Improving Learning through Formative Assessment using Technology

University of Nottingham

October 2015
The FaSMeD project

The research focuses on the use of iPads in mathematics lessons and how they can be used to facilitate or enhance formative assessment.

The lessons in this phase all involved some use of iPads (or laptops) but with different software and mathematical topics.
Research questions

- How do teachers **process** or **present** formative assessment data from students using a range of technologies?

- How do teachers **inform their future teaching** using such data?
Formative assessment

What is the impact from using the technology when:

• Building on student’s prior knowledge;
• Identifying and responding to students’ conceptual difficulties;
• Using questioning;
• Increasing student collaboration;
• Enabling students to become assessors?
Lesson 1: distance-time graphs

• Two diagnostic questions to start the lesson;
• Use of Showbie to send, receive and display selected student responses;
• Selected student work used to discuss and address misconceptions;
• Peer assessment and discussion based on responses to ‘mirrored’ questions.
Interpreting a graph

A walk to the shop...

One day John went for a walk to the shop. The graph shows his walk. Describe what may have happened.
A walk to the shop...

One day John went for a walk to the shop. The graph below shows his walk. Describe what may have happened.

![Graph showing walking distance over time](image)

- Distance from home (km)
- Time (minutes)

It took him 1 hour & 15 minutes to walk 5 km. Then he went back 3 km which took him 30 minutes. Then he walked 6 km in 1 hour & 15 minutes. He then stopped at 8 km for 30 minutes 😊
A long drive home

Sarah left her friend’s house at 5pm. Her drive home was expected to be 140km. She travelled at a constant speed of 80km/h for 30 minutes. She was then stuck in a stationary traffic jam for 10 minutes. The traffic then began moving at a constant speed of 60km/h for 20 minutes. Finally, the traffic cleared and she completed her journey home at a constant speed of 120km/h.

Complete the graph for Sarah’s journey.
Discussion and decisions
Completing and sharing

Sarah left her friend’s house at 5pm. Her drive home was expected to be 140km. She travelled at a constant speed of 80km/h for 30 minutes. She was then stuck in a stationary traffic jam for 10 minutes. The traffic then began moving at a constant speed of 60km/h for 20 minutes. Finally, the traffic cleared and she completed her journey home at a constant speed of 120km/h.

Complete the graph for Sarah’s journey.

Distance from home (km)

Time (minutes)
Mirrored questions

Set A

Complete the story below from the graph.

James is at his friend’s house, which is ____ from his house. He travels away from his house to see his Grandma at a _____ speed of _____ km/h for _____ minutes. He stays at his Grandma’s house for _____ minutes. He then travels home at a _____ speed of _____ km/h.

Set B

Complete the graph based on the story below.

James is at his friend’s house, which is 80km from his house. He travels away from his house to see his Grandma at a constant speed of 120 km/h for 20 minutes. He stays at his Grandma’s house for 30 minutes. He then travels home at a constant speed of 120 km/h.
Peer assessment and discussion
Lesson 2: algebraic expressions

• Diagnostic assessment prior to lesson using diagnosticquestions.com;
• Lesson plan adapted in response to the profile of student responses and reasons given;
• Use of Nearpod to send, receive and display selected student responses;
• Selected student work used to discuss and address misconceptions.
Pre-lesson diagnostic questions

https://www.diagnosticquestions.com
Selection of questions by teacher

- The above two shapes are similar. What is the value of $x$?
  - A) 18 cm
  - B) 12 cm
  - C) 14 cm
  - D) 24 cm

- Units of Measurement
  - 12 Questions
  - 4 Likes
  - A) 2800m
  - B) 0.28m
  - C) 0.028m
  - D) 2.8m

- Rearranging Formula: Step-by-Step
  - 7 Questions
  - 5 Likes
  - \( \frac{3z}{x} = \frac{6}{y} - \frac{z}{x} \)

- Quadratic Simultaneous Equations
  - \( x^2 + y^2 = 19 \)
  - \( y = x + 5 \)
  - Which of the following is a correct next step to solve these simultaneous equations?
    - A) \( x^2 + x + 25 = 19 \)
    - B) \( x^2 + y^2 = 19 \)
    - C) \( (x + 5)^2 = 19 \)
    - D) \( x + y = \sqrt{19} \)

- Inequalities Collection
  - Show $x > -1$ on a number line
    - A)
    - B)
    - C)
    - D)
Choices for student

\[-2 - (-6) = \]

A) -8  B) 8  C) -4  D) 4
Student response

\[ -2 - (-6) = \]

Two minuses make a plus
Options for student

When two minus signs are next to each other they cancel one and other out making a plus, therefore \(-2 + 6 = 4\)
Class profiles

- 58% of 27 attempts with a 13.3 age.
- Q5 shows 21 correct and 1 wrong.
- Different categories: Correct, Wrong, Class 8.1a Jv/ICB, Class 8.1aER/KW.
Questions for students

Write down an expression for the area of this shape ...

\[ \text{Area} = \frac{1}{2} \cdot n \cdot 3 \]
Class discussion
Lesson 3: Tessellation

- Students discuss common shapes and their properties with the teacher;
- Students make predictions of shapes that will tessellate;
- Students use the “Tessellation creator” app to test their predictions;
- Students explore tessellations of two or more shapes;
- Students view, assess and comment on work by their peers.
Discussing tessellation
Making predictions
Testing the predictions
Exploring further
Peer assessment

It's nice by 24/03/2012.

Izzy and Harry:

This is amazing
It is awesome
It is awesome
Cool 7/6 - jessie
The role of technology (1)

A direct replacement for paper-based methods of formative assessment?
The role of technology (2)

A replacement with the same function but additional benefits?

- Ease and speed of obtaining class profiles
- Easy access to student work in progress
- Easy access to student work for class discussion
- Less time drawing so more time for student discussion
The role of technology (3)

A replacement with the same function but some disadvantages?

- Discontinuity for the individual
- Lack of permanence
- Lack of accuracy in drawing
The role of technology (4)

A tool that significantly changes the process of formative assessment?

Presenting new questions and areas for exploration?

Changing the nature of peer assessment and discussion?
Functionality of technology in formative assessment

- Sending and sharing
- Processing and analysing
- Providing an interactive environment