in the future in order to improve their understanding. Students need to understand the feedback from the teacher so they are able to act on it, but the teacher does not want to discourage or confuse the student even more. A teacher must tailor her feedback to provide each student with different methods, ideas, and suggestions in order to meet the needs of the various students in her classroom. The author ended the article with the statement that most learning happens in small steps, and the best way to create those steps for each child is with dialogue and feedback.

Dialogue and feedback can be implemented immediately into any classroom if it is not already being used. If a teacher is not comfortable with dialogue and feedback with her students, she must remind herself and prompt herself to introduce it into her learning techniques.

Chen, M. (1999, November). *Benefits of investigations as non-traditional assessments in secondary mathematics*. Paper presented at the Annual Meeting of the Australian Association for Research in Education and the New Zealand Association of Research in Education (Melbourne, Australia).

The author of this empirical research paper explored investigations used as non-traditional assessments in a secondary mathematics classroom. The author also examined the results of the investigations and explained the benefits of using investigations as non-traditional assessments in secondary mathematics.

The participants were 18 mathematics students and four teachers in a secondary school in Brisbane, Australia. The students worked in pairs or groups to complete one of two assignments which assessed their knowledge of measuring length and area, and calculating height using trigonometry and triangles. It was noted that the teachers gave clear explanations on how to approach the problem and there was tight structure to the investigation. The author observed the students as they completed their assignments and interviewed them and the teachers individually afterwards. The author also read student journals to gather information. The biggest hindrance to the investigation was student misbehavior when they were allowed to go outside as part of the activity. The author concluded that social constructivism allowed students to experience meaningful learning, engage in their own learning, and interact with other students with positive results.

Investigations in mathematics are as crucial as labs in science. Investigation is a method all math teachers should use in their classrooms whenever possible. If a teacher is wary of allowing the students too much freedom because of behavior issues, the structure of the investigation could be tightened or loosened, depending on the make-up of the classroom.

Cherif, A., & Gialamas, S. (2000). "Creative final projects" in mathematics and science: An educational instrument for maximizing students' learning and understanding. *Journal of College Science Teaching, 30*(2), 272-278.

The authors of this theoretical article explored the use of a Creative Final Project in college mathematics and science classes as a formal assessment at the end of the course. The authors explained the motivation, the methodology, the finished products, and the results of the creative final project. The authors also discussed the success of the project and provided student feedback to better support the projects.

The authors explained that assigning a creative final project at the end of a college semester is not new. They described their own experiences with it, starting with their rationale and methodology. They argued that a creative final project helps students find the usefulness of science and mathematics, provides students with an opportunity to cultivate creativity, and allow students the freedom to investigate areas of a subject using their own medium. The authors provided tools for the instructor on how to implement a final project from including it in the syllabus to providing the students with a project proposal sheet. The authors also provided a rubric to assist in project evaluation. Although there wasn't any formal evaluation done of these projects, the authors measured the success by comments and feedback from the students, which were positive.

These guidelines for creative final projects can be modified for use in middle and high schools with just a few changes regarding scope and expectations. Teachers can challenge their students with alternative assessments in the form of creative final projects and follow the movement away from standardized testing in the classroom.

Clark, I. (2008). Assessment is for learning: Formative assessment and positive learning interactions. *Florida Journal of Educational Administration and Policy, 2*(1), 1-16.

The author of this theoretical article explored a formative assessment program for use in the classroom called Assessment for Learning (AfL). The author explained how the program is used in the classroom and its effects on it as well. The author also discussed the merits of the program, the five fundamental principles it is founded on, and the benefits of the program to the students as well as the teachers.

The author argued that AfL is necessary as an alternative to high-stakes testing because students, especially lower-achieving students, become disaffected and don't reach their full potential. AfL is a Constructivist Intervention based on Vygotskian theory, and the author argued it is necessary for learning because it allows teachers to provide a meaningful and appropriate guidance instead of lecture and restatement. AfL is based on five key principles which focus on communicative interaction; these principles reposition the students at the center of assessment and learning interactions instead of leaving them on the sidelines, waiting to find out what and how they will be learning. Traditional testing motivates students to learn to take a test and whatever else is necessary to get the grades they want. AfL motivates students to practice the synthesis and evaluation of information because the students know the purpose of the activity, but also the assessment criteria in advance.

Teachers can implement this program immediately, in part or in whole. AfL is directly in line with Common Core Standards and the new methods of teaching that are now being implemented in the classroom, so teachers may find them very easy to integrate into their classrooms.

Clark, I. (2011). Formative assessment: Policy, perspectives and practice. *Florida Journal of Educational Administration & Policy, 4*(2), 158-180.

The author of this theoretical article defined formative assessment (FA) and described the strategies and principles of creating effective FA. The author also explained the history and rationale behind FA and discussed the benefits of an open classroom based on FA.

The author explained the history of FA which dates back to 1967. The author provided information regarding the multi-dimensional (international, racial, income, and system based) achievement gap that remains despite the advent of the No Child Left Behind Act (NCLB) in 2002, and explained that educational strategies have most recently moved towards FA based on those statistics. The author described the need for FA partly because of the immediate feedback offered to the students, who can then rework problems or rewrite essays with a stronger knowledge base. The author acknowledged that the feedback provided must be scaffolded, applicable, concise, and constructive, and argued that the feedback only becomes formative when learners are "supported in their efforts to think about their own thinking" (p. 162). The author described the ideal FA classroom as a place where students can express who they are and have a strong sense of self-efficacy, and personal beliefs, opinions, guesses, and misconceptions are valued. The author concluded that high stakes testing creates disaffected students while FA engages and challenges students, and allows them to take ownership of their education.

Teachers should read this article to inform their teaching and assessment strategies and get more information regarding FA so they can have a greater understanding of what it is and begin using it in their own classroom.

Colen, Y. (2010). Funny face contest: A formative assessment. *Mathematics Teacher, 104*(1), 50-56.

The author of this empirical article discussed a formative assessment he used in his high school functions, statistics, and trigonometry (FST) classroom. He explained the activity, "Funny Face Contest," in detail and included his rationale as well as when and how he did it. The author also provided examples of student work and described his evaluation process.

The author described his decision to assign a creative formative assessment to his FST students because early on his the year they were unmotivated and were unable to recall algebra facts or demonstrate understanding. The Funny Face Contest assessed a student's ability to transform functions and allowed students to be creative with their graphing calculators. The author provided some guidelines and criteria for the students, and gave them a class period and one evening to finish the project. He reflected that his verbal directions should have been more clearly stated or provided on paper, but even so he was impressed with the results. The author discussed his evaluation process, including an anonymous vote by the students for the two best faces in each class. The author concluded the article by discussing the need to focus on learning with technology in order to engage students in critical thinking, and argued that mathematics teachers need to incorporate observations, projects, and student reflections as part of their assessment data.

This assessment was very specific to a particular type of class but a teacher could modify it to fit into a geometry or algebra class without using the calculators. The main idea that any teacher can take from this article is that teachers must become more creative in order to hold the attention of the students and engage them with fun, creative lessons.

Conaway, B. (1994). Authentic assessment and mathematics learning. *The Journal of Secondary Gifted Education, Fall*, 52-56.

The author of this theoretical research article discussed the differences between traditional assessments and authentic assessments, and how teachers might implement authentic mathematical assessments in classrooms. The author presented information regarding the movement toward authentic assessments being lead by the National Council of Teachers of Mathematics (NCTM), and described the six core standards proposed by NCTM.

The author first discussed three distinct differences between authentic and traditional assessment methods. Authentic assessments measure the process rather than the result, students are actively involved in the assessment process, and the assessment must be "continuous, dynamic, and designed to provide information about a student's progress which can be used to guide further instruction." Authentic assessment tools can include portfolios, rubrics, and other artifacts such as journals, student interviews, and audio/visual records. The six standards proposed by NCTM are Important Mathematics: assessment should reflect the most important aspects of mathematics; Enhanced Learning: assessment should enhance the learning process; Equity: each student should have optimal opportunities to demonstrate their mathematical knowledge; Openness: assessments should be open to review and scrutiny; Valid Inferences: assessment information should give teachers valid inferences about a student's learning; and Consistency: the assessment could be consistent with its purpose.

Teachers can implement these ideas directly into their classroom as they create their own authentic mathematical assessments, provided they have the creative license to design their own assessments.

Dirksen, D. (2011). Hitting the reset button: Using formative assessment to guide instruction. *Phi Delta Kappan, 92*(April), 26-31.

The author of this theoretical article discussed the use of frequent formative assessments in order to guide instruction and quickly identify areas of learning that students may need to review or relearn before moving on to another concept. The author also described various types of formative assessments that teachers can use in the classroom as well as the use of summative assessments in a formative manner.

The author argued that sometimes students need a way to start over again, just like in video games. Students learn at different paces, and most bell schedules don't allow time for such individualized instruction, but time must be taken to check for comprehension and understanding of key basic skills and competencies. The author explained the use and various benefits of many different types of formal assessments including observation, collaborative learning, structured review, jigsaw activities, quick writes, weekly summaries, graphic organizers, and journal writing. The author also described how summative assessments can be used as formative assessments, provided the learning is allowed to flow into the next unit or the information can be revisited in a later lesson. The author concluded with the argument that formative and summative statements can perform double duty depending on how teachers use them, and if teachers continuously perform these assessments the students will have a chance to push the reset button if they need to.

Teachers can implement many of these ideas and assessments immediately into their daily classroom procedures and lesson plans. A teacher who is intimidated by all of the ideas can start slowly with one or two, and add more in as time progresses.

Foster, D., & Noyce, P. (2004). The mathematics assessment collaborative: Performance testing to improve instruction. *Phi Delta Kappan*, *85*(5), 367-374.

The authors of this empirical research study examined the effectiveness of the Mathematics Assessment Collaborative (MAC), a group of school districts in California that joined together in order to create and institute their own performance assessments in an effort to reverse the trend of standardized testing and the ill effects that go along with them. The authors discussed the assessments that were designed for MAC, how the assessments were used to inform instruction, and whether MAC is achieving what it set out to do.

MAC consisted originally of 24 school districts in California's Silicon Valley. The districts used standards developed by the National Council of Teachers of Mathematics (NCTM) and partnered with the Mathematics Assessment Resource Service (MARS) in order to design exams for multiple grades that fit the core ideas of MAC as well as other specifications. The authors described the design of the exams and explained that they were scored using a rubric. The authors also discussed how these assessments are being used to inform instructional practice, which is providing a great impact on standard test scores. The first MARS exams were given in the spring of 1999, just before state-wide standard testing. The data gathered since then indicates that MAC students perform as well as or better than students who do not attend a MAC school, and so the authors conclude that students who are taught using alternative instruction and assessments can still perform well on standards based testing.

This data can be used by teachers who are not quite sure of whether it would be beneficial to use alternative instruction methods and assessments in their classrooms because the results indicate that students will still do well on standard tests.

Gearhart, M., & Saxe, G. (2004). When teachers know what students know: Integrating Mathematics Assessment. *Theory into Practice*, *43*(4), 304-313.

The authors of this empirical research study examined the effectiveness of the Integrated Mathematics Assessment program (IMA), a professional development program designed to aid teachers in interpreting student mathematical thinking and move students toward deeper understanding. The authors introduced the program and its features, and discussed its effectiveness for teachers who want to use an inquiry method with students to support and develop their mathematical understanding. The authors also described *Seeing Fractions*, a curriculum unit emphasizing visualization in fraction comprehension.

The participants in this study were divided into three groups of seven to nine teachers in each group. The first group participated in the IMA program and used *Seeing Fractions*. The second group also used *Seeing Fractions*, but they met throughout the year as a professional support community. The third group chose not to participate in any professional development and used textbooks that emphasized fraction properties. After observations and data collection, the authors concluded that the gains in conceptual understanding by the students in the IMA classrooms surpassed that of the other classrooms. In addition, the authors concluded that good curriculum materials are not enough to develop student mathematical concepts. Teachers must participate in professional development in order to further their own knowledge.

This data can be used by teachers to motivate them to participate in professional development in order to learn more about their subject matter. Teachers are more likely to teach and assess in ways that build upon children's understanding if they deepen their own knowledge of the importance of assessment and of knowing what students know.

Greenlees, J. (2011). The fantastic four of mathematics assessment items. *Australian Primary Mathematics Classroom*, *16*(2), 23-29.

The author of this theoretical article discussed the four components of assessment items: mathematical content, literacy demand, contextual understanding, and graphics. The author argued that each component has a strong, unique power and can stand alone as a tool of mathematical learning, but if students are skilled in all areas they will be able to overcome most if not all mathematical obstacles.

The author described all four components in detail and explained why each was important to a student's mathematical learning. Mathematical content is the heart of what the student knows and provides a strong base for the other three components. Mathematical literacy provides a student with the vocabulary and knowledge of jargon and concepts specific to math so that they can read a math problem, understand what the question is, and solve the problem. Contextual understanding has become more and more visible in the mathematics world. Problems in text books and on assessments have become more relevant to the everyday world so that students can see how they can apply their math skills in their own lives. Graphics (graphs, tables, and charts) are increasingly being embedded in assessments because they have become so important in representing and organizing data. The author concluded by arguing that all four components must be taught, and assessments must be a true indication of a student's mathematical knowledge.

A teacher can implement these four components quickly into lesson plans. Some suggestions are providing a word wall, collecting data throughout the year and graphing it, and providing students with real-world scenarios to solve. The four components will come together.

Hare, A. (1997). Active learning and assessment in mathematics. *College Teaching*, *45*(2), 76.

The author of this empirical study article explained her use of alternative mathematics assessment methods and the effect they had on the student preparation for the test. The author discussed the lack of preparation her students usually exhibited before a test and the rationale she used when she decided to try a different type of assessment procedure. The author also described a new classroom policy which allowed her students to self-correct their assessments for partial credit, and consequently increased their test scores and levels of understanding.

The author explained that she usually found her students ill prepared for their exams. The class would review the day before in class but most students did not look over the material beforehand and were not prepared to ask questions. As an alternative, she assigned the students the task of writing their own exam questions, gave them guidelines, and told them they had a week to do it. The results were positive, with students coming to the review class prepared with their own assessment questions and familiar with the chapter. The author was able to use the students' questions, thereby cutting down on her own preparation time. The author also discussed a new policy which allowed students to self-correct their exams. She found that the students spent more time afterwards reviewing the materials and their grades went up. Students took more responsibility for their own performance and were less anxious before the exams.

Teachers of all subjects can incorporate these two strategies immediately into their classrooms with little or no effort. Even though the students create the questions in this alternative assessment method, the teacher still has the ultimate control over the assessment.

Jenkins, J. (2010). A multi-faced formative assessment approach: Better recognizing the learning needs of students. *Assessment & Evaluation in Higher Education, 35*(5), 565-576. doi: 10.1080/02602930903243059

The author of this empirical research article explored a new approach to assessments in college classes which created an assessment that was both formative and summative. The author also examined the results of the multi-faceted assessment and compiled comments from the students after the assessment was completed.

The participants were college students in an Environmental Policy and Governance class at the University of Hertfordshire in England. The students were expected to complete a 2000-word assignment in the form of 2 essays. They were informed that this would be the only assessment. The author described the support given to the students specifically for the assessment which broke down the linear transfer of knowledge, thus enhancing dialogue between student/student as well as teacher/student. The support and formative assessment came in the form of on-line tutorials, submission of an outline and consequent feedback, detailed guidance notes, and e-learning pages. The author discussed the results of the multi-faceted assessment, highlighted some of the comments from the students, both positive and negative, and explained how formative assessments in higher learning can be integrated without additional workload to the instructor. The author concluded that the use of one multi-faceted assessment enhanced the overall student learning experience and created a more effective self-regulated study environment.

This technique could be modified and integrated into middle and high school classrooms in conjunction with other assessments. It could also be considered as a final project that is worked on throughout the semester.

Livne, N., & Milgram, R. (2006). Academic versus creative abilities in mathematics: Two components of the same construct? *Creativity Research Journal, 18*(2), 199-212.

The authors of this empirical research article investigated the differences between academic abilities and creative abilities in math students. The authors examined the results of the investigations and explained the correspondences between the type of thinking and the type of ability the students possessed.

The participants were 1090 high school students from 22 public schools in urban and rural areas of Israel, representing a wide range of intellectual abilities. Each participant was administered six assessments which measured general intelligence, general creative thinking, mathematic abilities, and creative mathematic abilities. The assessments were administered to groups of students in their classrooms in three two-hour sessions over a two-week period. The authors examined the data and evaluated the casual relationships between the different types of thinking and abilities. The authors found that creative thinking was linked to creative math ability, and consequently general thinking was linked to general math abilities. The authors were surprised to find that creative thinking was more strongly related to creative math abilities compared to general thinking and general math abilities, and concluded that the students with creative thinking were more likely to exhibit giftedness in mathematics. The authors felt this attributes to the lack of identifiable gifted math students; teachers look for math skills rather than creative thinking when looking for gifted math students.

This information is extremely important to all teachers as they try to identify giftedness in their students. Teachers may not identify gifted students if they don't know what to look for.

Raymond, A. (1994). Assessment in mathematics education: What are some of the alternatives in alternative assessment? *Contemporary Education, 66*(1), 13-17.

The author of this empirical research study examined the effectiveness of four types of alternative mathematics assessments in an elementary education class. The author discussed the National Council of Teachers of Mathematics (NCTM) and described its focus on problem solving, cooperative learning, and the use of manipulatives in mathematics classrooms in order to support an emphasis on process as well as product.

The participants in this study were elementary education students at Indiana University in Bloomington, Indiana. The class was designed so that students worked cooperatively to solve mathematical problems. Correspondingly, the assessments were designed for students as group problem solving exams to better reflect the learning environment of the classroom. Group exams were completed by groups of students who then participated in other alternative assessment methods such as written reflections, self-assessment, and group projects. The students exhibited better problem solving skills when working in groups and were able to understand their own level of knowledge when participating in self-reflection. The author concluded that teachers can gain greater insight into the knowledge of their students as well as the feelings of their students and the beliefs about mathematics and their own levels of knowledge.

This data can be used by teachers to help them understand the motivation behind the movement towards authentic alternative mathematics assessments. With the implementation of Common Core Standards, teachers will have to teach and assess using new methods which build upon their students' understanding of mathematics and their ability to solve problems. Teachers will need to integrated alternative assessments into their classrooms.

Sherrod, S., Dwyer, J., & Narayan, R. (2009). Developing science and math integrated activities for middle-school students. *International Journal of Mathematical Education in Science and Technology, 40*(2), 247-257. doi: 10.1080/00207390802566923

The authors of this empirical research study examined different middle school science activities which integrated mathematics and science in the classroom. The authors discussed the implications of mathematics in science and the need for integration in order to help students develop a positive attitude towards mathematics and its usefulness in all aspects of life.

The participants in this study were three middle school science teachers and 59 students in the southern United States. The students belonged to a wide range of ethnic and socio-economic backgrounds. The first activity was about composting, and the students had to figure out carbon/nitrogen ratios. In the second activity about contour lines, students gained an understanding of topographic maps and comparing two-dimensional drawings with three-dimensional models. The third activity, "Popsicle Glaciers," required students to create bar graphs with the data they gather while watching the experiment. The first two activities went well, but the third one was not completed because the teacher didn't allow enough time for the popsicles to melt so the students didn't have enough data to report. The authors concluded that these activities actively engaged the students and allowed them to be scientists and mathematicians at the same time, which aided in their comprehension.

This data can be used by teachers to motivate them to create integrated lessons so that students can become more actively engaged and learn more concepts with hands-on learning. Teachers must be determined and open-minded in order to be more creative in the lessons they plan, but they must also see that these types of activities can be accomplished in the classroom.

Shirvani, H. (2009). Examining an assessment strategy on high school mathematics achievement: Daily quizzes vs. weekly tests. *American Secondary Education, 38*(1), 34-45.

The author of this empirical research study explored the effects of weekly quizzes in a high school mathematics class versus daily quizzes. The author examined the results to determine if there was a significant impact on student achievement as measured by a final exam as well as daily homework grades.

The participants were 69 high school Hispanic students from four geometry classes, all taught by the same teacher. Thirty-eight students were female and 31 students were male. The school was located in a rural community in the southern part of the United States with a population of over 95% Hispanic ethnic background. The control group and treatment group each consisted of two classes of students. The treatment group received a daily 10-minute quiz at the end of the class period which was graded and returned the following day. The teacher reviewed the quiz at the beginning of the next class. The control group received a 10-minute worksheet every day and a test on Friday. The teacher would review the worksheet at the beginning of the next class. The authors found that there was a significant difference between the two groups' performances. The treatment group outperformed the control group both on the final exam and in their homework grades as well. It was also found that students studied more frequently instead of cramming.

Teachers can utilize this research to analyze their own assessment practices in the classroom and realize that assessment is the quickest strategy to improving student learning. Weekly or bi-weekly quizzes may not provide the students with the feedback they need in order to monitor their own learning.

Simpson, N. (2005). Alternative assessment in a mathematics course. *New Directions for Teaching and Learning, 100,* 43-53.

The author of this theoretical research article explored alternative assessments in her college Honors Calculus class. The author discussed why she decided to replace the standard assessments with alternative assessments and then explained the benefits of these new assessments and how they have evolved since she began using them.

The author was a calculus teacher at a liberal arts college who decided to explore alternative assessments in her Honors Calculus class when her students questioned her on the need for a cumulative final exam, pointing out that it was redundant. The author examined the level of assessment she was receiving with standard assessments (quizzes, tests, final exams) and agreed with the students, replacing the standard final exam with a visual synthesis and an individual portfolio. The author discussed the process of designing the alternative assessments and the modifications that took place after reflecting on their efficacy as well as the benefits of the new assessments including the reception from the students and the in-depth self-reflection from the students. The author concluded with the argument that these new assessments tell her what the students have learned, not what the students can do.

Middle and high school teachers can implement these assessments with modifications to subject matter only because the author included all her questioning techniques and her rubrics. The assessments the author designed are positive, engaging tools teachers could use to look deeper into what their students have learned.

Suurtamm, C. (2004). Developing authentic assessment: Case studies of secondary school mathematics teachers' experiences. *Canadian Journal of Science, Mathematics and Technology Education, 4*(4), 497-513.

The author of this empirical research study discussed the trends in mathematics education and the need for new techniques in mathematics assessment. The author defined authentic assessment as techniques used to provide a broader range of measures of mathematical skills and understanding which move away from focus on the answer and use of algorithms. This is based on the belief that mathematical understanding is now more valuable than memorizing algorithms.

The participants in this study were two male and three female secondary school (high school) mathematics teachers in Ontario, Canada. They exhibited a wide range of level of teaching experience and backgrounds, and all chose to include authentic assessment methods in their classroom. The study was conducted over a one-year period and the teachers met twice in focus-group meetings. All five teachers included authentic activities and assessments in their classrooms, even though they felt isolated from the rest of their peers by doing something different. Several teachers experienced difficulty in matching their forms of assessment with the more traditional method of using percentages because they were using ratings scales and rubrics. The participants experiences difficulties and faced challenges throughout the year but felt they could be overcome with increase support from their peers and administration.

This information can be used by teachers of all disciplines who are looking to implement authentic activities and assessments in their classrooms. Reading about the experiences of others can help teachers avoid pitfalls and challenges as they move away from more traditional methods and into curriculum and activities providing real-world application.

Threlfall, J., Pool, P., Homer, M., & Swinnerton, B. (2007). Implicit aspects of paper and pencil mathematics assessment that come to light through the use of a computer. *Educational Studies in Mathematics, 66,* 335-348. doi: 10.1007/s10649-006-9078-5

The authors of this empirical research study examined whether there were positive or negative effects resulting from the translation of a paper-and-pencil mathematics assessment into a computer-based assessment. The authors compared specific items on an assessment to determine whether the validity of those items was undermined by the computer translation.

The English participants were ages 11and 14, and at the end of key stages in their education. The students were divided into four groups, each of which took one test on paper and one on computer but in different combinations, which allowed for linkage of the items without any pupil taking both the paper-based and computer-based version of the same item. The data showed that there were only slight differences between the two mediums (5% or less). Paper and pencil was slightly favorable to 14-year-olds but the 11-year-olds did slightly better with computers; however, for individual questions there were greater differences. The authors explained these results with the idea that some items posed on the tests required manipulation of shapes which was easier to do on the computer, and "keeping track" of choices used was also easier on the computer. Other items worked better on paper, specifically those that required calculations or the drawing of shapes.

Most teachers do not have the option of assessing their students on computer on a regular basis so this study may not be useful at this time. The understanding though, that computers can make mathematics easier for students to understand is something teachers must have in order to move into the technological age.

Vaille, J., & Kushins, H. (1993). *Creative math assessment: How the "Fizz & Martina approach" helps prepare students for the math assessment test.* Watertown, MA: Tom Snyder Productions, Inc.

The authors of this booklet described the Fizz & Martina approach and explained what it is, how it's used, and the benefits of the program. The authors also provided details regarding the program and how it mirrored the California Learning Assessment System (CLAS) and discussed some of its negative aspects.

The authors provided a brief background on the student population in California, the reform movement in California and how it shaped curriculum, and the advancement of standardized testing. The authors also described the CLAS, which has four types of assessment strategies: open-ended problems, enhanced multiple choice questions, investigations, and portfolios. The Fizz & Martina program was originally created to prepare California students to take the CLAS and the authors provided charts showing the relationship between the program and the CLAS; however the program has since spread to other states based on its own merits. The authors described the technique of students watching a video and then working in groups to solve a problem from the video. The authors also provided examples of how the program encourages students to incorporate writing into their math lesson and be able to explain on paper and verbally how and why they solved a problem the way they did.

This program and others developed by Tom Snyder Productions is currently available on the internet for use in primary grades. There is also an interactive whiteboard program for teachers to use in with current technology. Teachers can integrate all or parts of this program in their classrooms at the click of a button!

Vazquez, L. (2008). A, E, I, O, U, and always Y: A simple technique for improving communication and assessment in the mathematics classroom. *Mathematics Teacher, 102*(1), 16-23.

The author of this theoretical article explained a technique to help mathematics student explain how they got answers to math problems. The author also provided examples of how it is used, a hand-out given to students which explains the method and how to use it, samples of student work, and an assessment rubric for the teacher to use for grading. The author concluded that the use of the A.E.I.O.U. technique was a positive addition to her classroom.

The author described the A.E.I.O.U. method and why she developed it for use in her classroom. The letters stand for Answer, Efficient Explanation, Information, Organization, and Understanding, and the method is taught to the students at the beginning of the year. The students use the parts of the technique in order as they work through a math problem, and reference the rubric to aid them in understanding the expectations of the assignment. The author discussed how this technique gives teachers a better understanding of what the students do and do not comprehend, and the ability of the students to rework their answers after reviewing A.E.I.O.U. the expectations on the rubric. The author described additional benefits of using this technique for teachers and students alike, and stated that her students were better able to discuss their problem-solving strategies and "develop[ed] a heightened awareness of their own thinking and reasoning."

This technique could be integrated into math classrooms quickly with hand-outs to give to the students and posters to put up on the wall as a reminder of what to do. Teachers could use the rubric on daily assignments as well as summative assessments.

Volante, L., & Beckett, D. (2011). Formative assessment and the contemporary classroom: Synergies and tensions between research and practice. *Canadian Journal of Education, 34*(2), 239-255.

The authors of this empirical research article investigated the differences between the research done on formative assessment and the actual practices used by teachers in the classroom. The authors discussed the findings and identified areas of inconsistency within those assessment practices and provided suggestions on how to close the gaps.

The participants were 20 teachers working in elementary and secondary schools from two school districts in southern Ontario, Canada. The participants represented both male and female, and experience ranged from three years to 28 years. The study consisted of open-ended questions related to assessment experience, professional development, and assessment strategies. The participants were interviewed individually and results were compiled and analyzed by the authors. The authors identified various types of formative assessment that the teachers use in class and how frequently they were used. They also identified areas where teachers have problems such as questioning without asking the right questions, or feedback which the students don't take into consideration. Most teachers admitted they needed to do a better job of promoting self-assessment in their classrooms. The authors concluded that the use of formative assessment strategies most associated with student improvement was lacking and professional development was a key to providing teachers with the tools to implement those strategies.

This information is helpful for a teacher because it promotes self-reflection and provides insight into what types of formative assessments a teacher is using, and whether they are being use to the best of their abilities.

Watt, H. (2005). Attitudes to the use of alternative assessment methods in mathematics: A study with secondary mathematics teachers in Sydney, Australia. *Educational Studies in Mathematics, 58*, 21-44.

The author of this empirical research study examined methods of assessment currently being used by teachers in Sydney, Australia. The author also explored the attitudes of these teachers towards various alternative assessment methods.

The participants in this study were sixty teachers from eleven secondary schools in metropolitan Sydney. The schools were a combination of government (public) schools and private schools representing a mixture of government, private independent, coeducational, and single-sex schools. The author created a survey consisting of eight questions measuring the teachers' use of traditional mathematical assessment methods and attitudes towards alternative assessments. The author found that teachers were satisfied with traditional mathematics assessments and used occasional alternative assessment methods such as oral tasks and observations. There were six main responses to the question of why alternative assessments were not used: insufficient time for implementation, unstructured nature, unsuitable, unreliable/subjective, and insufficient resources at hand to permit implementation. A trend was found in that the teachers with the least experience were least satisfied with traditional assessments. The author attributed this to possible differences in teacher preparation experiences.

This data can help teachers make an informed decision regarding their own use of alternative assessment in mathematics. Teachers must decide for themselves whether alternative forms of assessment are too subjective or whether there is enough time and resources to implement them.

Wood, R., & Ashfield, J. (2008). The use of the interactive whiteboard for creative teaching and learning in literacy and mathematics: A case study. *British Journal of Educational Technology, 39*(1), 84-96. Doi: 10.1111/j.1467-8535.2007.00703x

The authors of this empirical research study examined the use of interactive white boards (IWB) in the classroom, whether they have been successfully integrated into the classroom, and whether they enhance and support pedagogic practice. The authors discussed two aspects of creativity in the classroom and how it is affected by IWBs; first, how IWBs can be used by teachers to teach creatively, and second, how IWBs can encourage students to develop their own creativity.

The case study consisted of ten observations of numeracy and literacy whole-class IWB lessons in five primary schools in England. The authors also conducted interviews with teachers and group discussions with students. The researchers took notes independently of each other, and looked for instances during the lessons of four different categories which included Enhanced Learning Experience, Nature of Interaction, Maintaining Attention, and Distinct Characteristics of the Technology. The interviews and group discussions were recorded on audio tape and later transcribed. The authors concluded that the IWBs enhanced the ease of the lessons but not the creativity or interaction. A question arose as to whether the IWB merely replaces existing presentation devices, and it was found that creativity was determined by the teacher, not by the technology used.

This data can be used by all teachers, whether or not they use an IWB, so they can become more informed of what an IWB can and cannot do. This research indicates that a teacher who wants to be more creative and learn to use an IWB for lessons and assessments will have to do that on their own.