

INTRODUCING FORMATIVE ASSESSMENT

PROFESSIONAL DEVELOPMENT GUIDE

Introduction

Research shows that teaching is more effective when it assesses and uses prior learning so that the teaching may be adapted to the needs of students (Black & Wiliam, 1998)¹. Prior learning may be uncovered through any activity that offers students opportunities to express their understanding and reasoning. This process, often referred to as formative assessment, may be defined as:

"... 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 & Wiliam, 1998, p. 91)¹

This module considers the different ways this can be done and focuses on the following questions:

- How can problems be used to assess performance?
- How can this assessment be used to promote learning?
- What kinds of feedback are most helpful for students and which are unhelpful?

Activities

Activity A: What is formative assessment?	3
Activity B: Teachers' own experiences of formative assessment	4
Activity C: Principles and strategies for formative assessment	5
Activity D: Analyse students' responses to problem-solving tasks	6
Activity E: Observing formative assessment in action	7
Activity F: The effects of feedback on student learning.....	9
Activity G: Exchanging experiences.....	11

Time

Approximately 3 hours (or two 1½ hour sessions) plus teaching time

Acknowledgement:

In preparing this material, we acknowledge the permissions given by the Bowland Charitable Trust to adapt the professional development resources, Bowland Maths (www.bowlandmaths.org), that they had previously funded the University of Nottingham to produce for the UK. This includes many of the handouts and most of the video extracts. Additional resources were also adapted from *Improving Learning in Mathematics*, a government funded program in the UK and from the *Mathematics Assessment Project* funded by the Bill and Melinda Gates Foundation.

© 2010 Centre for Research In Mathematics Education University of Nottingham, adapt for FaSMEd by African Institute for Mathematical Sciences School Enrichment Centre and University of Duisburg-Essen.

¹ Black, P., & Wiliam, D. (1998). *Inside the black box: raising standards through classroom assessment*. London: King's College London School of Education 1998.

Research to help your planning for this module

Black, P., & Wiliam, D. (1998). *Inside the black box: raising standards through classroom assessment*. King's College London School of Education.

Now published by GL Assessment:

<http://shop.gl-assessment.co.uk>

This short booklet offers a summary of the extensive research literature into formative assessment. It shows that there is clear evidence that using formative assessment raises standards, and suggests how formative assessment can be improved. This booklet is essential reading for all teachers.



Black, P., & Harrison, C. (2002). *Working inside the black box: Assessment for learning in the classroom*. King's College London School of Education.

Now published by GL Assessment:

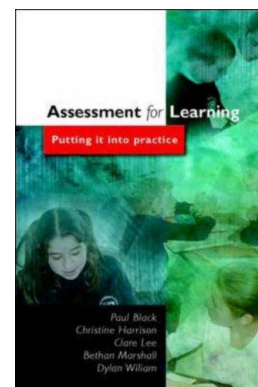
<http://shop.gl-assessment.co.uk>

In this booklet, the authors describe a project with teachers in which they studied practical ways of implementing formative assessment strategies and the effect this had on learning. The section on feedback and marking (pages 8-9) are particularly relevant to this module.



Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: Putting it into practice*. Buckingham: Open University Press.

This book gives a fuller account of the earlier booklets *Inside the black box* and *Working inside the black box*. It discusses four types of action: questioning, feedback by marking, peer- and self-assessment and the formative use of summative tests. The section on feedback and marking (pages 42-49) is particularly relevant to this module, while the section on peer and self-assessment (pp 49-53) is relevant for module *Improving student collaboration*.

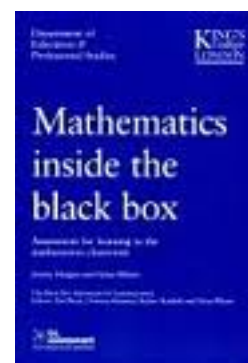


Hodgen, J., & Wiliam, D. (2006). *Mathematics inside the black box*. King's College London School of Education.

Now published by GL Assessment:

<http://shop.gl-assessment.co.uk>

This booklet applies the above findings specifically to Mathematics. It considers some principles for Mathematics learning, choice of activities that promote challenge and dialogue, questioning and listening, peer discussion, feedback and marking, and self and peer assessment. This booklet is essential reading for all mathematics teachers.



Activity A: What is formative assessment?

The different types and purposes of assessment

Start this activity with a group discussion about the different types and purposes of assessment. You might like to use the questions here as a starting point.

- Why do you assess students?
- What different purposes do your assessments serve? Make a list.

Their list of reasons might include: diagnosing difficulties; celebrating achievement; motivating students; selecting students for classes; maintaining records to keep teachers and parents informed of progress; to assess teaching methods.

To summarise, there are two main purposes of assessment:

- *Summative assessment* - to summarise and record overall achievement at the end of a course, for promotion and certification. Most 'high stakes' tests and external examinations are designed for this purpose. Summative assessment is also used to evaluate the relative effectiveness of a particular course, teaching method, or even an institution. Summative assessment is sometimes called *Assessment of Learning*.
- *Formative assessment* – to recognise achievements and difficulties at the beginning or during a course, so that teachers and students can take appropriate action. This type of assessment forms an integral part of all teaching and learning. Formative assessment is sometimes called *Assessment for Learning*.

The potential of formative assessment to improve learning

Briefly mention the research evidence that sets out the case for formative assessment. This is summarised by Black and Wiliam in several accessible publications for teachers (see p. 2), most of which are freely downloadable from the Internet. These researchers set out to find out whether or not improving formative assessment improves 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..." (Black and Wiliam, 1998)².

This module will examine the implementation of formative assessment, based on this and other research. Give the teachers each a copy of **Handout 1: The importance of formative assessment**. Note that this handout includes reference to one of the four research publications on page 2 of this guidance. You might like to refer to the other three in your discussions.

² Black, P. and Wiliam, D. (1998). "Assessment and Classroom Learning", Assessment in Education, pp. 7-74.

Activity B: Teachers' own experiences of formative assessment

What do teachers know about their students and what action do they take as a consequence?

Ask participants to work in pairs for this activity. Ask them to think about the following questions and to discuss their responses with their partners.

- What strategies do you use to find out what your students know and understand?
- Think of two students in your class, one who is particularly strong and one who is finding the work very difficult. Take it in turns to describe the students' strengths and difficulties to your partner, in as much detail as possible.
- How did you become aware of these strengths and difficulties? On what evidence do you base your judgments? Test results? Memories of oral responses during lessons? Observations of the student working? Written work?
- In what ways do your assessments of these students affect your lesson planning? Give examples.

What difficulties do teachers encounter?

Issue participants with copies of **Handout 2: Difficulties with formative assessment** and ask them to work through the difficulties on the handout in the same pairs. They can make a note of their responses to the following questions on their handouts.

- How far are the difficulties on the handout valid in your context?
- If any are, then what may be done about them?
- How would you answer a teacher who asks the following? What approaches would you suggest that they use?
- “I know it makes sense to assess students as we go along, but how can I, in the midst of a lesson, know what each of my 30 students is thinking?”

Activity C: Principles and strategies for formative assessment

Issue participants with a copy of **Handout 3: Principles for formative assessment**. The ideas presented here are all drawn from research into formative assessment.

- Bearing in mind the difficulties discussed in Activity B, how would you suggest that your formative assessment practices be improved?
- Discuss the principles and strategies outlined on **Handout 3**.
 - Which of these do you currently use in your own teaching?
 - Which do you find most difficult? Why?
- What other principles or strategies do you think are important?

Show the teachers the video found on the Mathematics Assessment Project website³. Before you do this, tell them that you want them to consider, as they watch, what formative assessment strategies the teacher used. In particular, ask them to focus on how teachers gathered information about their students' current levels of understanding.



Video: Using formative assessment strategies

This video demonstrates how some teachers in English schools used a range of approaches, including mini whiteboards, posters and observations, to assess students informally.

Hold a discussion about what the group noticed and ask them how well they think these approaches work in terms of formative assessment. Emphasise, however, that gathering information is not formative assessment; it is important that teachers use their own knowledge of mathematics, teaching, the students' learning trajectories and knowledge of the individual students to make inferences about the students' understandings and to use this information to inform teaching.

NOTE: The module *Technology for Formative Assessment* discusses not only the non-digital technologies (e.g. mini whiteboards) shown in the video, but also some digital technologies that can be used to help make the thinking of the students visible. You might like to refer to that module at this stage.

³ http://map.mathshell.org/pd/modules/1_Formative_Assessment/html/videos_c1.htm

Activity D: Analyse students' responses to problem-solving tasks

In this activity, teachers are provided with two problems together with four student responses to each. The tasks are: *Counting Trees* and *Cats and Kittens*. These tasks use a variety of mathematical content, but both focus on problem solving and modelling skills. Often, such tasks prove more difficult than the individual elements of mathematical content would suggest, as students are required to choose and combine techniques in non-routine ways.

Briefly discuss problem-solving tasks with the group, particularly pointing out that it is difficult to assess the process skills involved in problem solving using traditional summative assessment. Using formative assessment allows teachers to monitor students' progress, however.

Give teachers:

Handout 4: *Problem-solving in the classroom* (brief discussion about problem-solving and a summary of what is in Handouts 5, 6 and 7);

Handout 5: *Counting trees* (a problem solving task with four sample responses and some questions for teachers to respond to);

Handout 6: *Cats and kittens* (a problem solving task with four sample responses and some questions for teachers to respond to);

Handout 7: *Suggestions for questions* (a list of generic questions related to the four phases involved in problem-solving referred to in **Handout 4**).

Use **Handout 4** to explain what the teachers should do next.

If you are working with a larger group of teachers, divide them into smaller groups to work through and discuss **Handout 5, 6 and 7**. Ask each group to read through the tasks on **Handout 5** and **Handout 6** and then to choose the task that would be most suitable for a class they will soon teach.

- Consider the four student responses in **Handout 5** and **Handout 6**.
- What does each student's response tell you about his or her capacity to use each of the processes required in problem solving: represent, analyse, interpret and evaluate, communicate and reflect?
- What questions you could use to help these students move on? (Refer to the generic questions in **Handout 7**)

Note: The professional development module *Improving learning through questioning* also considers, in some detail, ways in which teachers can respond to students' answers to problem-solving tasks. The list of questions included on **Handout 7** could also be used there; you should choose when you want to use it and at which stage you want to hold a discussion about formative assessment and problem-solving.

Activity E: Observing formative assessment in action

Explain to the group that you will be showing them two video clips of three British teachers: Andrew, Dominic and Amy. They taught the lessons referred to in previous activities, *Counting Trees* and *Cats and Kittens*. They also taught a lesson called *Security Cameras*, which can be found on the Mathematics Assessment Project website at this address:

<http://map.mathshell.org/lessons.php?unit=6305&collection=8>.

In an earlier lesson, these teachers had asked students to attempt one of the tasks individually, with no help. They then collected in their students' responses, assessed the work qualitatively and prepared written feedback in the form of questions.

In the first video⁴, the teachers discuss the feedback they gave on the three tasks, and also, importantly, how they felt and what they learned.



Video: Teachers discussing feedback

Give the teachers **Handout 8: Formative assessment in action**, on which they should write their responses to the video.

- The teachers discuss the comments and questions they wrote on their own students' work.
- To what extent do their comments resonate with your experience?

⁴ http://map.mathshell.org/pd/modules/1_Formative_Assessment/html/videos_d1.htm

The second video clip⁵ is taken from the follow-up lesson. In pairs, students have compared their work and most have solutions that are different to those of their partners. Explain that in the video, they will see:

- Andrew exploring how students respond to his feedback on the "counting trees" problem;
- Amy listening to, then questioning, individuals as they try to share their ideas and produce joint solutions to the "security camera" problem;
- Dominic listening to presentations from students on their methods and reasoning for the "cats and kittens" problem;
- Amy concluding her lesson by asking students to describe how they have used her feedback to improve their work.

Ask them to look out for the different kinds of assessments used by the teachers.



Video: Observing Formative Assessment

- Watch the video and consider the following questions:
- What different kinds of assessment can you see?
- What is the purpose of each kind of assessment?
- What do both the teachers and students learn?

Hold a discussion, referring the teachers to the questions on **Handout 8**, and asking them to write down some notes to each of the questions. You might like to refer to the five key strategies for formative assessment (see **Handout 3**):

- Clarifying/ Understanding/ Sharing learning intentions and criteria for success,
- Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding,
- Providing feedback that moves learners forward,
- Activating students as instructional resources for one another,
- Activating students as owners of their own learning.

⁵ http://map.mathshell.org/pd/modules/1_Formative_Assessment/html/videos_e1.htm

Activity F: The effects of feedback on student learning

So far we have focused on the teachers' role in providing assessment feedback, mainly in the form of questions, to students. In this activity we will consider the use students make of different types of feedback and the impact this has on their learning.

Watch the video⁶ of Andrew's students as they discuss the impact of assessment feedback on their learning. Ask the teachers to make rough notes about their thinking about what the students are saying.



Video: Students discussing impact of feedback

- Which of their comments strike you as particularly important?
- What are the implications of their comments?

Distribute **Handout 9: The effects of feedback on students' learning**.

This handout presents some results of research from Black and Wiliam (1998)⁷ into the relative merits of feeding back assessment information to students in different forms. In particular, it compares the a) effects of feeding back quantitative information in the form of marks, levels and rankings with b) the effects of offering qualitative information in the form of specific, content-focused feedback.

Ask the teachers to read the handout and respond to the questions.

- The dangers of giving marks, levels, rewards and rankings
- What are the implications of this for your practice?
- What would happen if you stopped giving marks or levels on pupils' work?
- Why are so many teachers resistant to making this change?
- The advantages of giving clear, specific, content-focused feedback
- What are the implications of this for your practice?
- Does this kind of feedback necessarily take much longer to give?

⁶ http://map.mathshell.org/pd/modules/1_Formative_Assessment/html/videos_g1.htm

⁷ Black, P., & Wiliam, D. (1998). *Inside the black box: raising standards through classroom assessment*. London: King's College London School of Education.

In your follow-up discussion, emphasise again that research shows that students benefit most from feedback that:

- focuses on the task, not on grades or scores;
- is detailed rather than general;
- explains why something is right or wrong;
- is related to objectives;
- makes clear what has been achieved and what has not;
- suggests what the student could do next;
- offers specific strategies for improvement.

Conclude this module by discussing some ways of applying what has been learned in this professional development module to other mathematics lessons.

Suggest to the teachers that they plan their own formative assessment lesson for a problem solving task such as *Counting Trees* or *Cats and Kittens*. If they want further ideas for problem solving lesson, they could visit the Mathematics Assessment Project website, where there are about thirty problem-solving lessons. (There is a hyperlink provided in the PowerPoint accompanying this module).

It is important that they make the lesson 'their own' but they might like to base their plan on the one provided in **Handout 10: A formative assessment lesson plan**. Teachers should be ready to report back to the group in the next professional development session.

Activity G: Exchanging experiences

After the teachers have implemented their planned lessons in the classroom, meet together to discuss what happened. Begin by asking the teachers to answer the following questions on

Handout 11: *Exchanging experiences.*

- Consider the following questions:
- What worked well and less well in terms of formative assessment?
- What did you learn about the students' understanding from the initial activity?
- How did the students respond to your feedback?
- What worked well and less well in terms of problem solving?
- What are the implications of this lesson for your future teaching?

Then ask teachers to share their experiences of teaching a problem solving lesson, focusing in particular on how they used formative assessment. Some teachers may want to share their students' work as examples to highlight learning progressions or difficulties. For this reason, make sure to ask the teachers to bring interesting student solutions with them to this session.