USING TECHNOLOGY FOR FORMATIVE ASSESSMENT

PROFESSIONAL DEVELOPMENT GUIDE

Introduction

This module will help teachers reflect on some of the ways in which technology can support formative assessment. The focus is on the use of digital and non-digital technologies and the ways in which these can be used to gather information about students' current levels of understanding and, in some cases, provide feedback related to their work. The module is organised according to the 'Functionalities of Technology' dimension of the FaSMEd framework (see Figure 1). Other modules in the toolkit provide guidance about ways in which teachers could use information they gather in formative ways.

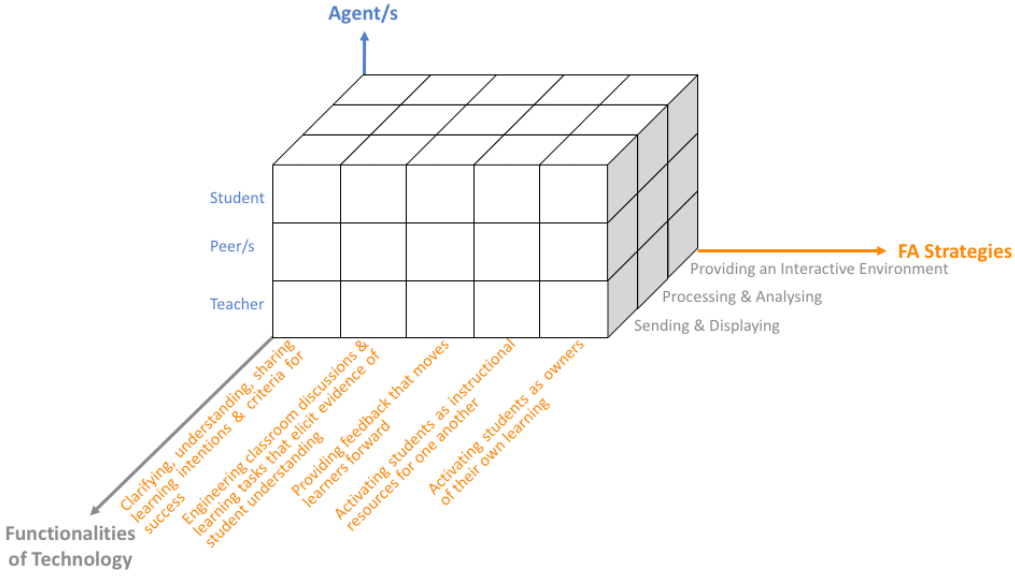


Figure 1: Overview of the FaSMEd framework[1]

Activities

Time

Approximately 2 hours

[1] For more information visit https://microsites.ncl.ac.uk/fasmedtoolkit/theory-for-fa/the-fasmed-framework

Activity A: Technology in the classroom; technology for formative assessment

Give the teachers **Handout 1:** *Technology in the classroom.* Ask them to work in pairs to think about what different technologies are available for use in mathematics and science classrooms. Ask them to list all the technologies they can think of and then to consider which technologies can help with formative assessment.

- Which technologies are available for use in mathematics/science classrooms?
- Which technologies can help you, the teacher, with formative assessment?

Ask them to compare their answers with each other.

Emphasise the fact that technology is a broad term, encompassing a wide range of instruments and devices which could be, but do not have to be, digital. Show them the slide listing a variety of technologies, and discuss.

Examples of digital technologies:

- Computers, tablets, smart phones, calculators;
- Projection technology, including interactive whiteboards;
- Data logging, dynamic geometry software, computer algebra systems.

Examples of non-digital technologies:

- Pens, pencils, chalk;
- Paper, mini-whiteboards;
- Cuisenaire rods, vernier calipers, counters, playing cards.

As a group read through the comments of Fred, Archie and Jane on **Handout 1**. Ask the teachers to work in pairs to discuss the differences between what Fred and Archie say, and what Jane says, and to write their own answers in the space provided.

To remind teachers about key aspects of formative assessment, engage them in a discussion and ask them to give their own definitions of formative assessment. You may like to display the following definition given by Black and Wiliam in their seminal work in this area:

"… 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 para, 91)

The focus here, however, is on the use of technology for formative assessment. Remind the group that gathering information, as described by Fred and Archie in **Handout 1**, is not formative assessment: it is a first step but it is the teacher's (or students' or software's) response to this information that is really important.

Discuss the following questions together and ask the teachers to write their responses on **Handout 1**.

- How can technologies contribute to the processes of formative assessment?
- What is the role of the teacher in formative assessment (when technology is used)?
- Suggest better questions to ask!

Now issue **Handout 2:** *Technology and formative assessment*. Allow the teachers enough time to explore the FaSMEd framework and then point out that even if they do not fully understand what is meant by the three functionalities of technology, they should not worry as these are addressed in Activities B, C, D, E and F.

Ask them to think about the framework as a whole, to discuss it with a partner and to write their comments in the space at the bottom of the page.

Activity B: Sending and displaying

As discussed, formative assessment involves (but is not limited to) gathering information about students' current levels of mathematical/scientific understanding. Other professional development modules in this toolkit suggest ways in which this can be achieved, such as asking questions.

Technology can be used in a variety of ways to help gather this information, as seen in Fred's and Archie's examples in Activity A. Both these examples can be seen as involving students in sending information to the teachers, and in Archie's case, the answers are displayed for the whole class to see. A more familiar approach is to ask students to come to the board and write their answer, but modern technologies provide many other possibilities.

Ask teachers to discuss in pairs which technologies they think could be used for students to send and display their work as well as for teachers sharing tasks or questions with the students during a lesson. Ask them to record their shared ideas on **Handout 3:** *Sending and displaying **during** a lesson*.

- Which technologies could help you understand the current levels of understanding of individual students?
- Can you think of technologies which help students understand their own, or their peers', current understanding?
- What issues arise when student work is displayed for the whole class to see?

As a group, share the ideas of some or all of the teachers.

Together look at **Handout 3,** which gives some examples of technologies used by the FaSMEd consortium for the purposes of sending and displaying. These can be discussed with the teachers.

Then discuss the possibility of using technology to send work, and receive responses, before a lesson begins. Again ask the teachers to work in pairs and to consider both potential technologies and formative assessment possibilities associated with this idea.

Point out that there might be some issues associated with sending work out to be completed before a lesson. Some of these issues are well known, such as the relative advantages to children living in households where they are supported in completing homework. Others may relate to, for example, Internet connectivity.

Give out **Handout 4:** *Sending and displaying **before** a lesson*. Ask the teachers to consider the questions below and write their thoughts in the spaces provided on the Handout.

- How could you use technology to send work to students before a lesson?
- How would you use students' work, completed prior to the lesson, for formative assessment?
- What issues should teachers consider when sending work to be completed before a lesson?

Hold a short discussion with the group, bringing together the thinking of the teachers. Draw their attention to the text below the questions on the handout, which provides some examples of sending work prior to a lesson for formative purposes.

Activity C: Processing and analysing (using voting software)

The aspect of the FaSMEd framework called 'processing and analysing' refers mainly to the functionalities of technologies related to providing information for teachers and students about the students' performance on a given item or set of items.

Archie, in Activity A in this module, described how his class use a set of 'clickers'. He explained that he could see who had the given the correct answer to a question and who had been wrong. In this example, the clicker software processes the responses given by the children by checking them against the known correct answer. The software is able to analyse the responses student-by-student and also to aggregate the results for the whole class.

Ask the teachers to discuss in pairs how they would use this kind of information in the classroom. Give them a copy of **Handout 5:** *Processing and analysing.*

- What are the benefits to you, as a teacher, of having information about how each student responded to each question?
- What are the challenges associated with having *so much* information available?

Ask them to respond to these questions on the handout; but note also that the handout has a question relating to Activity D.

Now show the video[2] of the French FaSMEd teacher who discusses his use of clicker software. Ask the group to consider what he says with respect to the two questions above. Also ask them if any other issues arose for them.

Video: FaSMEd teacher using Clickers

[2] https://microsites.ncl.ac.uk/fasmedtoolkit/professional-development/modules-new/using-technology-formative-assessment/so-much-information/

You might like to point the teachers towards the *disrupt learning!* blog found here:

https://karenmahon.com/2012/08/02/five-tips-for-using-student-response-systems-for-formative-assessment/

This blog, written by a teacher for other teachers, provides five simple hints about using voting systems in the classroom. Note in particular, the fourth point which states: Remember that the tool is only as good as the instruction with which you are using it. Figure out what you need to know and how you want to measure it.

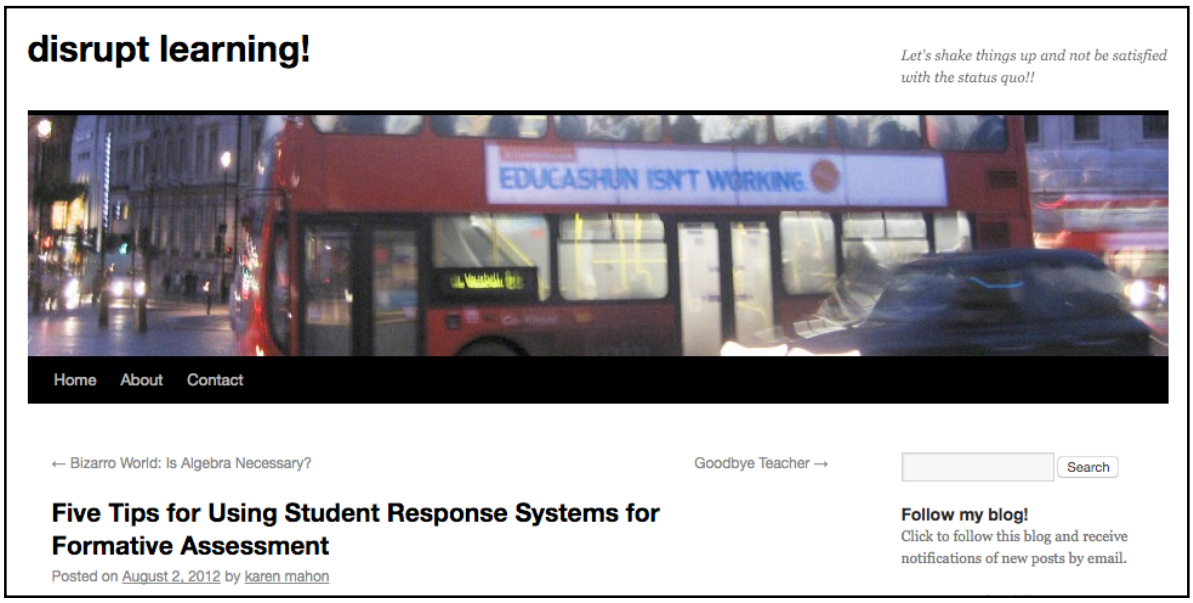


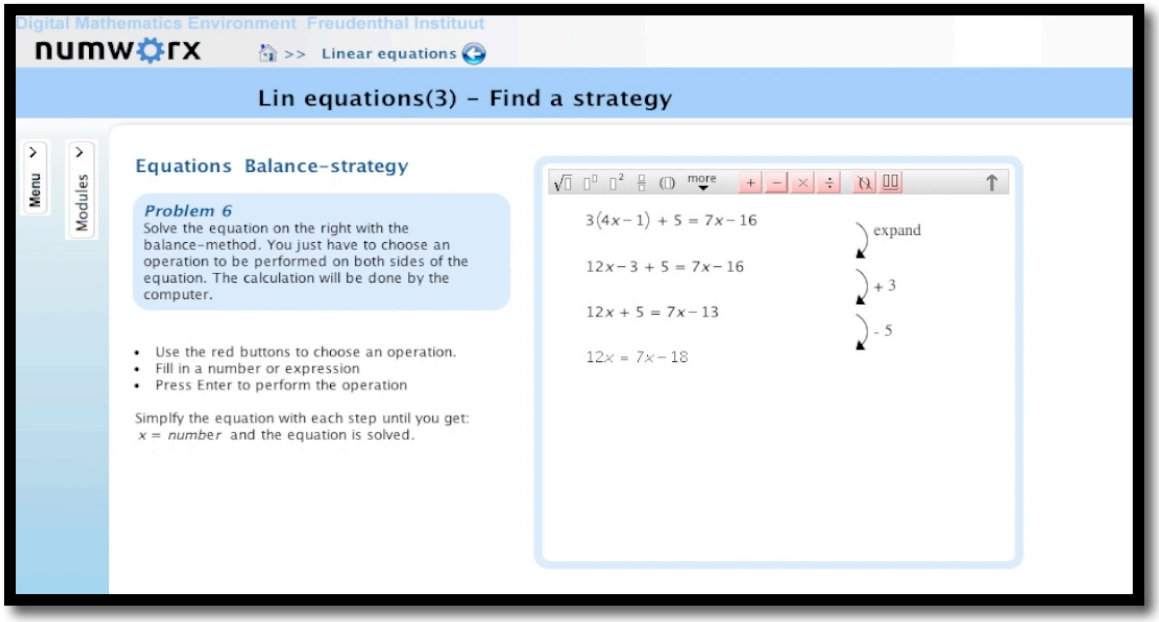
Figure 2: disrupt learning! blog

Activity D: Processing and analysing (feedback)

A key aspect of formative assessment is feedback, which was discussed in Module 1: *Introducing formative assessment.* When computer software and hardware are introduced into the mathematics classroom, the potential for providing feedback is immediately increased: this is partly due to the fact that computers are able to do some or all the mathematics that the students are asked to do and this provides opportunities for students to test out ideas and check answers (for example).

Research shows that, on the whole, feedback from the computer is of value: it is immediate, non-judgemental and costs nothing. However, research also shows that students sometimes misinterpret feedback or interpret it in ways that the teacher does not expect. They might also use a trial and improvement strategy to get a correct answer rather than using a more efficient approach. The important thing for teachers is to work out whether, when and how this sort of feedback would benefit their students.

Hold a short discussion about feedback generated by the computer, and ask them what experience they have of using computer-generated feedback. Show the video[3] of screen activity from two digital environments designed for use in the mathematics classroom: the 'Digital Mathematics Environment' (DME), which was developed by one of the FaSMEd partners and *Mathspace*, which was used by some of the teachers who worked with FaSMEd.



Video: Using computer generated feedback for formative assessment

[3] https://microsites.ncl.ac.uk/fasmedtoolkit/professional-development/modules-new/using-technology-formative-assessment/dme-and-mathspace/

Ask the teachers to work in pairs to discuss the two video clips, thinking about, for example:

- whether they would use this, or similar, software with their own classes;
- whether they prefer either of the environments, and why;
- how they think their students would respond to the feedback given by the computer;
- the extent to which the feedback is formative and helpful for student learning;
- how they would improve the feedback.

There is space on **Handout 5** for them to record their thoughts and comments.

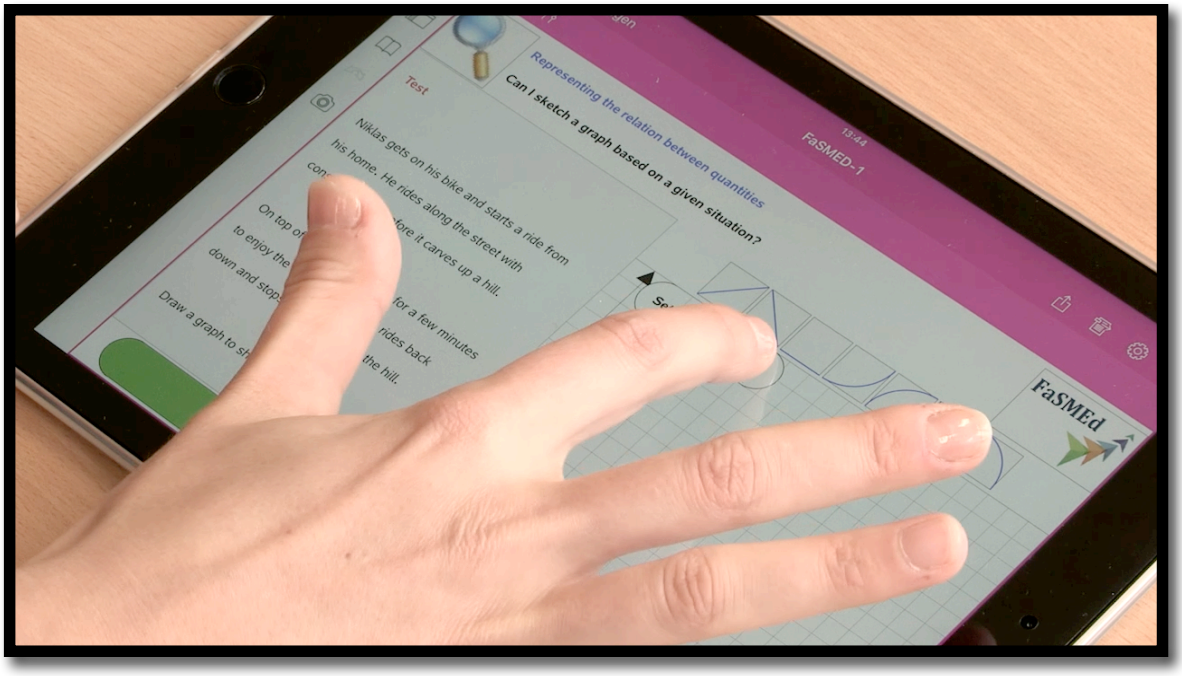
Provide the teachers with **Handout 6**: *An expert's view on using Mathspace.* While this handout refers specifically to Mathspace, many of the comments are generic and would apply to any of this type of software. Ask the teachers to read through the expert's view and discuss as a group which of these views they share and which they disagree with.

Activity E: Providing an interactive environment (self-assessment)

Whereas some software is designed to provide immediate correct/incorrect feedback for students, such as seen in Mathspace and the DME (Activity E), other software simply provides an interactive environment, and it is up to the student or teacher to make use of the functionalities of the software for their own formative purposes.

One of the FaSMEd partners, University of Duisburg-Essen, designed a software tool for students to become assessors themselves rather than having the technology evaluate their answers. Therefore, students are provided with a check-list with information on typical misconceptions in the field of functions to examine their own solution to an open assessment task. Based on this self-assessment, students can choose to view more information on their previous mistakes and work on specific practice tasks.

Show the teachers the video *Can I sketch a graph based on a given situation?*[4] In which the researcher demonstrates how the tool works and explains the thinking behind the tool. Ask them to think about how they might use a tool such as this in their own classrooms.



Video: Technology provides diagnostic feedback

Ask the teachers to work in pairs to discuss possibilities of using this software in their classrooms. Use these, or similar, questions to guide their discussion. **Handout 7**: *Providing an interactive environment (diagnostic feedback)* has space for teachers to make notes about the discussion.

- What are the implications of using this software for your teaching?
- How would your students respond to the software?
- To what extent would you describe this software as formative?

[4] https://microsites.ncl.ac.uk/fasmedtoolkit/professional-development/modules-new/using-technology-formative-assessment/essen-mathematics-case-study/

Activity F: Providing an interactive environment (interpreting on-screen activity)

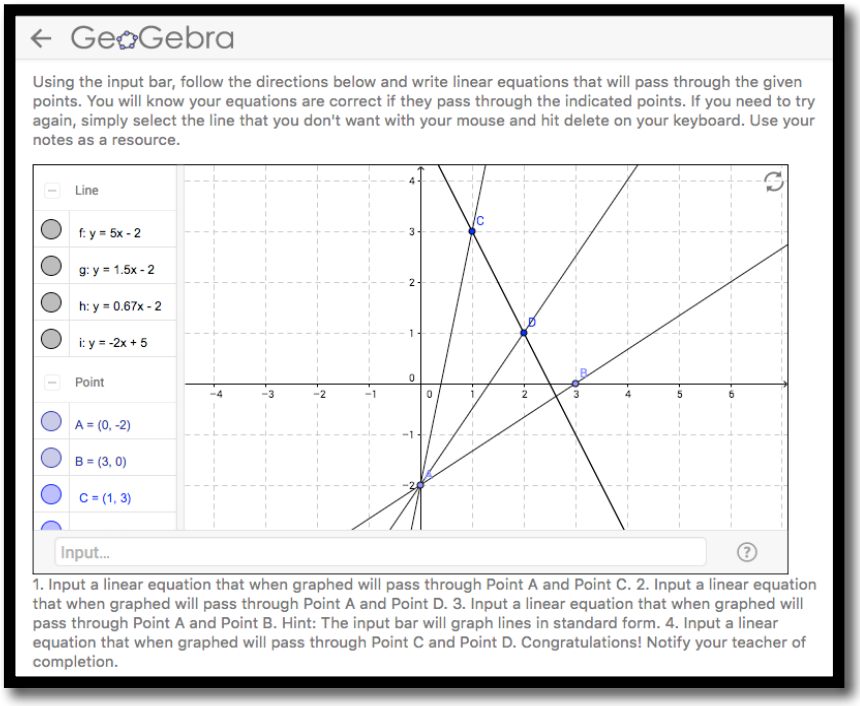
GeoGebra is free interactive software which can be used in many ways for almost all areas of mathematics, for example, geometry, algebra and functions. It is highly likely that the teachers in your group will have come across it, and they may have used it in their own classrooms.

Begin the session by finding out what teachers know about GeoGebra, asking them to share their experiences of using it in the classroom (if appropriate). Steer the discussion towards the sorts of feedback GeoGebra provides for students but keep in mind the fact that the extent of this discussion will depend on the teachers' previous experience of using GeoGebra.

If necessary explain or demonstrate that in GeoGebra students are able to type equations into an 'Input' area, and the graphs of the equations are automatically produced on the screen.

Now show the teachers the GeoGebra video[5] which has two main parts:

- A clip from a professional development presentation, by Daniel Pearcy, which discusses possibilities for students to self-check their mathematics as they go along, and then demonstrating how to create one tool (sliders) which students can use to explore mathematical objects, in this case a linear graph. The full video can be found at https://www.youtube.com/watch?v=Dbd_RqPkC9U&list=PL2-ccj9Vs8aFBtPK6vhtf6eYXJHTHZ-bf&index=4
- A screencast showing a student attempting to respond to an activity especially designed for formative assessment in GeoGebra. This activity can be found at https://www.geogebra.org/m/Xu5fNNKT.



Video: Using GeoGebra

[5] https://microsites.ncl.ac.uk/fasmedtoolkit/professional-development/modules-new/using-technology-formative-assessment/formative-assessment-geogebra/

Ask the teachers to discuss the video clips and to make notes on **Handout 8:** *Providing an interactive environment (examples from GeoGebra)*, focusing on questions such as:

- What is the role of GeoGebra in providing formative assessment?
- What is the role of the teacher?
- What sort of classroom norms would you need to establish in order to use GeoGebra in this way for effective formative assessment?

Also ask them to think about the way the student worked through the worksheet in the latter part of the video, perhaps drawing out some discussion about using a 'trial and improvement' approach which requires little connection between the equation and the graph.

This brings into question the classroom norms teachers need to establish if they are to use software in this way for formative assessment. Emphasise the importance of students taking responsibility for their own learning.

Finally, show them the quote taken from Dan Meyer's blog:

My concern with the GeoGebra applet is that the person who made the applet has done the most interesting mathematical thinking. I love creating GeoGebra applets. I generally don't have a good story for what students do with those applets, though. In this example, I suspect the student will drag the slider backwards and forwards, watching for when the numbers go from small to big and then small again, and then notice that the rectangle at that point is a square. The person who made the applet did much more interesting work.

http://blog.mrmeyer.com/2016/who-wore-it-best-maximizing-area/

As a group, discuss this quote, and then finish off the session with a short review of the module, reminding the teachers that technology can be used in at least three main ways for formative assessment:

- Sending and displaying
- Processing and analysing
- Providing an interactive environment.

Emphasise in this discussion that it is important for teachers to be clear about the respective roles of the teacher, the technology and the student when technology is used for formative assessment.

