

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 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

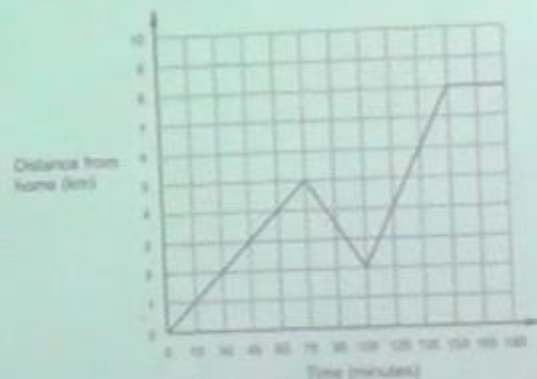
A walk to the shop...

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

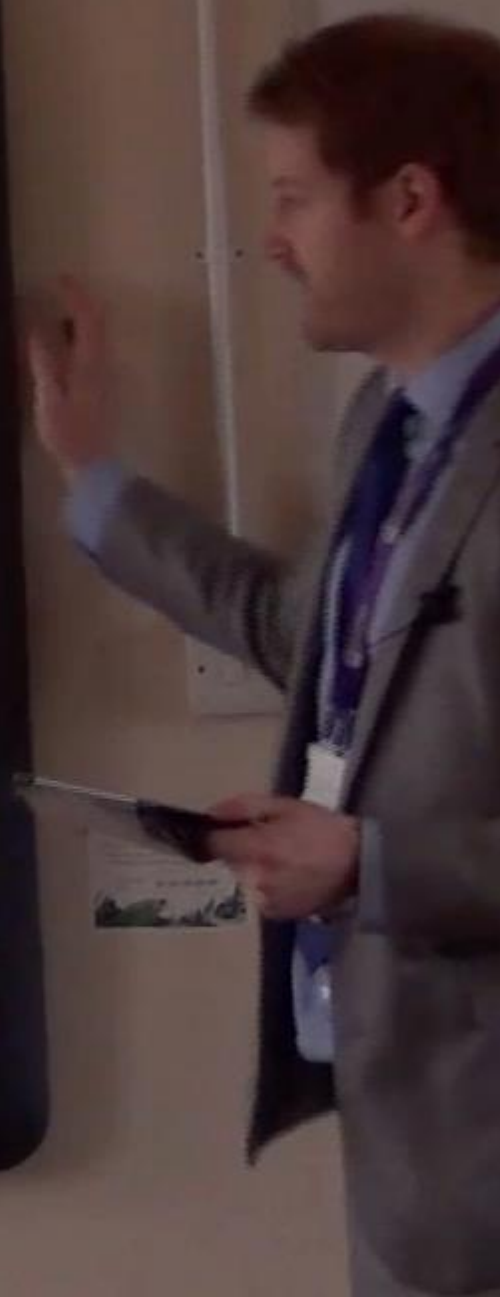


A walk to the shop...

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



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.



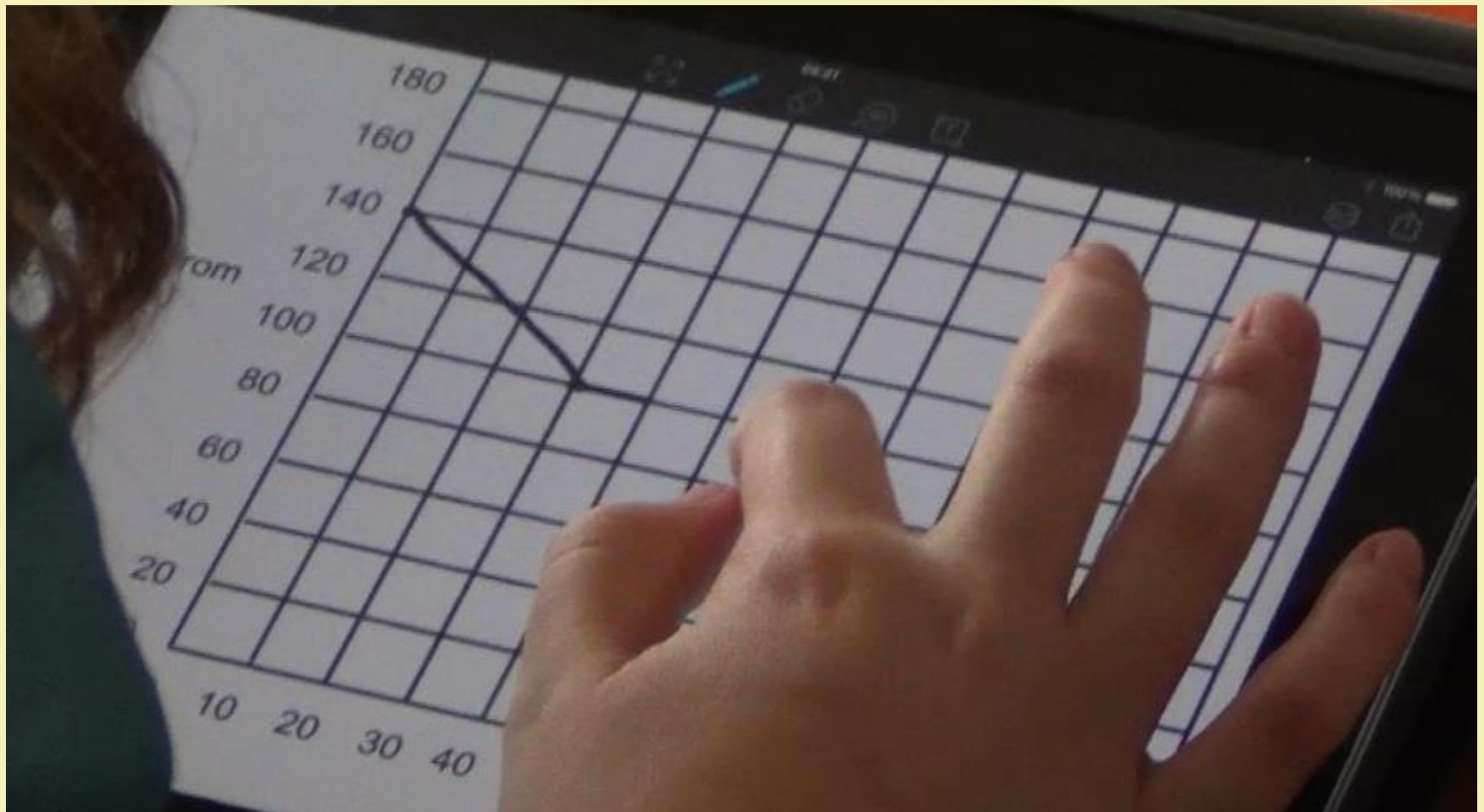
Drawing a graph

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.

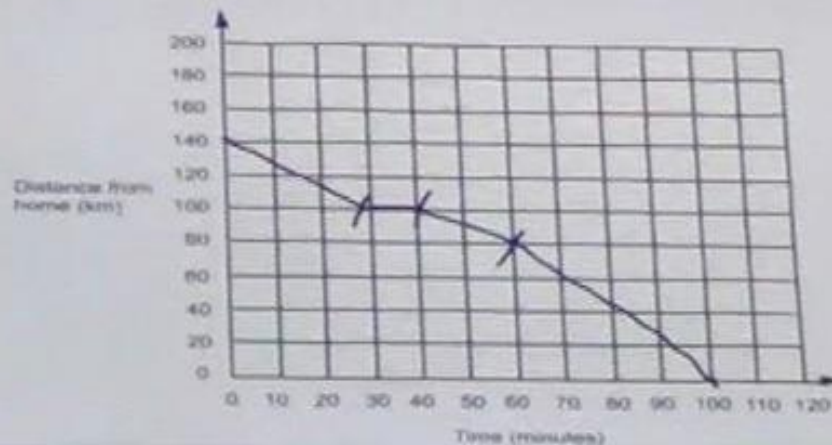
Discussion and decisions



Completing and sharing

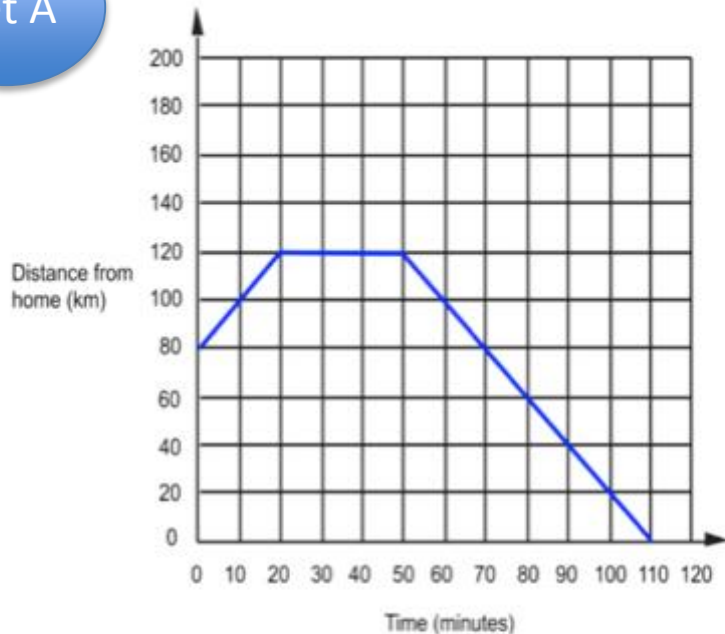
Sarah left her friend's house at 5pm. Her drive home was expected to be 140km. She travelled at a constant speed of 80km/h for 30 minutes. She was then stuck in a stationary traffic jam for 10 minutes. The traffic then began moving at a constant speed of 60km/h for 20 minutes. Finally, the traffic cleared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

Complete the graph for Sarah's journey.



Mirrored questions

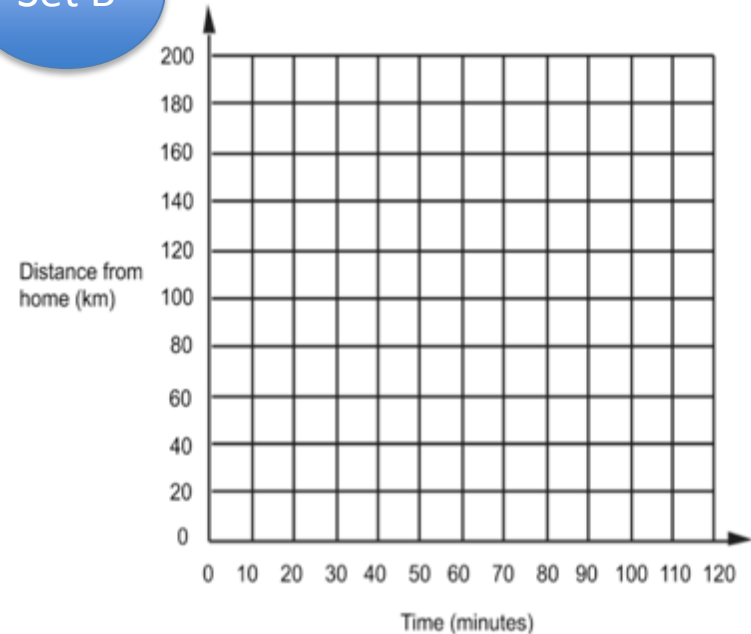
Set A



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 to 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>



The screenshot shows the homepage of the Diagnostic Questions website. The background is a dark, blurred image of a desk with a keyboard, a book, and a small electronic device. At the top, there is a navigation bar with links: Questions, Quizzes, Products (with a dropdown arrow), Data (with a dropdown arrow), About (with a dropdown arrow), LOGIN, and REGISTER. In the center, there is a logo consisting of a circle divided into four quadrants of different colors (green, blue, orange, and red). Below the logo, the text "Diagnostic Questions" is displayed in a white, sans-serif font. Underneath that, the tagline "Identifying, Understanding and Resolving Misconceptions" is written in a larger, bold, white font. At the bottom, there are four statistics presented in a grid-like fashion, each with a large number and a descriptive text below it:

7195	452449	10191	58914
Free Diagnostic Questions	Answers given by our community	Teachers sharing and creating	Students learning together

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

Length, Area and Volume Sc...

12 Questions
 4 Likes

2800m ... m

A 2800m **B** 0.28m
C 0.028m **D** 2.8m

Units of Measurement

12 Questions
 1 Likes

x y z

Which of the following is a good next step to make z the subject of the formula?

A $\frac{3z}{x} = \frac{6}{y} - 1$ **B** $\frac{3z}{xz} = \frac{6z}{yz} - \frac{z}{z^2}$
C $\frac{x}{3} = \frac{y}{6} - \frac{z}{1}$ **D** $\frac{3z}{x} = \frac{6z}{y} - 1$

Rearranging Formula: Step-b...

7 Questions
 5 Likes

$x^2 + y^2 = 19$
 $y = x + 5$

Which of the following is a correct next step to solve these simultaneous equations?

A $x^2 + x^2 + 25 = 19$ **B** $x^2 + y^2 = 19$
 $y^2 = x^2 + 25$
C $x^2 + (x + 5)^2 = 19$ **D** $x + y = \sqrt{19}$
 $y = x + 5$

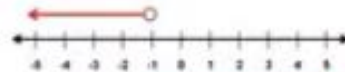


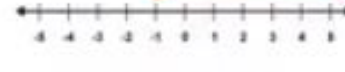
Quadratic Simultaneous Equations

$-2 - -6 =$

A -8 **B** 8
C -4 **D** 4

11a6 revision quiz 1

Show $x > -1$ on a number line

A) 
 B) 
 C) 
 D) 

Inequalities Collection

Choices for student

$$-2 - -6 =$$

A

-8

B

8

C

-4

D

4

Student response

$$-2 - -6 =$$

Two minuses make a plus

A

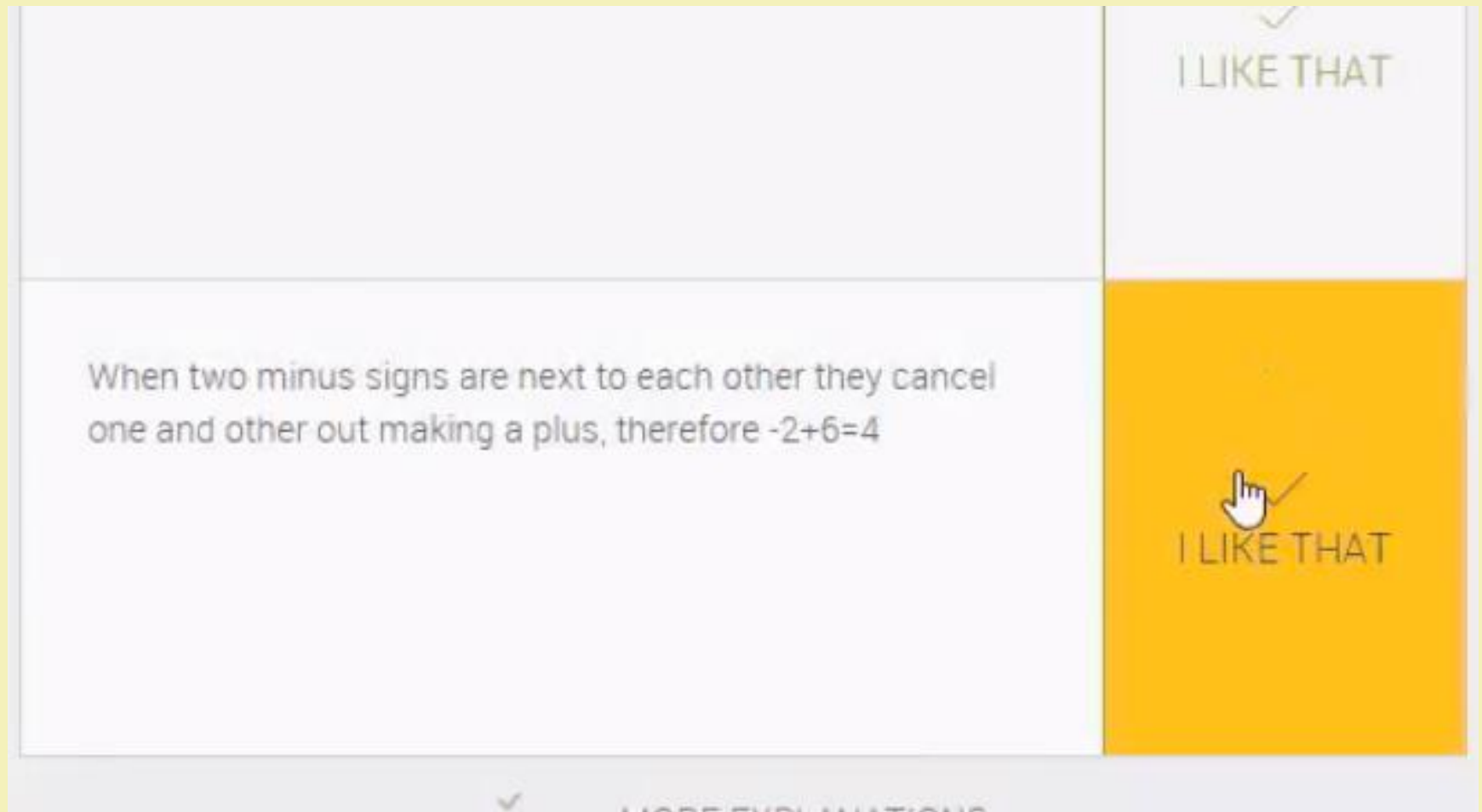
B

C

D



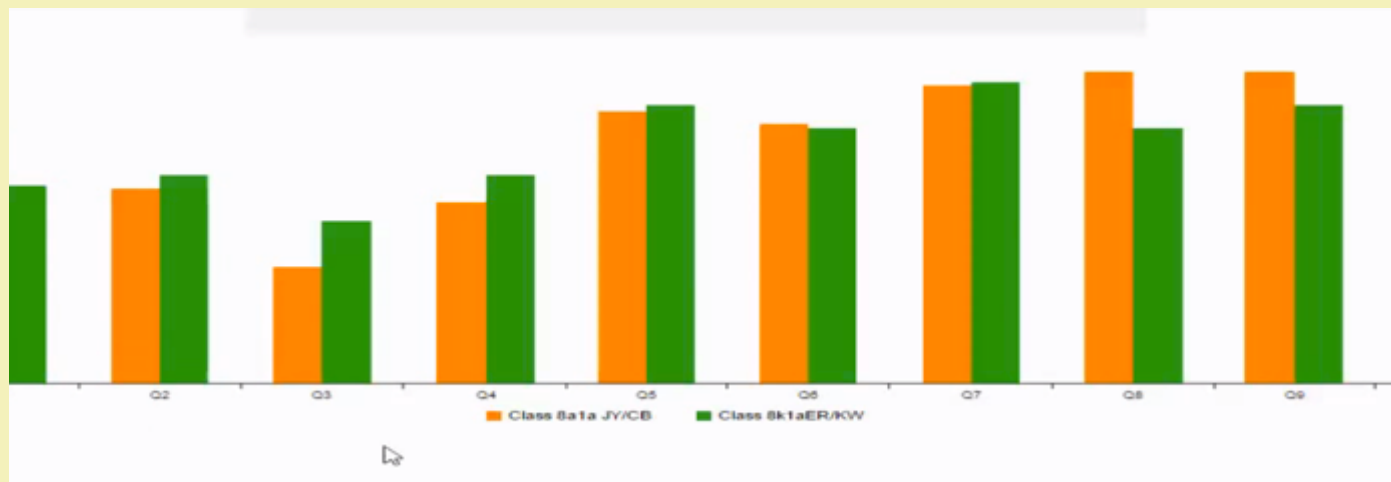
Options for student



Teacher overview

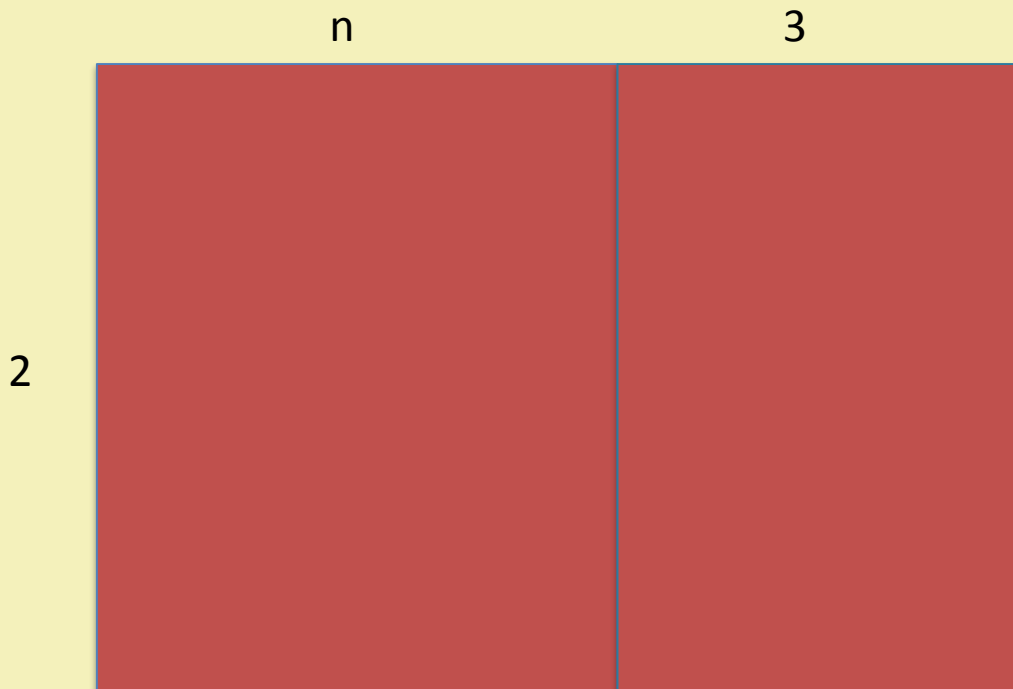
5	<p>Which of these shows an incorrect equivalent fraction? (Filled-in numbers are shown in red)</p> <p> $\frac{3}{5} = \frac{2}{10}$ $\frac{3}{5} = \frac{15}{25}$ $\frac{3}{5} = \frac{21}{35}$ $\frac{3}{5} = \frac{30}{50}$ A B C D </p>		22	Try Again View Explanations
6	<p>Point (A) is translated by the vector $\begin{pmatrix} -2 \\ 4 \end{pmatrix}$. Where does the point go?</p>	<p>Charlotte Cleary - It goes two left (-2) and 4 up (4) and it gets to point b.</p>	22	Try Again View Explanations
7	<p>A boat is travelling on a bearing of 090°. In what direction is it travelling?</p> <p> (A) West (B) East (C) North (D) South </p>		22	Try Again View Explanations

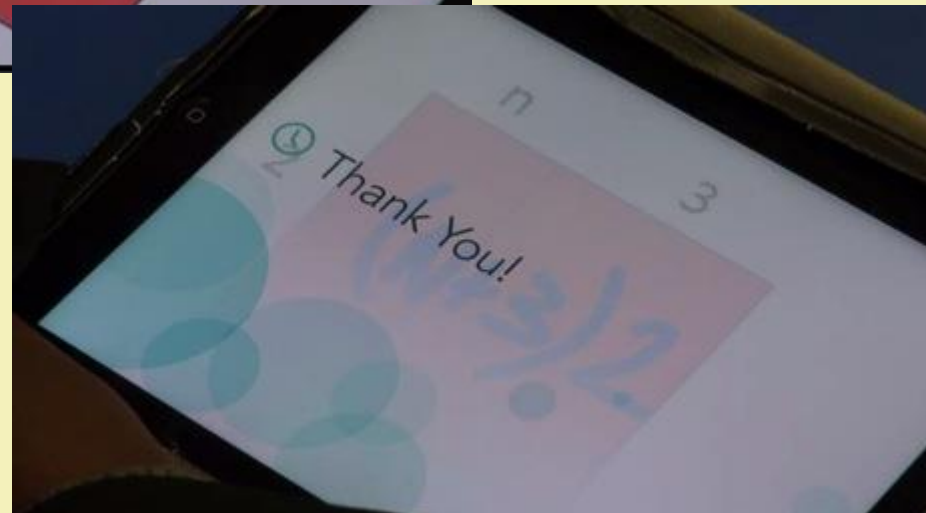
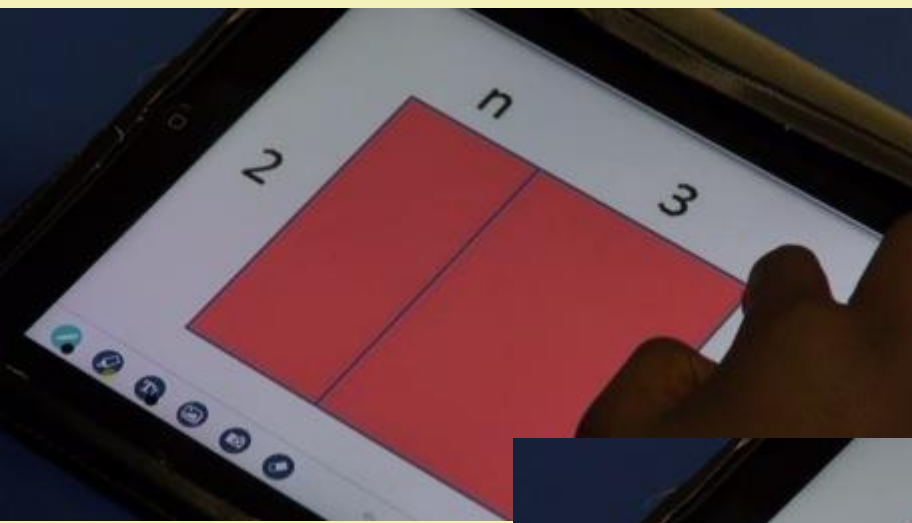
Class profiles



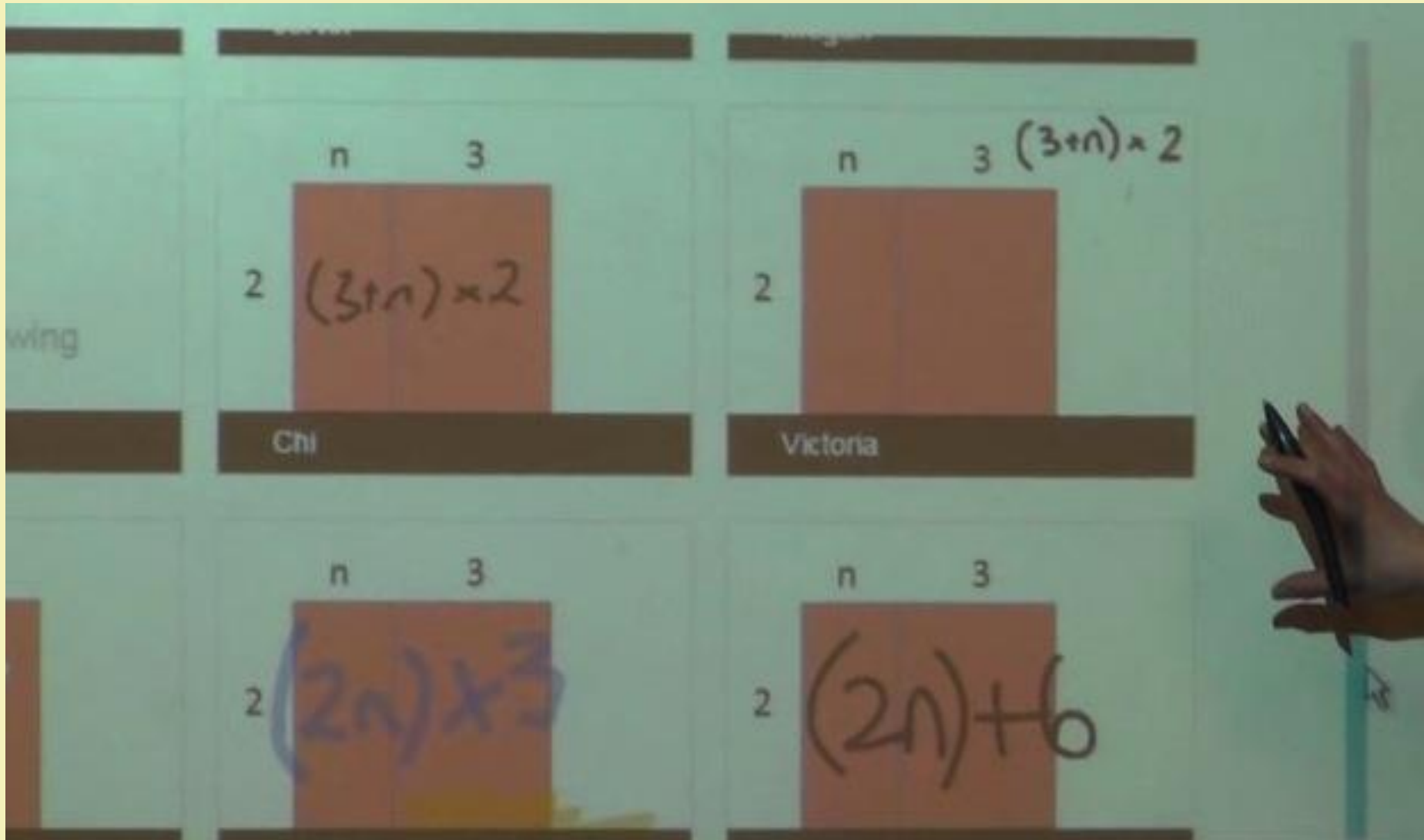
Questions for students

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





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.



1



2



3



4



5



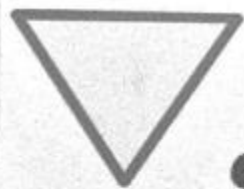
6



7



8



9



10



11



12



13



14



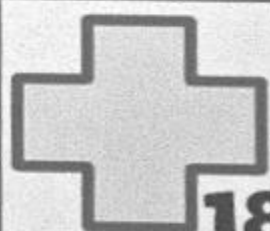
15



16



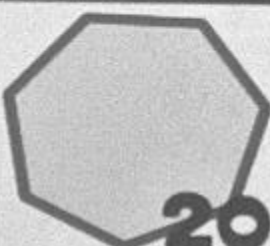
17



18



19



20



21



22



23



24



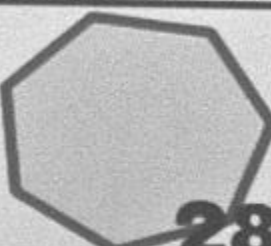
25



26



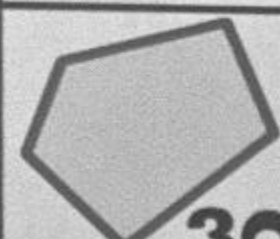
27



28

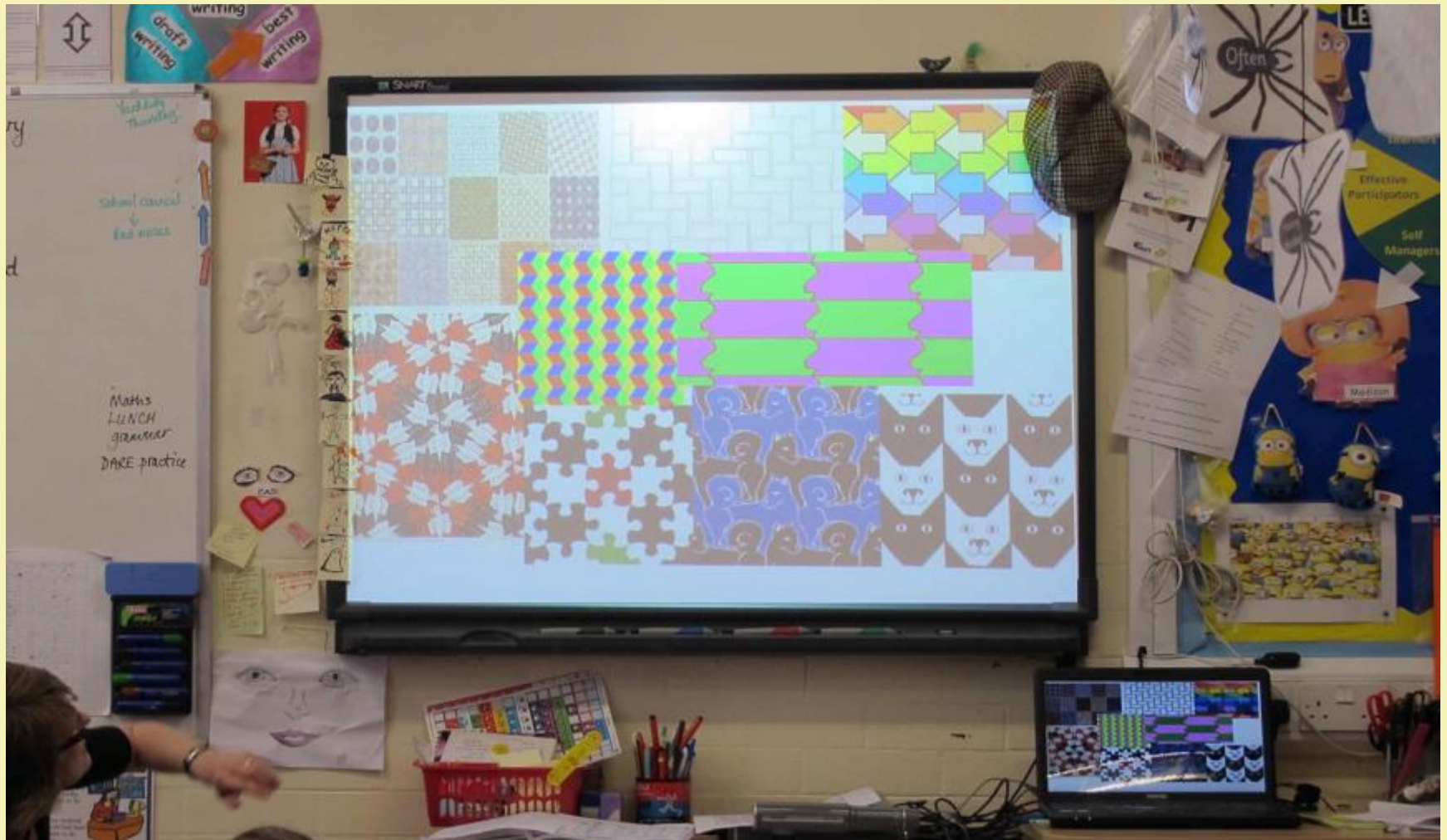


29



30

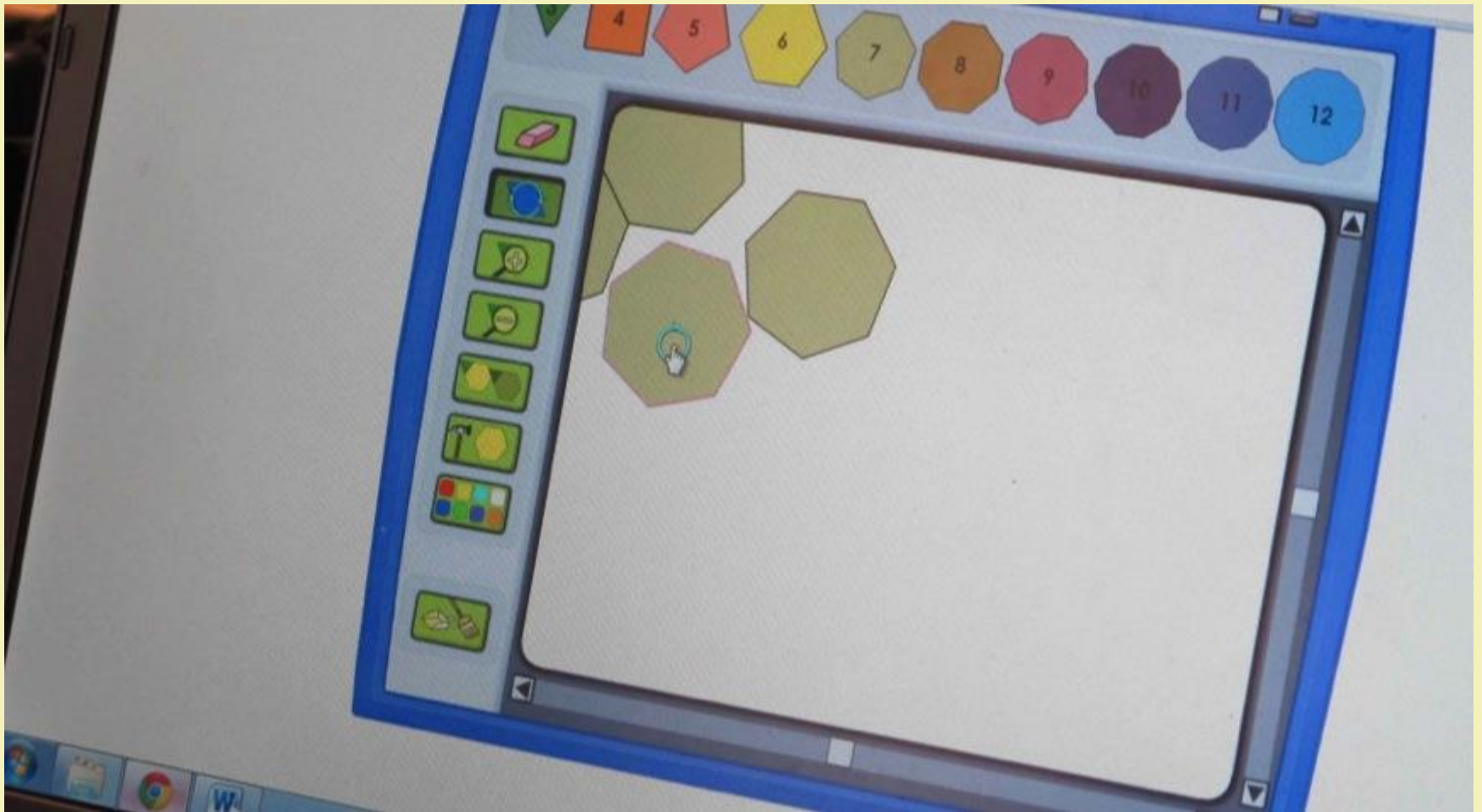
Discussing tessellation



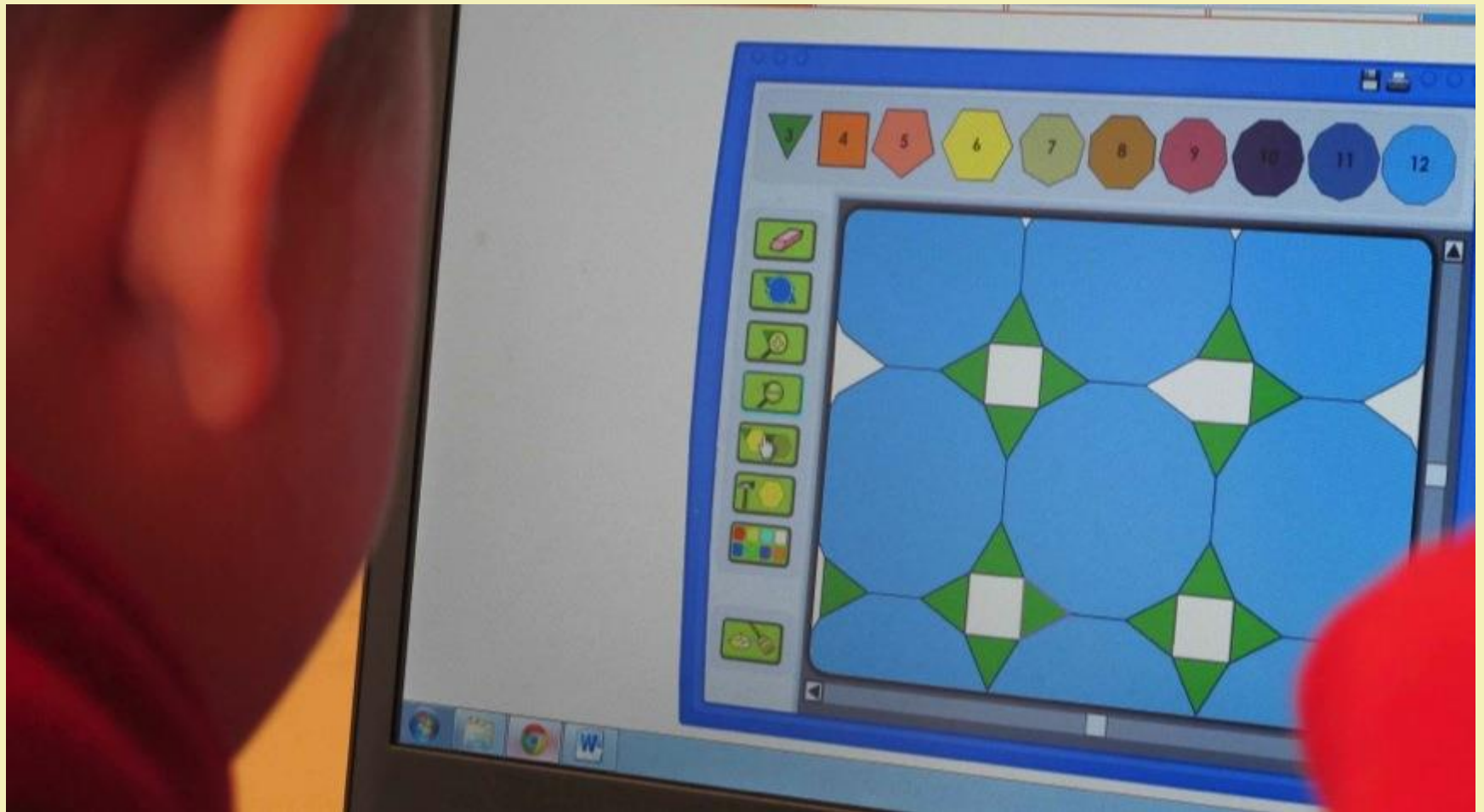
Making predictions



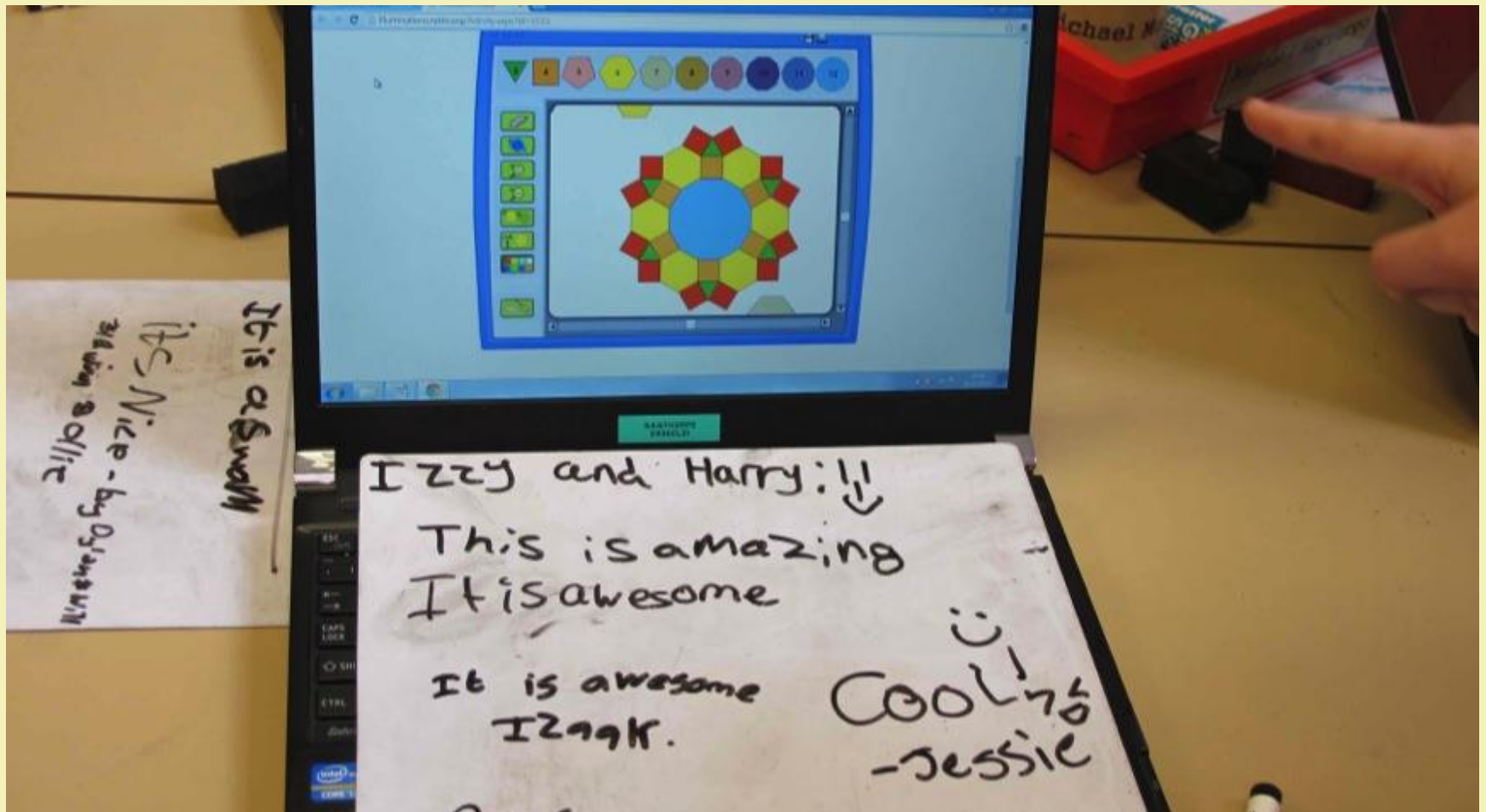
Testing the predictions



Exploring further

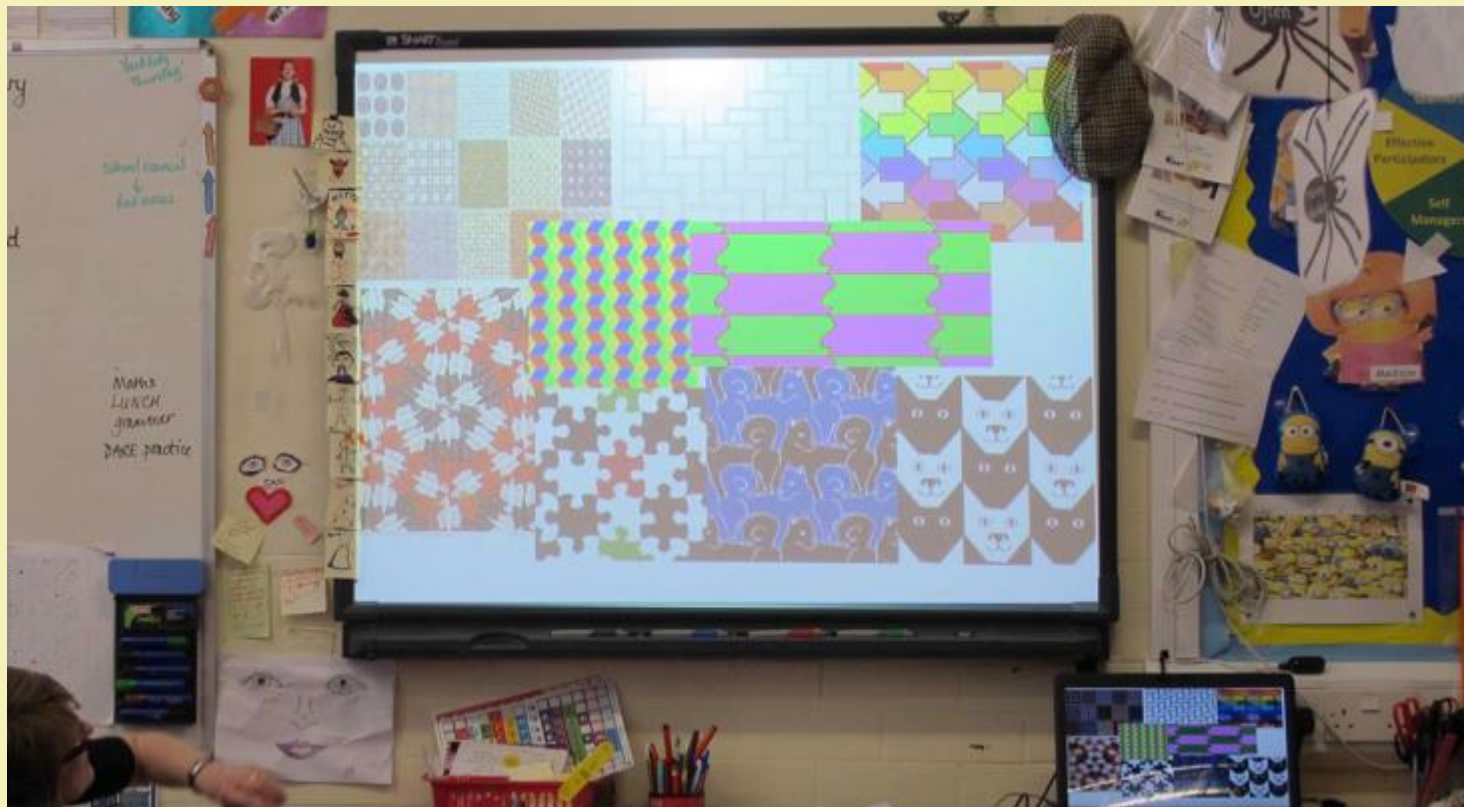


Peer assessment



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?

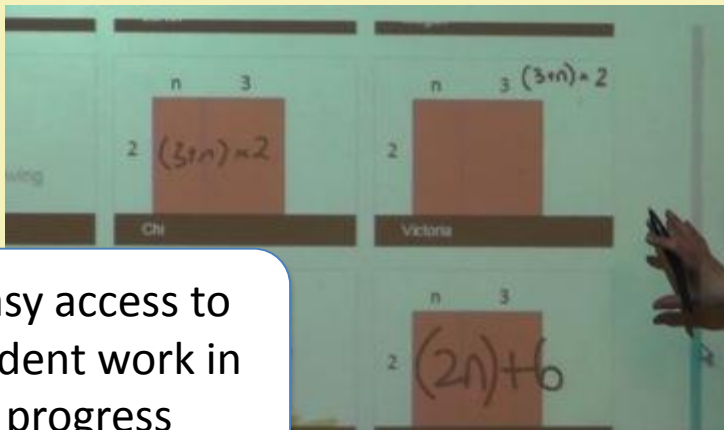
Ease and speed of obtaining class profiles



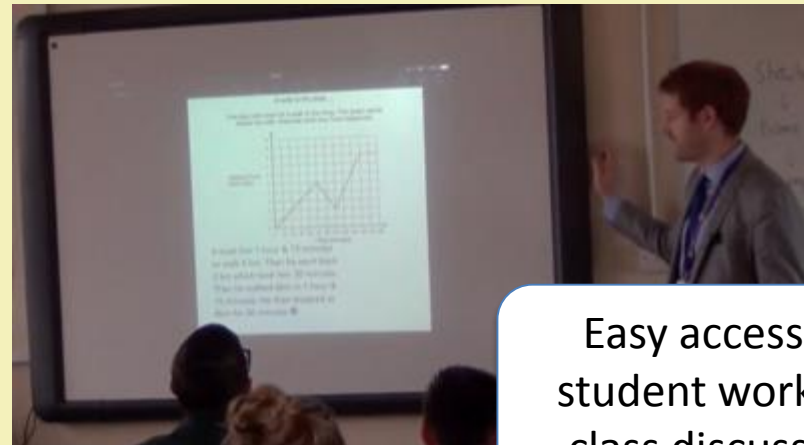
Less time drawing so more time for student discussion



Easy access to student work in progress

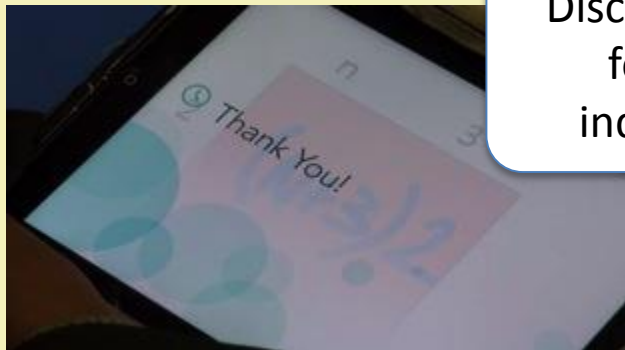


Easy access to student work for class discussion

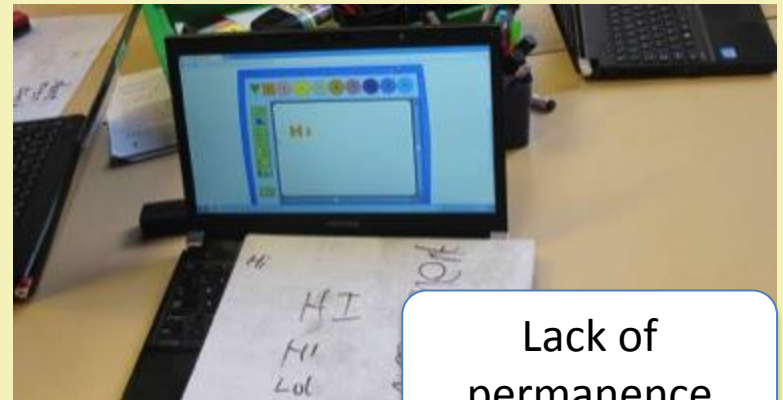


The role of technology (3)

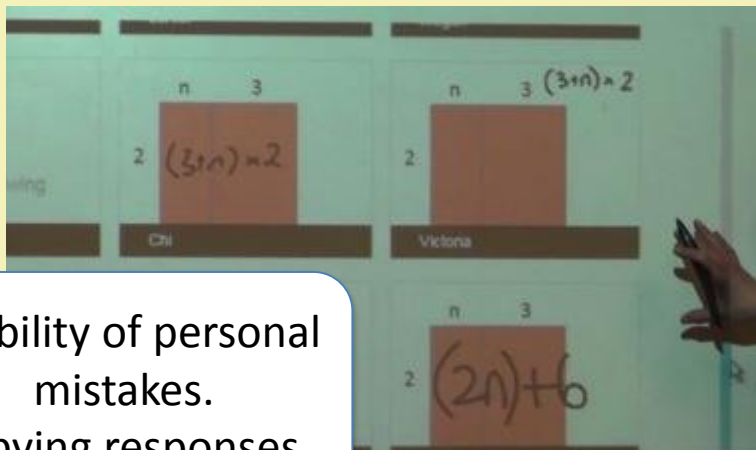
A replacement with the same function but some disadvantages?



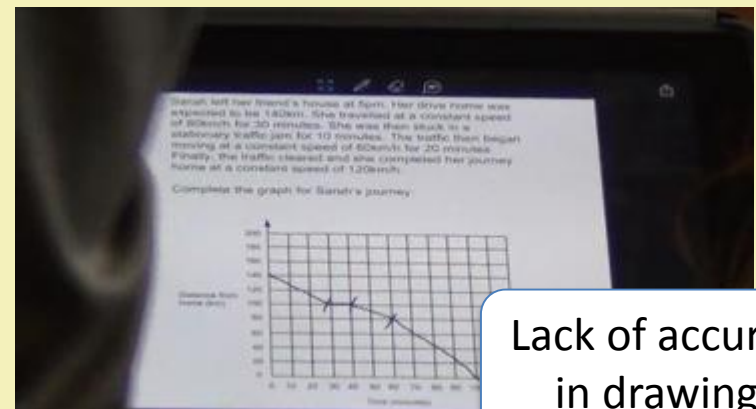
Discontinuity
for the
individual



Lack of
permanence



Visibility of personal
mistakes.
Copying responses.

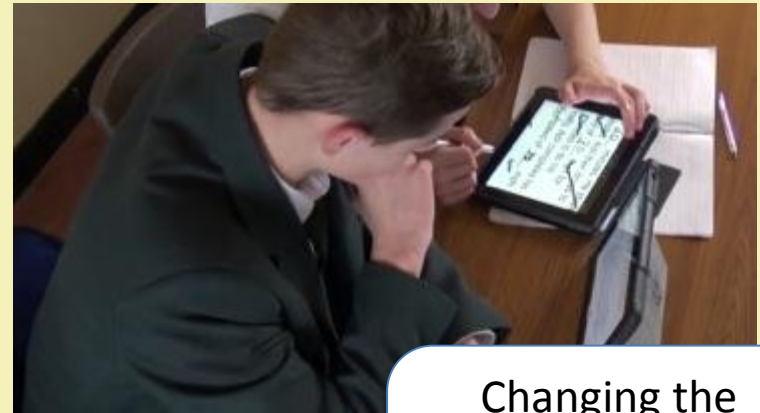
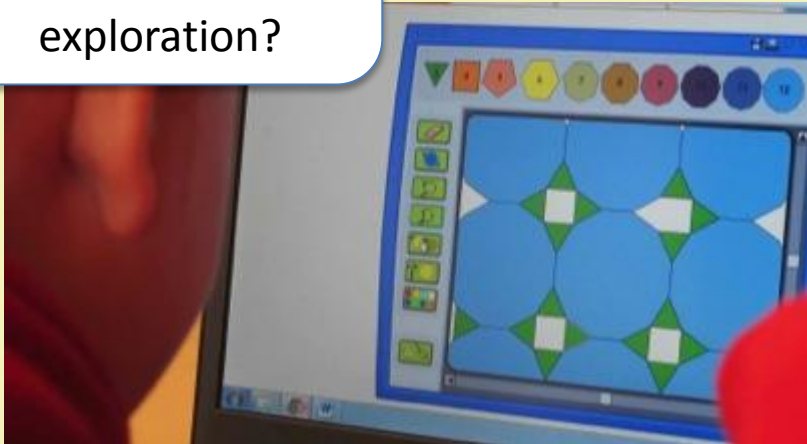


Lack of accuracy
in drawing

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

ASK

Elicit information by questioning or observing.

ANSWER

Respond orally, in writing or via technology.

ANALYSE

Interpret response, offer and interpret feedback.

ADAPT

Modify teaching and learning

