Mathematics Improvement Network



Formative Assessment How can it improve teaching and learning?

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Workshop Outline

- Assessing Students
- What is Formative Assessment?
- Five Formative Assessment Strategies:
 - Clarifying Learning Intentions
 - Eliciting Evidence of Student Learning
 - Giving Formative Feedback
 - Students as Learning Resources for One Another
 - Students Taking Ownership of Their Own Learning
- Reflections



Assessing Students

Assessment Methods



- How do we assess our students?
- Which assessment methods *improve* our teaching and students' learning?

Reasons for Assessment

We assess our students for many reasons, for example, to:

- 1. maintain records so that teachers or parents can be informed of progress
- 2. celebrate achievement, rewarding effort and success
- **3. select** learners for groups, courses, careers
- 4. diagnose student difficulties and so inform teaching
- 5. motivate learners by showing them what we value and what they still need to learn
- 6. evaluate teaching methods to see which work more effectively



What is Formative Assessment?

Formative Assessment

- What is 'formative assessment'? based on your experiences, readings, and understandings, how would you define/describe 'formative assessment'?
- What about 'formative assessment' is **challenging** when used in the classroom?
- Take a couple of minutes, on your own, to think, and then discuss at your table with a partner. Be prepared to share with the whole group.

Summative & Formative Assessment

- Summative evaluates student learning at the end of an instructional period, often generating a score that can be compared against a standard or benchmark
- Formative recognizes ongoing achievements and difficulties during an instructional period, without grading, allowing teachers and students to take appropriate action as the course progresses

Formative Assessment Definition

'... all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged. Such assessment becomes 'formative assessment' when the evidence is actually used to adapt the teaching work to meet the needs'.

(Black, P., & Wiliam, D. (1998). Inside the black box: raising standards through classroom assessment. Phi Delta Kappan, 80(2), p.140)

Using the Evidence

'Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited'.

(Black, P. J., & Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability,* 21(1), p. 9)

What We Need to Know



Five Formative Assessment Strategies

Five Formative Assessment Strategies

- 1. Clarifying and sharing learning intentions and criteria for success
- 2. Engineering effective classroom discussions, questions, and learning tasks that elicit evidence of learning
- 3. Providing feedback that moves learners forward
- 4. Activating students as instructional resources for one another
- 5. Activating students as the owners of their own learning

(Wiliam, D., & Thompson, M. (2007). Integrating assessment with learning: What will it take to make it work?)

Instructional Processes Framework

	Where the learner is going	Where the learner is now	How to get there
Teacher	1. Clarifying, understanding, and sharing learning intentions	2. Eliciting evidence of student learning	3. Providing feedback that moves learners forward
Peer		4. Activating students as learning resources for one another	
Learner		5. Activating students as owners of their own learning	

Adapted from Wiliam and Thompson (2007)

Do These Strategies Improve Learning?

'We checked many books and nine years' worth of more than 160 journals, and earlier reviews of research. This process yielded 580 articles or chapters to study. We prepared a review using material from 250 of these sources'.

All... studies show that... strengthening... formative assessment produces significant, and often substantial, learning gains. These studies range over ages, across several school subjects, and over several countries ...' (Typical effect sizes 0.4 to 0.7)

(Paul Black and Dylan Wiliam, 'Assessment and Classroom Learning', Assessment in Education, March 1998, pp. 7-74)

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1. Clarifying Learning Intentions

Clarifying Learning Intentions

Procedural Fluency

- Carrying out procedures accurately and fluently
- Conceptual Understanding
 - The ability to describe and define a mathematical object, represent it in different ways, explain its properties, explain why a mathematical statement is true, or why a procedure works

Problem Solving Strategies

The ability to make strategic decisions when solving problems, to reason, to prove and communicate results

Classroom Challenges

http://map.mathshell.org

Conceptual Understanding

CONCEPT DEVELOPMENT

Mathematics Assessment Project CLASSROOM CHALLENGES A Formative Assessment Lesson

Interpreting Distance-Time Graphs

Mathematics Assessment Resource Service University of Nottingham & UC Berkeley

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Grade 8 lesson

Helps to identify students who:

- interpret distance time graphs as pictures of situations
- have difficulty relating speeds to slopes of these graphs

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2. Eliciting Evidence of Student Learning

Classroom Challenge Structure

Before the lesson

Individual task

Students work unaided on an assessment task

Teacher reviews work and prepares qualitative feedback

The lesson

Collaborative activity

After a whole class introduction, students work in small groups on a collaborative task

Small group discussion

Students compare their work with their peers

Whole class discussion

Students share as a whole class what has been learned

After the lesson

Individual reflection

Students reflect on their pre-assessment and use what they have learned to complete a post-assessment task

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Initial Individual Task

Before the lesson, students work on a task designed to reveal their current understandings and difficulties

Journey to the Bus Stop Every morning Tom walks along a straight road from his home to a bus stop, a distance of 160 meters. The graph shows his journey on one particular day. 200 180 160 140 120 Distance from 100 home in meters 80 40 50 60 70 80 90 100 110 120 10 20 30 Time in seconds Describe what may have happened. You should include details like how fast he walked. 2. Are all sections of the graph realistic? Fully explain your answer

Journey to the Bus Stop

Every morning Tom walks along a straight road from his home to a bus stop, a distance of 160 yards.

The graph shows his journey on one particular day.

- 1. Describe what may have happened.
- 2. Is the graph realistic? Why?

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3. Giving Formative Feedback

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Giving Formative Feedback

Handout 2 contains some examples of student work for the Journey to the Bus Stop task.

- 1. What does each student's response tell you about his or her capacity to tackle the task?
- 2. If you were the teacher of these students, what formative feedback would you give them, to help them improve their understanding or methods?

Try to frame this feedback in the form of oral questions you could ask in the classroom.

Journey to the Bus Stop: Alice's Response

Tom walked along a road for 100 yards. Instead of walking another 30 yards he took a short cut down an alleyway which took him 20 minutes. He walked very quickly then he caught the bus to his College which took about 50 minutes

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Journey to the Bus Stop: Ben's Response

'When he get out he starts walking fast to the bus stop then he slows down then he picks up the speed again and then this speed goes constant'.

Common Issues Table

Common issue	Possible questions and prompts
Student interprets the graph as a picture E.g. as the graph goes up and down, Tom's path goes up and down.	 If a person walked at a steady speed up and down a hill, <i>directly away from</i> <i>home</i>, what would the graph look like?
Student interprets graph as speed–time E.g. The student has interpreted a positive slope as speeding up and a negative slope as slowing down.	 How can you tell if Tom is traveling away from or towards home?
Student fails to mention distance or time E.g. The student has not worked out the speed of some/all sections of the journey.	 Can you provide more information about how far Tom has traveled during different sections of his journey?
Student fails to calculate and represent speed	 Can you provide information about Tom's speed for all sections of his journey?
Student adds little explanation as to why the graph is or is not realistic	 Is Tom's fastest speed realistic? Is Tom's slowest speed realistic? Why?/Why not?

Counting Trees Task

Circles show old trees

How could you estimate the number of trees of each type? Explain your method.

Use your method to estimate the number of old trees and young trees.

Students' Responses to Feedback

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4. Students as Learning Resources for One Another

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Introducing the Collaborative Task

- A. Tom took his dog for a walk to the park. He set off slowly and then increased his pace. At the park Tom turned around and walked slowly back home.
- B. Tom rode his bike east from his home up a steep hill.
 After a while the slope eased off. At the top he raced down the other side.

C. Tom went for a jog. At the end of his road he bumped into a friend and his pace slowed. When Tom left his friend he walked quickly back home.

Time

Annotating the Graph

Matching Graphs and Stories

Adding a Different Representation

G

Distance from

Home

Opposite Tom's home is a hill. Tom climbed slowly up the hill, walked across the top, and then ran quickly down the other side.

stop and waited. He realized that he had missed the bus so he walked home.

Q		
	Time	Distance
	0	0
	1	10
	2	20
	3	40
	4	60
	5	120

Ρ,		
	Time	Distance
	0	0
	1	40
	2	40
	3	40
	4	20
	5	0

Time

Tom walked to the store at the end of his street, bought a newspaper, and then ran all the way back.

6

Tom ran from his home to the bus

Sharing Posters

	Where the learner is going	Where the learner is now	How to get there	
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5. Students Taking Ownership of Their Own Learning

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Individual Reflection

Sylvia bikes along a straight road from her friend's house, a distance of 7 miles.

The graph shows her journey.

Describe what may have happened.

Include details like how fast she bikes.

Student Ownership Opportunities

• Students assess work containing errors

Students imagine they are teachers and assess the work. They underline mistakes, state the correct answer and explain the thinking that could have led to the mistake, writing advice for the work's author

• Students produce a revision guide

With worked examples, explanations of key words and full answers

• Students create their own class test

Devising questions to test understanding of a mathematical idea, producing an answer and scoring scheme and then marking the test

Students interview each other

Asking questions like 'what were you expected to learn/have you learnt?', 'what did you find hard to understand/are still confused by?', 'what did you understand well?', 'what mistakes did you make?' etc.

Reflections

Formative Assessment Opportunities

- a. Students work on an individual task designed to reveal their current understandings
- b. Teacher reviews this work, creating questions for students to answer in order to improve their solutions
- c. Whole-class introduction provides guidance on how to work through the collaborative task
- d. Students work in small groups matching written descriptions with graphs
- e. Tables of data are added to match with existing matches
- f. Students share their work with another group
- g. As a whole-class, significant learning points are discussed
- h. Students return to original task and try to improve their individual work on a post task

Supporting Formative Assessment

- **Student feedback** e.g. mini-whiteboards, manual signaling, traffic light colors, no hands up, popsicle sticks, exit cards
- Classroom response systems using technology e.g. Kahoot, clickers
- Presentation of work e.g. posters, students presenting to class
- Self assessment e.g. opportunities for students to reflect
- **Peer assessment** e.g. sharing/exchanging work, sample student work used in some Classroom Challenges

Five Formative Assessment Strategies

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Thank you

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