Middlesex University London

Collaboration and co-creation at a distance:

Using technology to enhance student engagement online

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PROVISION

- Dept. of Design Engineering and Mathematics

- The provision:
  - Mathematics
  - Engineering
  - Product Design
  - Aviation

- DEM Staff issued with equipment in phased approach

ENGAGING WITH MATHS ONLINE

- Problem based approaches
- We want our students to
  - Construct logical arguments
  - Write formal mathematics
  - Build complicated calculations and proofs
  - Interrogate arguments/solutions of others

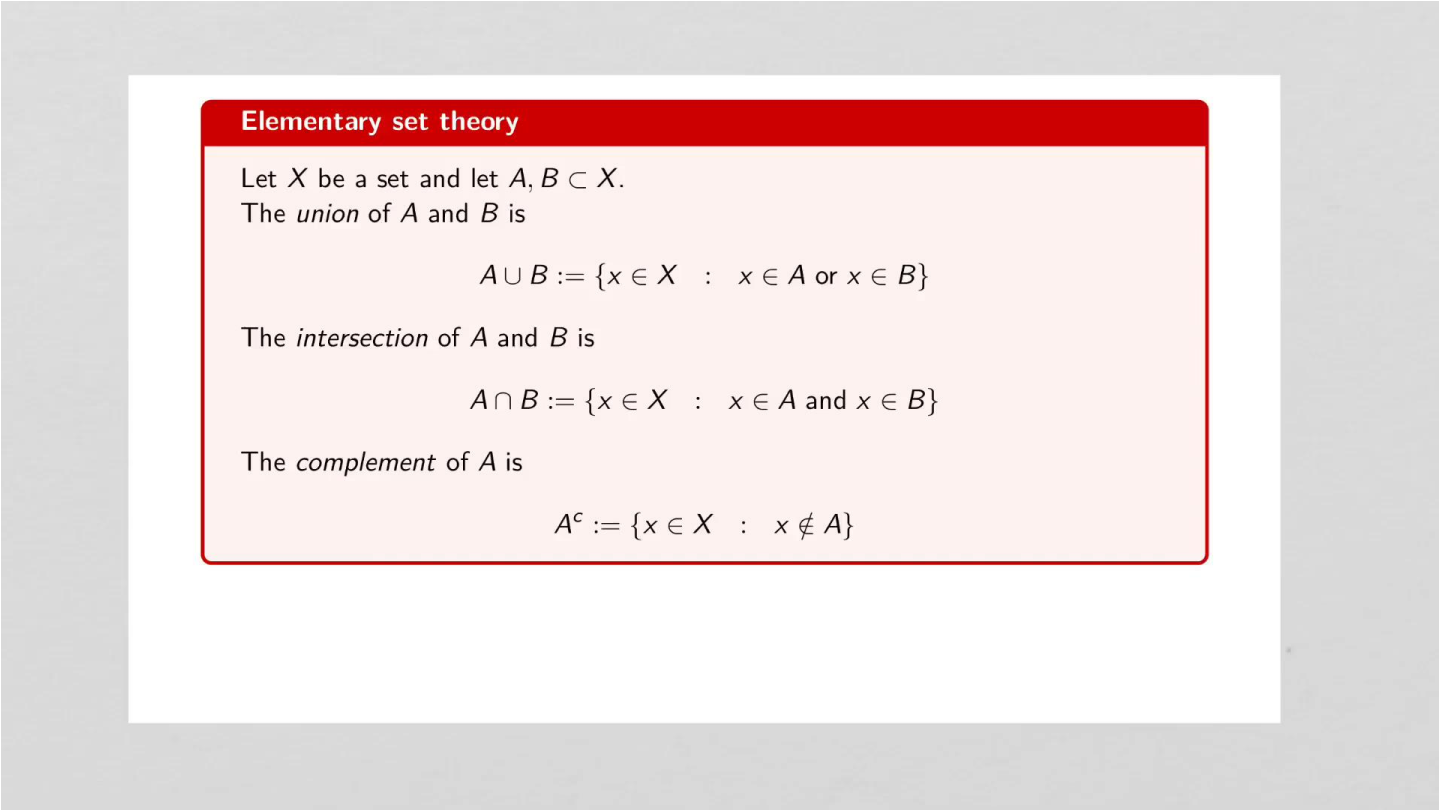
STAFF USING IPADS

Phased in from Sep. 2018

Goals:

- Make richer, more interactive maths content
- Quicker, more useful feedback

RECORDING LECTURES HANDWRITING ON NOTES



Handwrite over lecture notes

- Live in lecture or
- Pre-recorded “snippets”

Students get:

- Video recording with full audio
- .pdf of marked-up notes

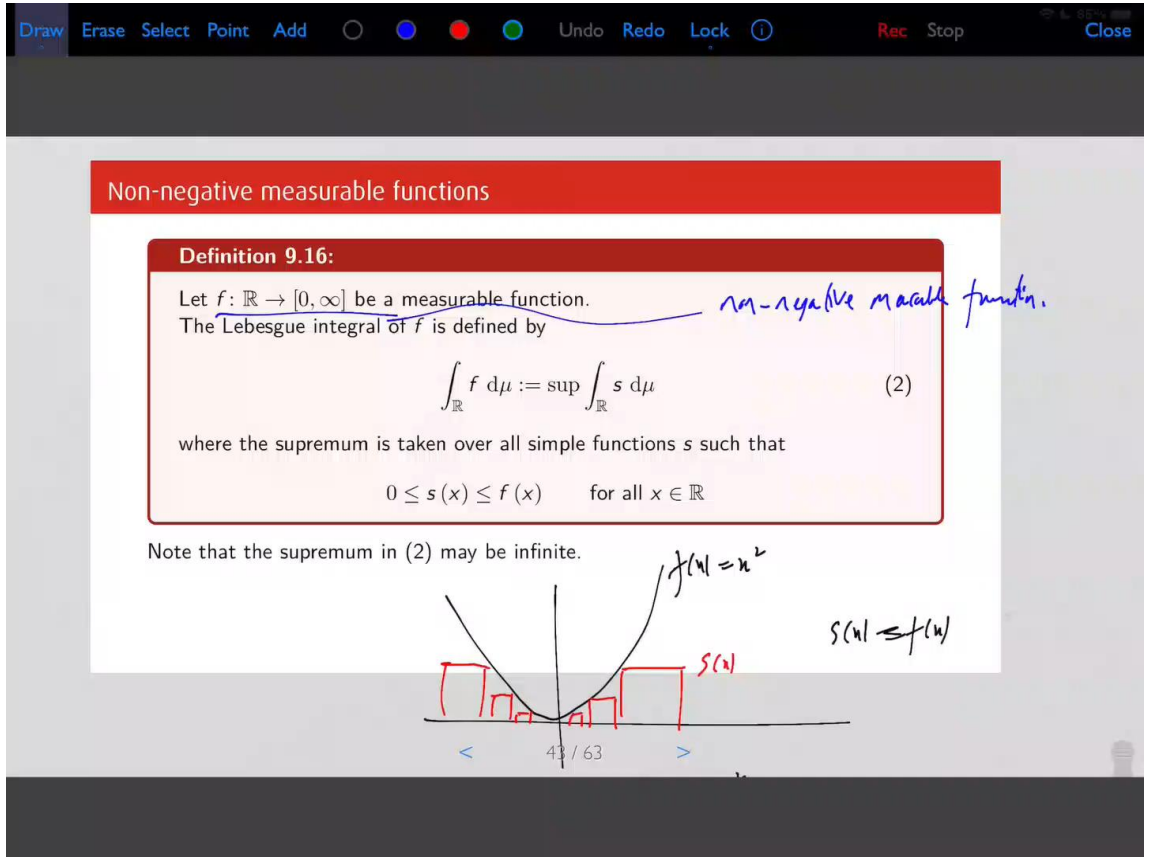
Wireless connection to projector

- Work with groups
- Invite student contributions

Hugely popular

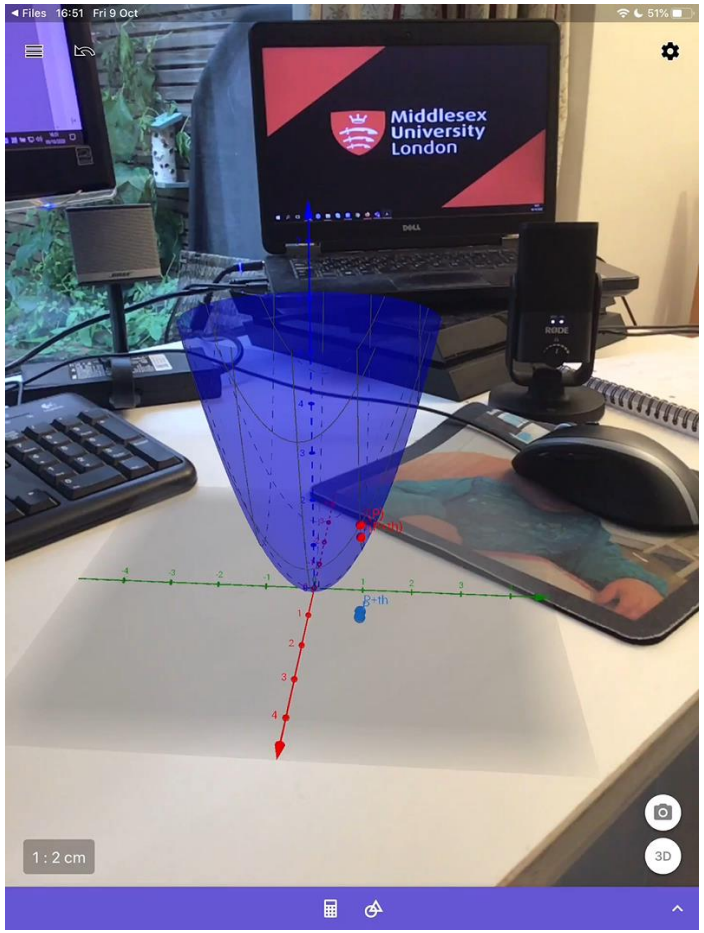
- Module evaluations
- On average lecture videos watched 3 more times
- No drop in attendance

SWITCH TO POWERFUL APPS IN LECTURES



Graphical calculator (Desmos)

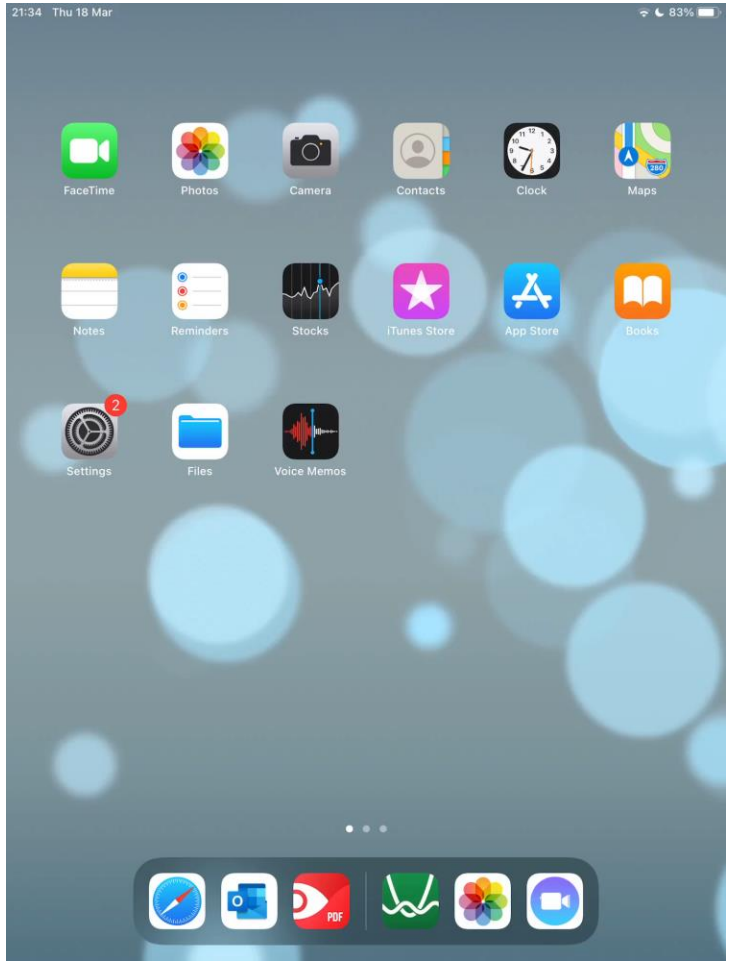
SWITCH TO POWERFUL APPS IN LECTURES



Augmented reality (Geogebra)

All part of the recorded lecture

FEEDBACK

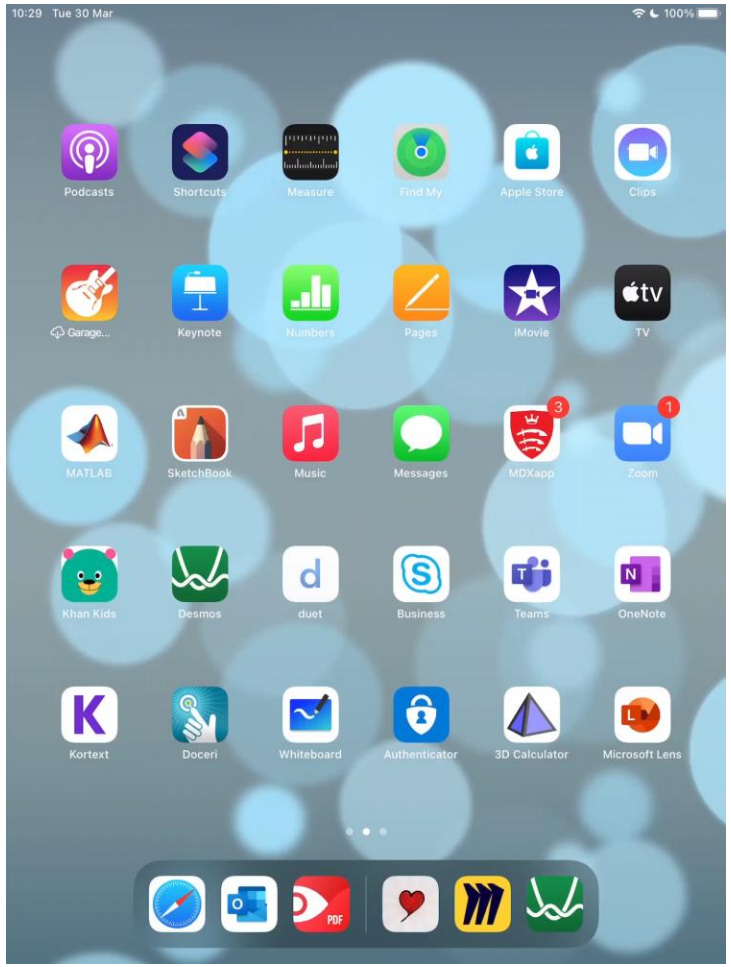


On summative work

- Save from VLE into a synced folder
- Open in PDF Expert on iPad
- Comments are automatically synced back

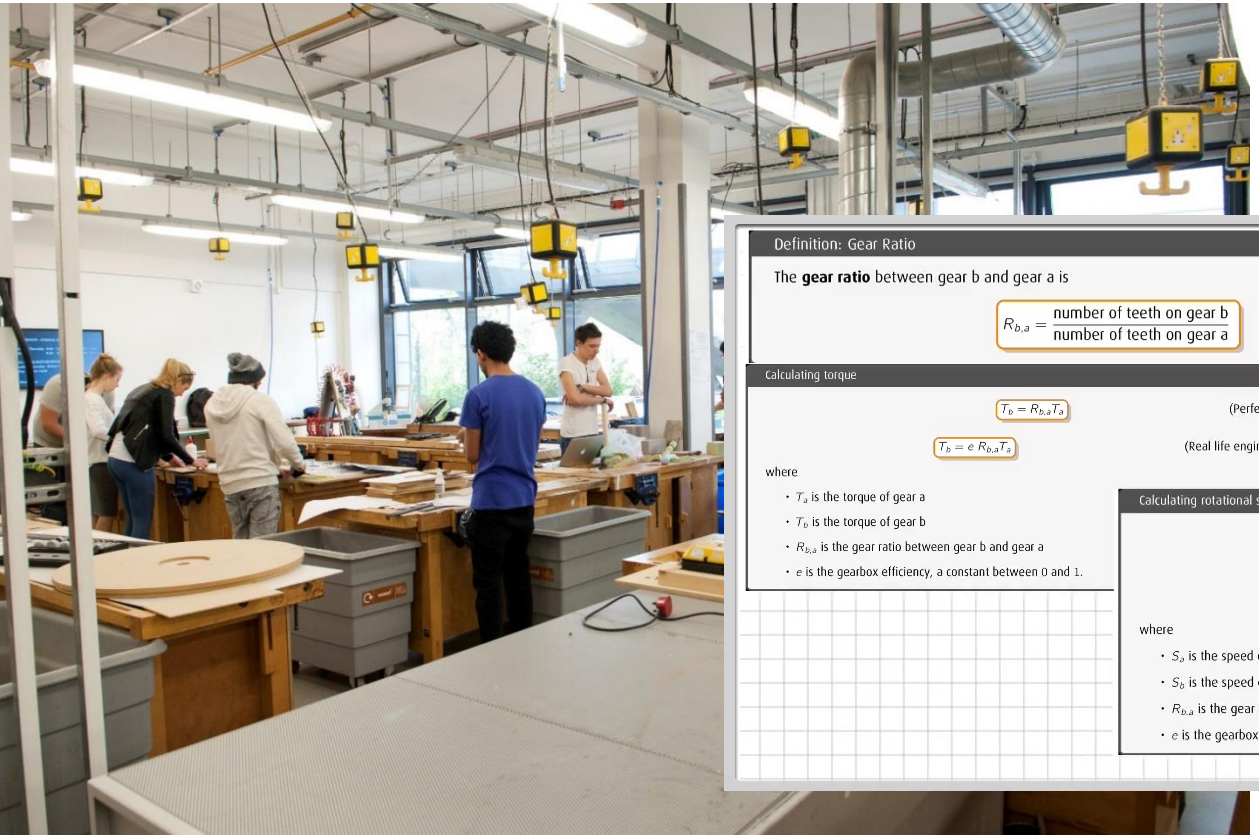
- Quicker
- More detailed
- Mathematical notation and diagrams
- Copy + Paste comments between students

FEEDBACK



Quick responses to student emails

MATHS IN AN APPROPRIATE SETTING: 2019



Definition: Gear Ratio

The **gear ratio** between gear b and gear a is

$$R_{b,a} = \frac{\text{number of teeth on gear b}}{\text{number of teeth on gear a}}$$

Calculating torque

$T_b = R_{b,a} T_a$ (Perfect case)

$T_b = e\, R_{b,a} T_a$ (Real life engineering)

where

- T_a is the torque of gear a
- T_b is the torque of gear b
- $R_{b,a}$ is the gear ratio between gear b and gear a
- e is the gearbox efficiency, a constant between 0 and 1.

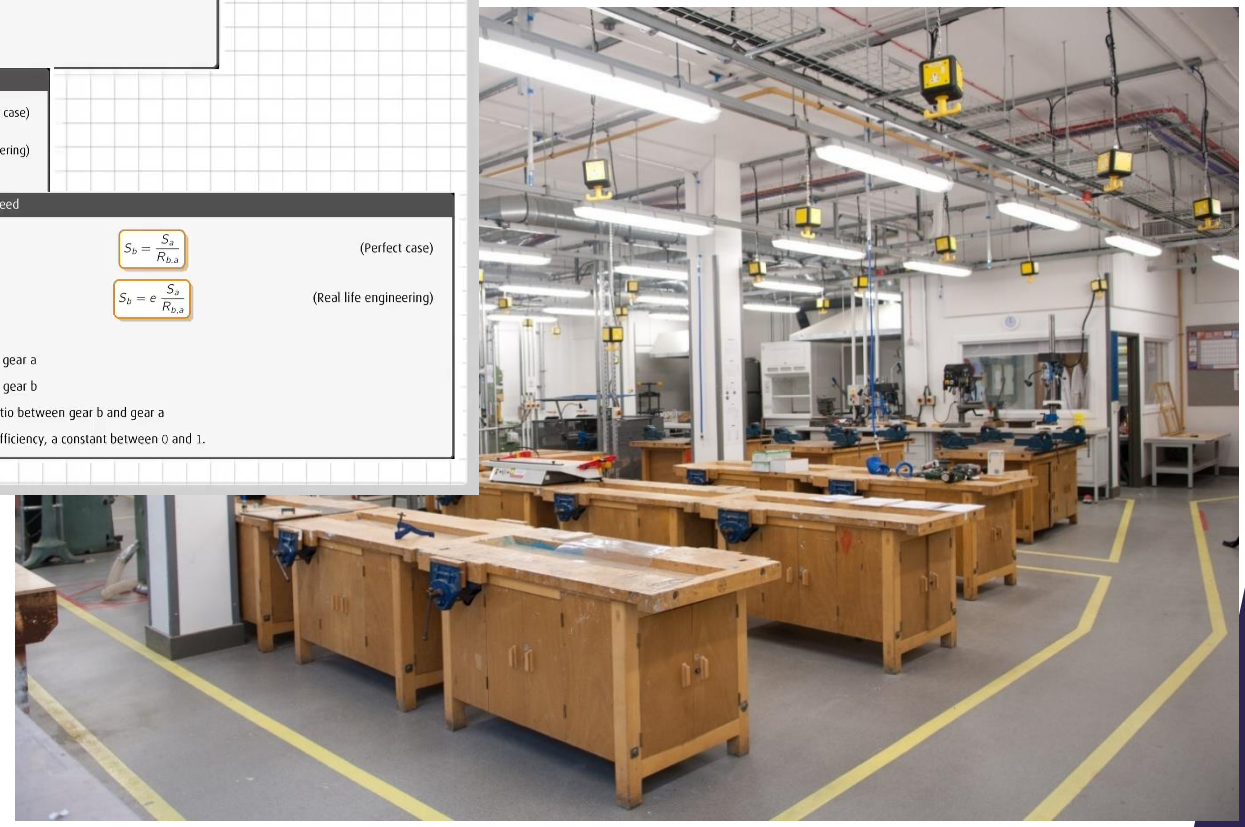
Calculating rotational speed

$S_b = \frac{S_a}{R_{b,a}}$ (Perfect case)

$S_b = e\,\frac{S_a}{R_{b,a}}$ (Real life engineering)

where

- S_a is the speed of gear a
- S_b is the speed of gear b
- $R_{b,a}$ is the gear ratio between gear b and gear a
- e is the gearbox efficiency, a constant between 0 and 1.



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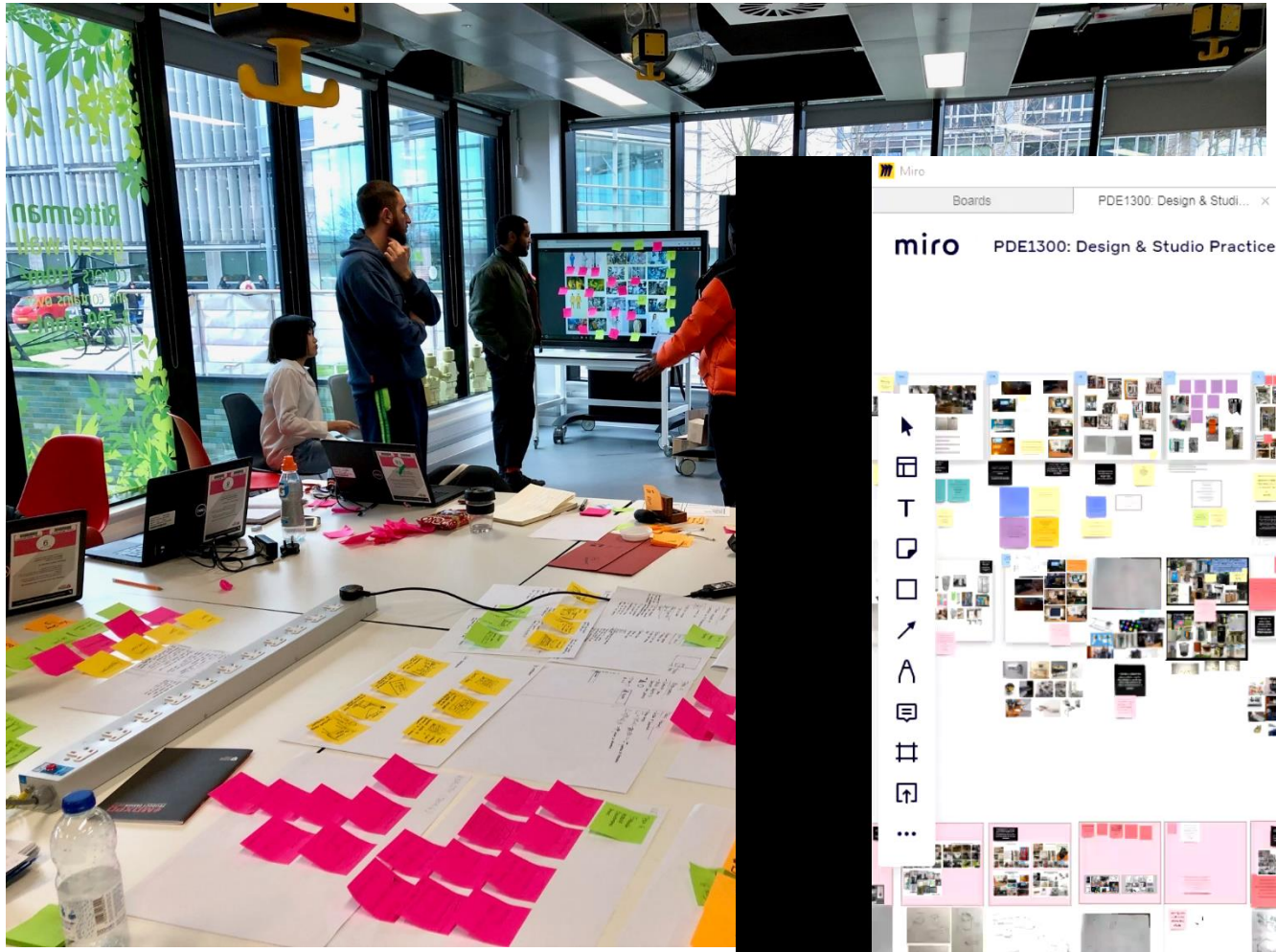
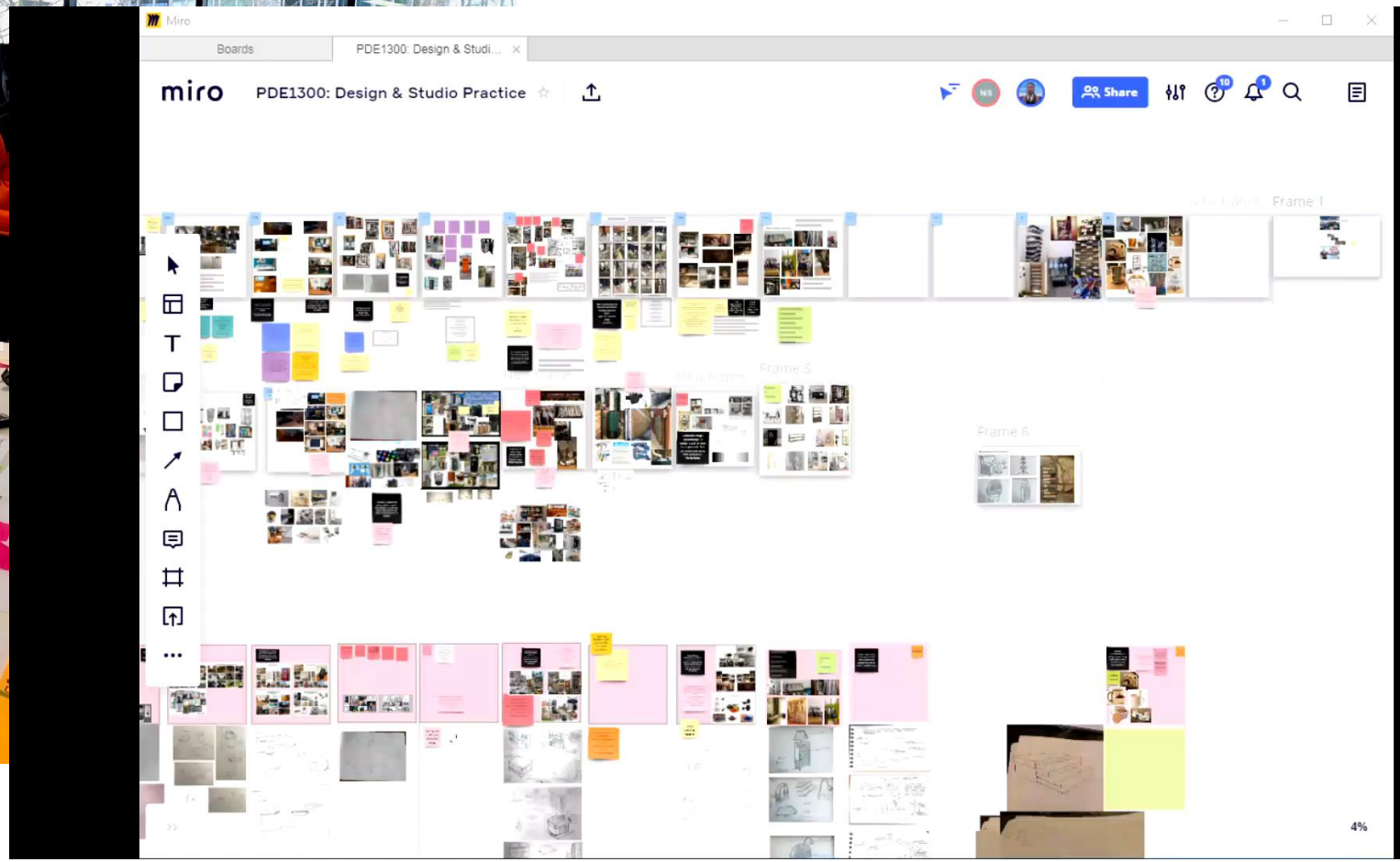
MATHS IN AN APPROPRIATE SETTING: 2021



Product Design Engineering Studio



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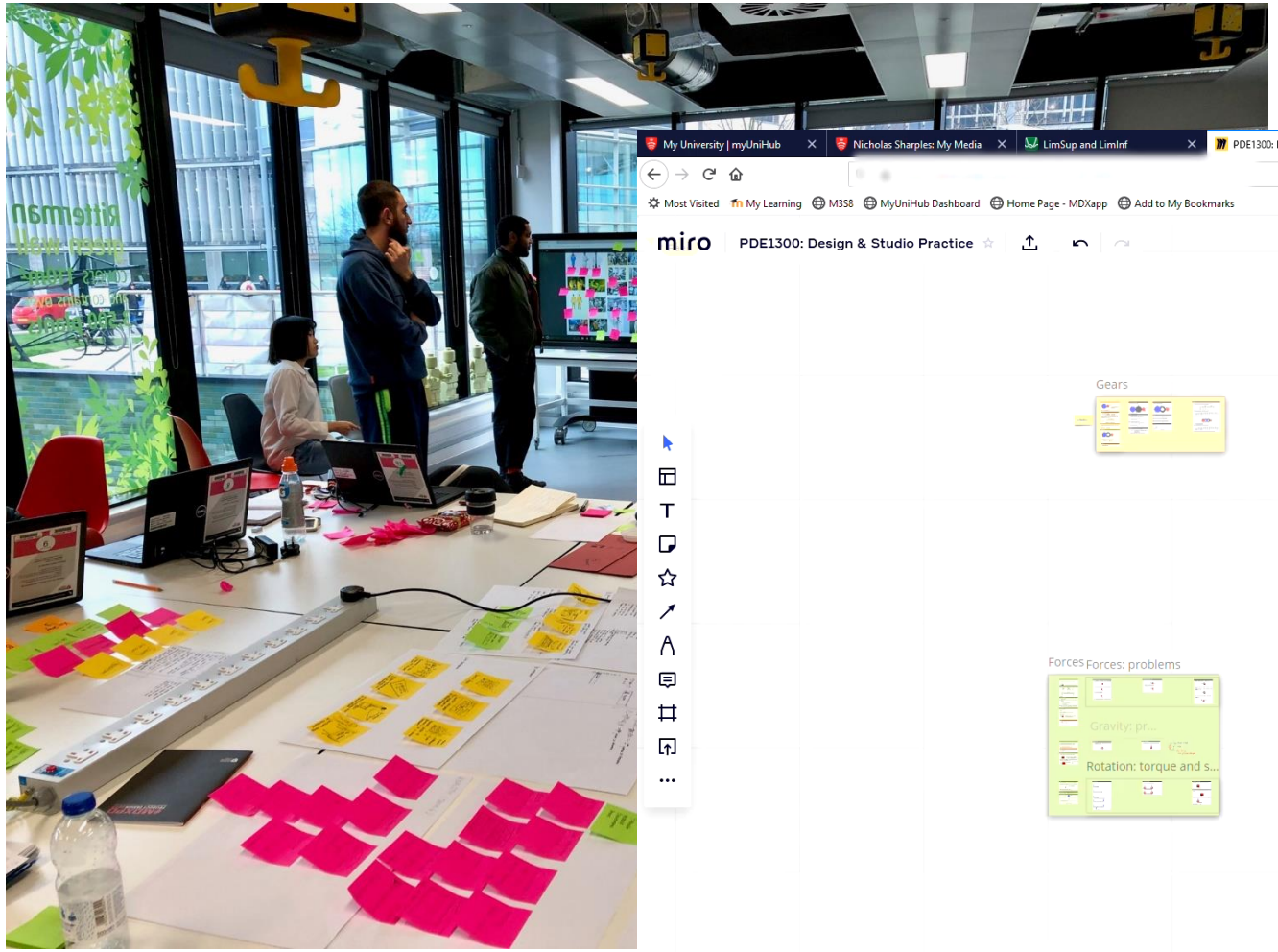

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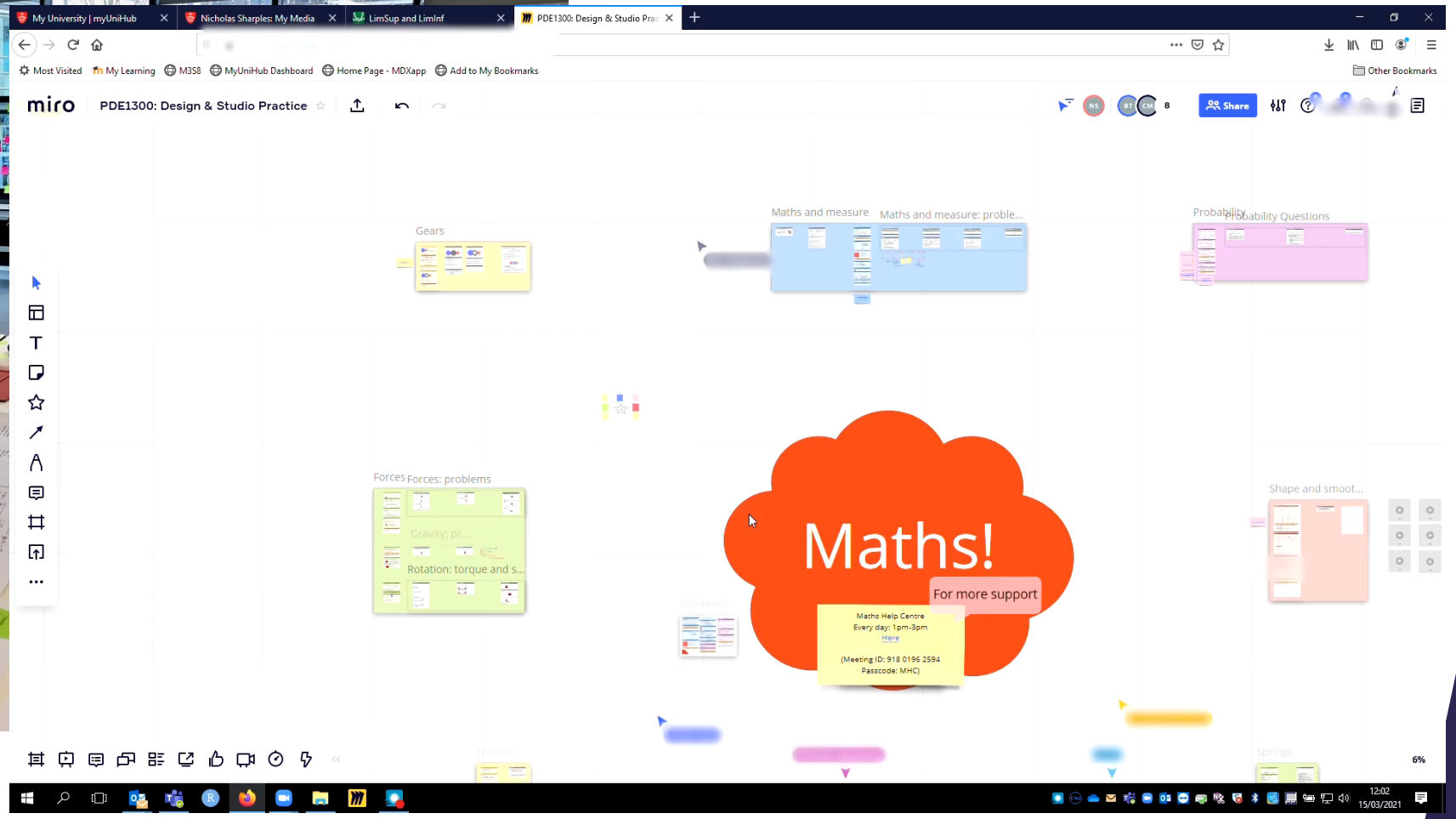

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COLLABORATION AND CO-CREATION AT A DISTANCE

IPADS FOR STUDENTS

Specialist maths response to COVID-19

We delivered iPads to all returning and new students on

- BSc Mathematics
- BSc Mathematics with Computing
- MSc Financial Mathematics

AIMS

Ensure all students

- have the tools required to support their mathematical learning
- can engage and interact in learning sessions
- can share written mathematics
- can collaborate on mathematical problems

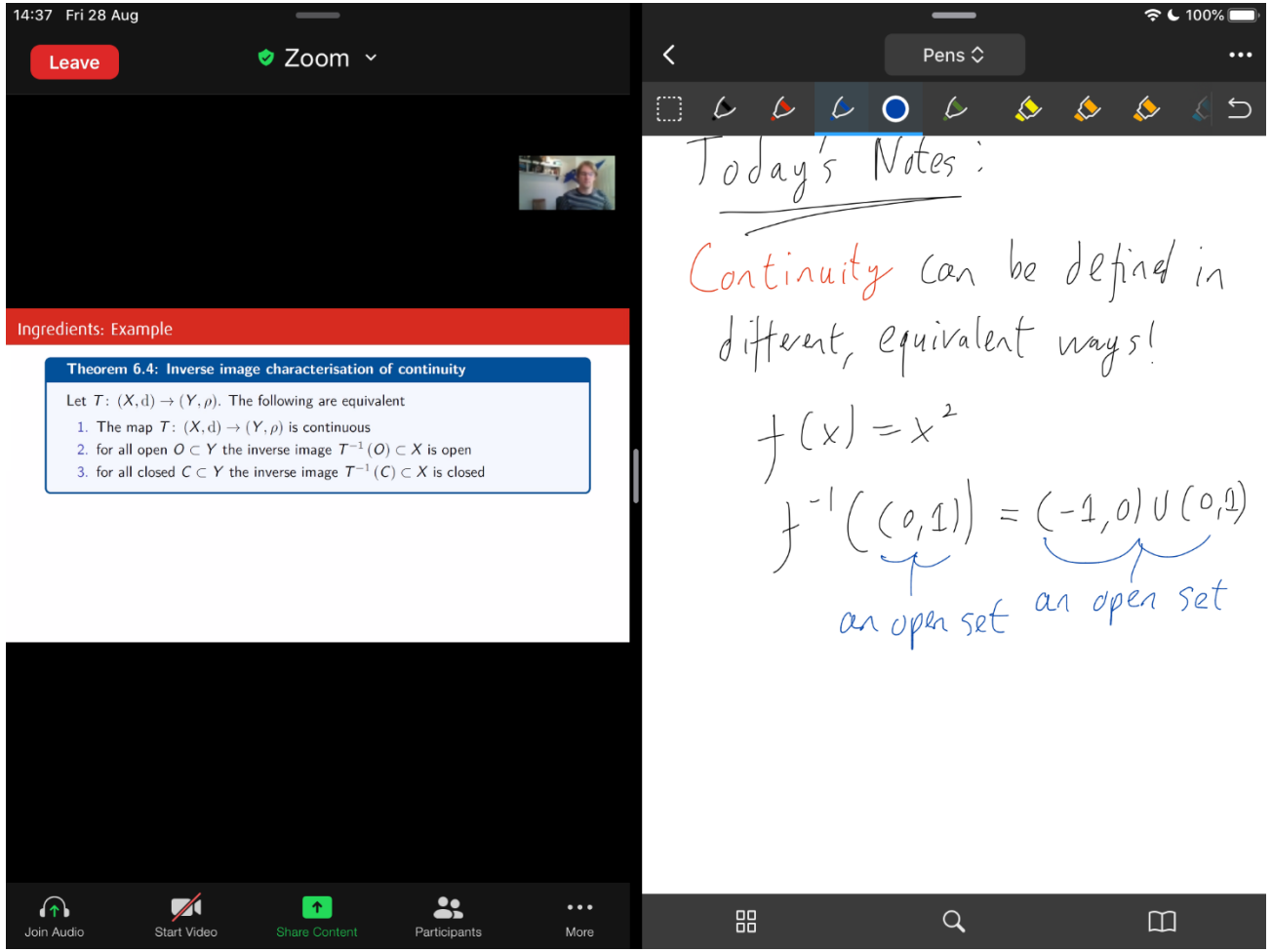
LOGISTICS: STUDENT IPADS

- “Managed” iPads allocated to students
- Delivered to students’ home addresses
- Set-up:
  - Initial deployment of Apps – chosen by us
  - Further Apps can be pushed down on request
  - Settings agreed by a project team

WHAT WE CAN DO

- Collaborate
- Communicate
- Feedback
- Widen participation and equality of access with a common hardware platform

ACCESS LECTURES!



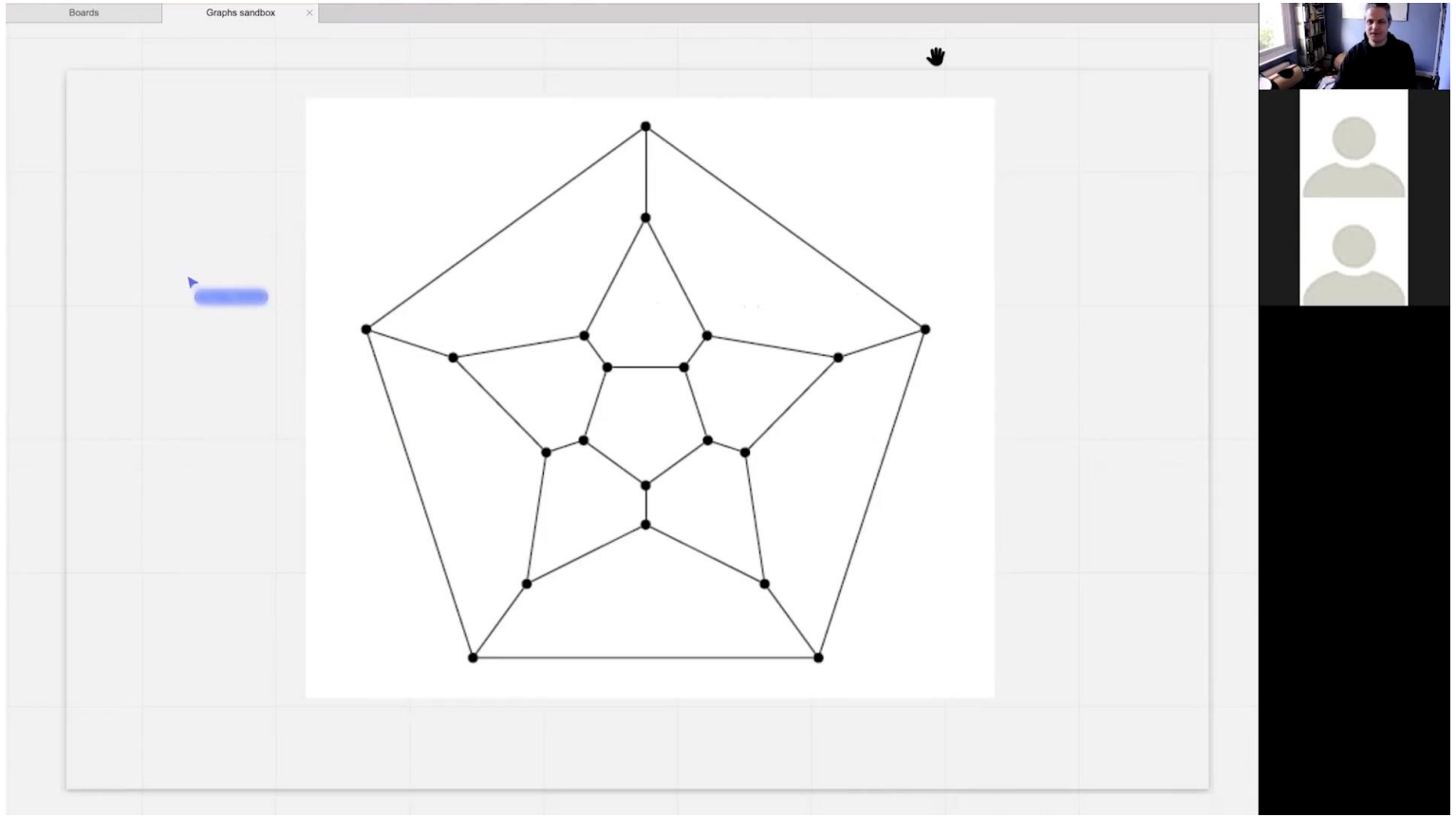
Digital poverty

- March 2020 – many students had no device to access online lectures
- Can split screen to:
  - stream lecture
  - take notes
  - join online activities

Widened participation
Improved equality of access

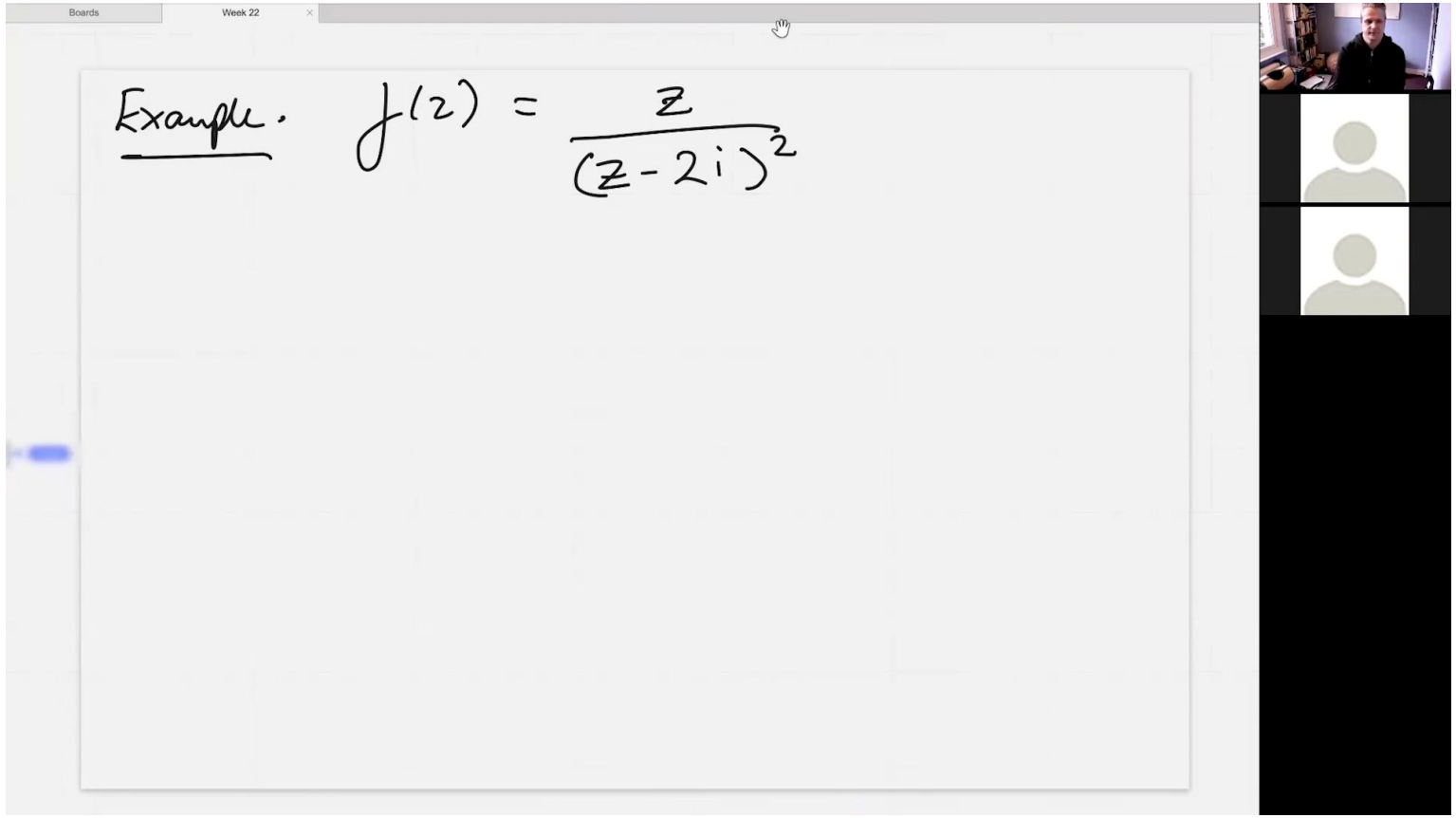
But internet connectivity could still be a problem…

COLLABORATE



- iPads allow handwriting on a persistent, collaborative space for each lecture/topic/problem
- Students continue working together after lectures

COLLABORATE



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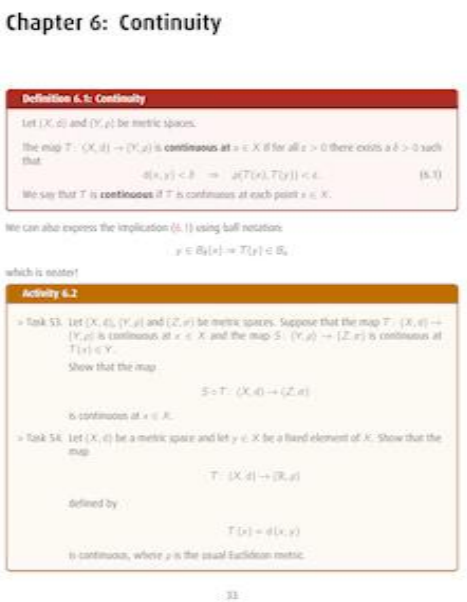
COLLABORATE

[redacted]



Chapter 6: Continuity

Definition 6.1: Continuity

Let (X, d) and (Y, ρ) be metric spaces.

The map $T : (X, d) \to (Y, \rho)$ is **continuous at** $x \in X$ if for all $\varepsilon > 0$ there exists a $\delta > 0$ such that

$$d(x, y) < \delta \quad \Rightarrow \quad \rho(T(x), T(y)) < \varepsilon. \tag{6.1}$$

We say that T is **continuous** if T is continuous at each point $x \in X$.

We can also express the implication (6.1) using ball notation:

$$y \in B_\delta(x) \Rightarrow T(y) \in B_\varepsilon$$

which is neater!

Activity 6.2

- Task 53. Let (X, d), (Y, ρ) and (Z, σ) be metric spaces. Suppose that the map $T : (X, d) \to (Y, \rho)$ is continuous at $x \in X$ and the map $S : (Y, \rho) \to (Z, \sigma)$ is continuous at $T(x) \in Y$.

  Show that the map

  $$S \circ T : (X, d) \to (Z, \sigma)$$

  is continuous at $x \in X$.

- Task 54. Let (X, d) be a metric space and let $y \in X$ be a fixed element of X. Show that the map

  $$T : (X, d) \to (\mathbb{R}, \rho)$$

  defined by

  $$T(x) = d(x, y)$$

  is continuous, where ρ is the usual Euclidean metric.

33

[redacted]

- iPads allow handwriting on a persistent, collaborative space for each lecture/topic/problem
- Students continue working together after lectures

FEEDBACK

Some students do all their work with iPads in collaborative whiteboards

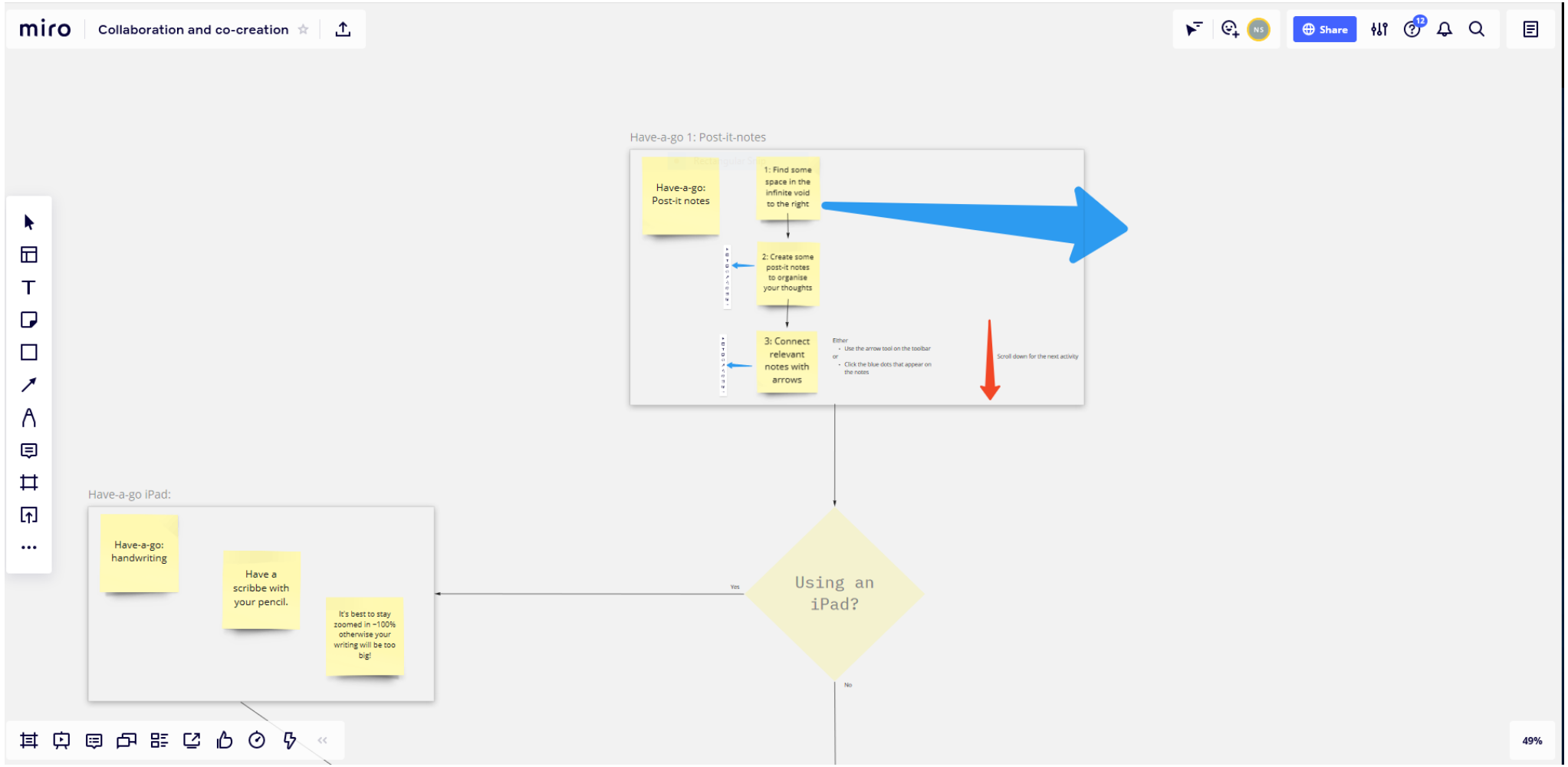
- Really easy to give feedback
- Email notification when students do some work

HAVE-A-GO

- Join the Miro Board for this on-demand session:

bit.ly/3h3KFOg

HAVE-A-GO


miro
Collaboration and co-creation
Share
Have-a-go 1: Post-it-notes
Have-a-go: Post-it notes
1: Find some space in the infinite void to the right
2: Create some post-it notes to organise your thoughts
3: Connect relevant notes with arrows
Either
Use the arrow tool on the toolbar
or
Click the blue dots that appear on the notes
Scroll down for the next activity
Using an iPad?
Yes
No
Have-a-go iPad:
Have-a-go: handwriting
Have a scribbe with your pencil.
It's best to stay zoomed in ~100% otherwise your writing will be too big!
49%

STUDENT VOICE

Survey sent to iPad recipients February 2021

- UG and PG students $n = 17$

BSc Mathematics
BSc Mathematics with Computing
MSc Financial Mathematics

WHAT INITIAL CHALLENGES DID YOU THINK THE IPAD COULD HELP WITH?

We had to write down a lot of equations, theorems and expressions in our workshops that just saying them out loud was not feasible.

Writing simultaneously with my lecturer. The iPad made it almost the same as I am in classroom next to my lecturer.

Student collaboration was a lot easier with the iPad, and it was easier to show your solutions in class to a problem and get feedback from the lecturer.

I thought the iPad would act as a whiteboard which would be accessible by students and allow lecturers to bridge the issue of not being able to scribble down quick proofs.

Before the iPads I couldn't show the lecturers my work so felt like I couldn't communicate with them.

HOW EFFECTIVE HAVE THE IPADS BEEN TO SOLVE THESE CHALLENGES?

Somewhat, it's proved an effective option for lecturers who use them and has helped to improve interactiveness of sessions.

Very effective. I am now able to show my work during classes and get feedback right at the moment.

Very effective

Very effective indeed.

It was really effective and helped facilitate online learning.

As a class we were all able to collaborate and do exercises together… it had a huge impact on me by reducing the stress of having the work done on time.

Immensely effective

Highly effective

Very effective

Best department because they care student study and there future. Thanks you for providing iPad.

the iPad was so helpful , 10/10

Very helpful

9 out of 10. The missing mark is for the occasional **poor internet connection.**

Very effective.

I think that iPad help us to solve these challenge and problem which is very fast and easy to find out the answer.

HOW EFFECTIVE HAS THE IPAD BEEN IN SUPPORTING YOU TO LEARN MATHEMATICS?

The iPad has been a gamechanger in online learning

It has been very effective. Things as simple as the undo button shortened my courseworks by hours. I was able to show my exact working out to my lecturer to more easily find mistakes.

The apps designed for writing electronically which helps engage in learning Maths better - I wouldn't have been able to use these apps on my desktop.

Until the iPad, I was using my phone to join classes, which was hard.

Without the iPad we wouldn't be able to share our ideas on the same page and write it quickly.

With the iPads I am able to show my work and get help.

It has helped make online learning more interesting and has made student collaboration much easier despite being online.

HOW HAS HAVING AN IPAD IMPROVED THE WAY YOU LEARN?

It has made my learning easier and less stressful.

Using the apps I could take notes easier, and working through the material faster.

Saving time, working closely with my classmates

My efficiency skyrocketed. An iPad allows for things pen and paper simply cannot grant.

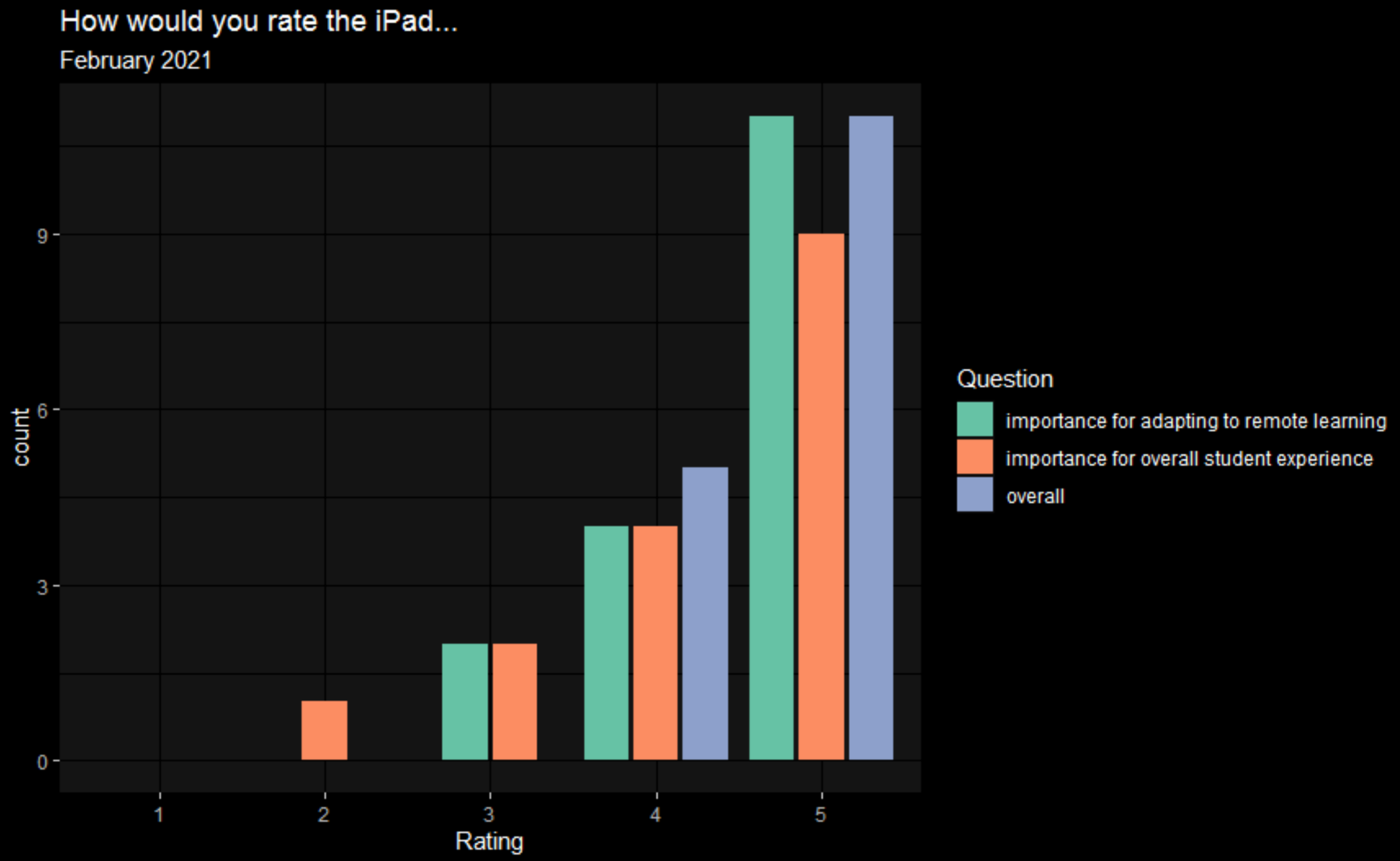
Its improved my learning in a more organised and efficient fashion.

Collaboration and attending lectures has become way easier. Also reading notes is pleasure on iPad.

Allows me to interact with my classes

Easier to show working and to easily get feedback right away during lectures

STUDENTS' ATTITUDES



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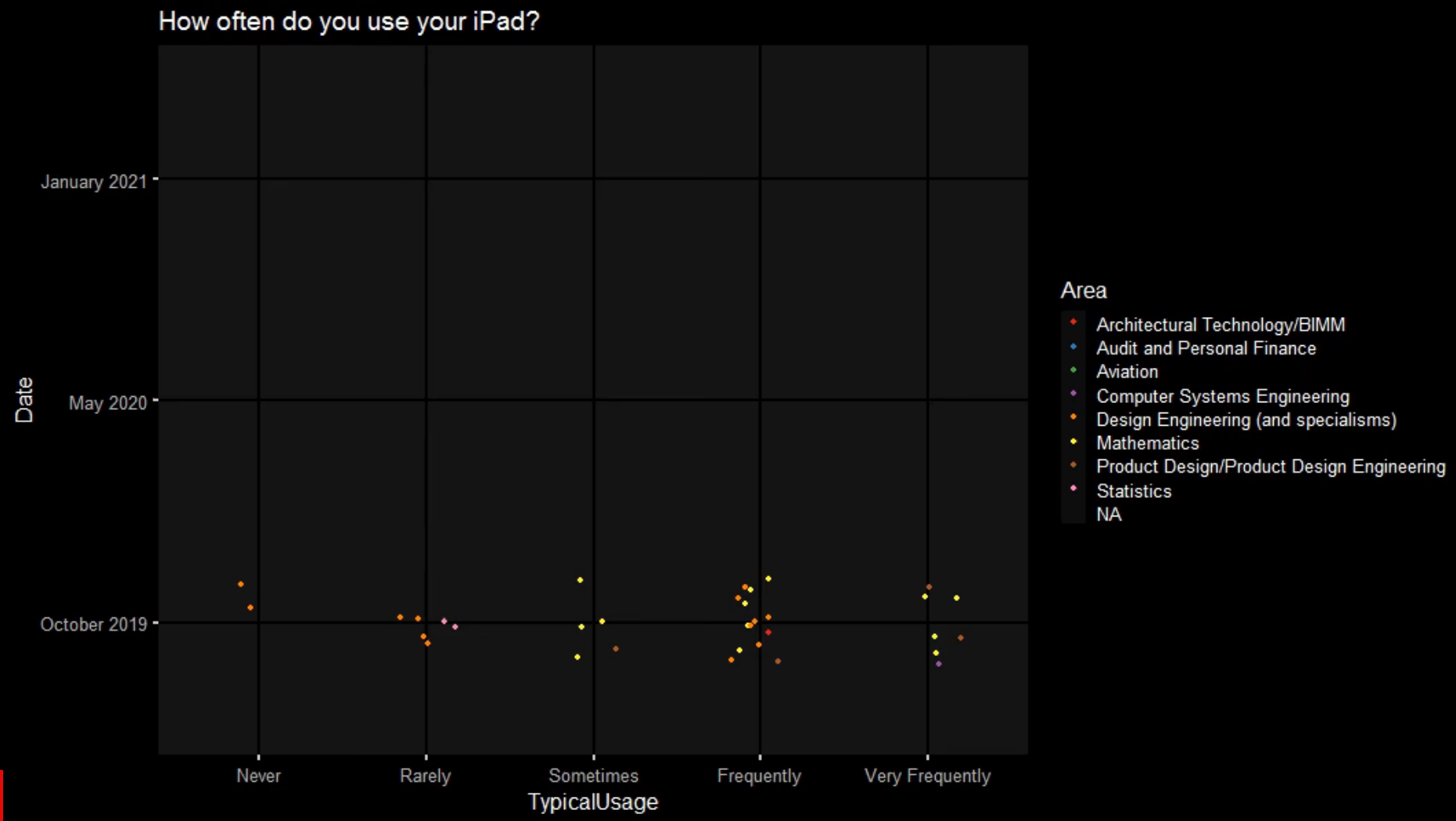
STAFF SURVEY DATA

Surveys from Design Engineering and Mathematics staff

- October 2019 $n = 25$
- May 2020 $n = 22$
- January 2021 $n = 28$

STAFF JOURNEY



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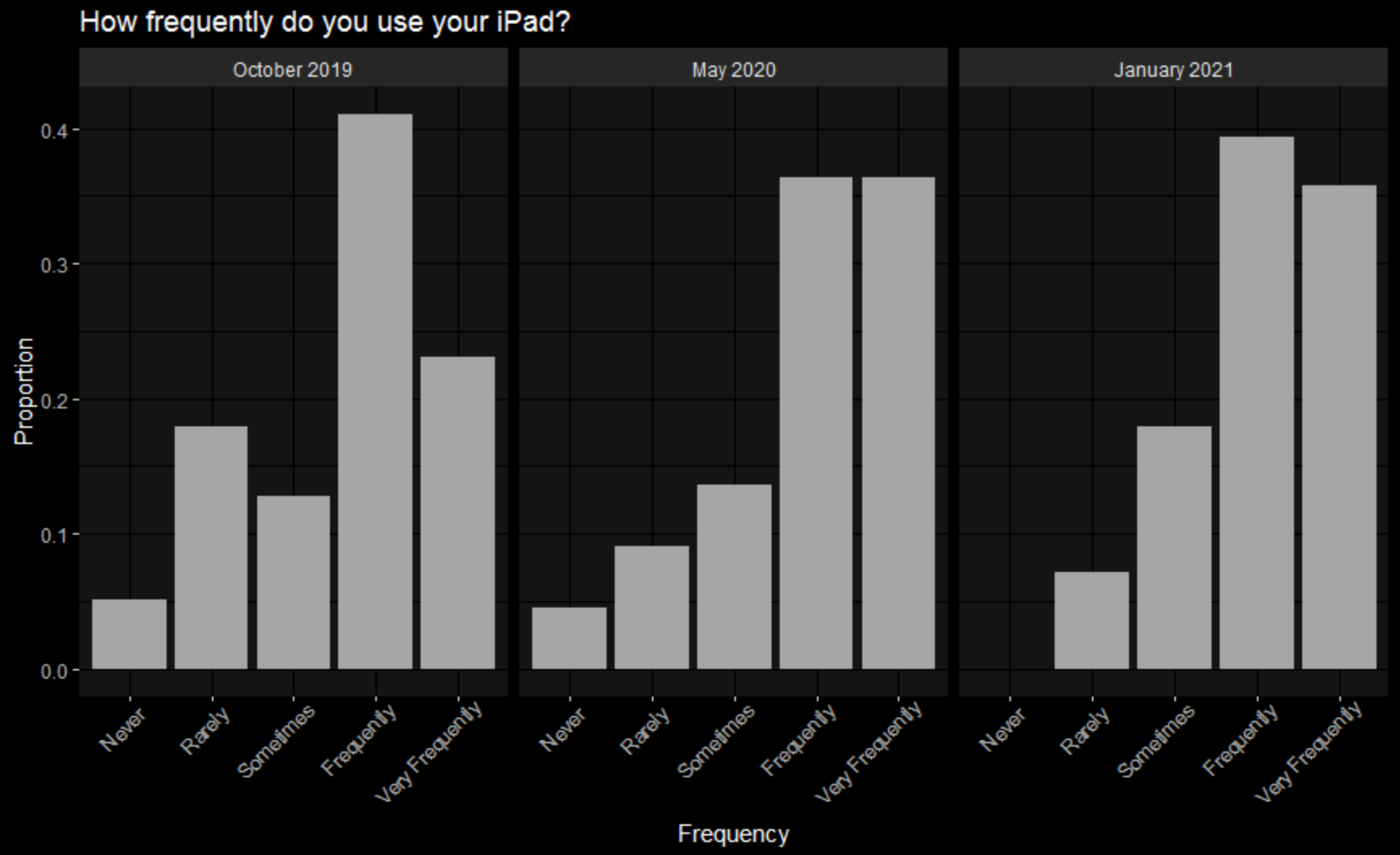

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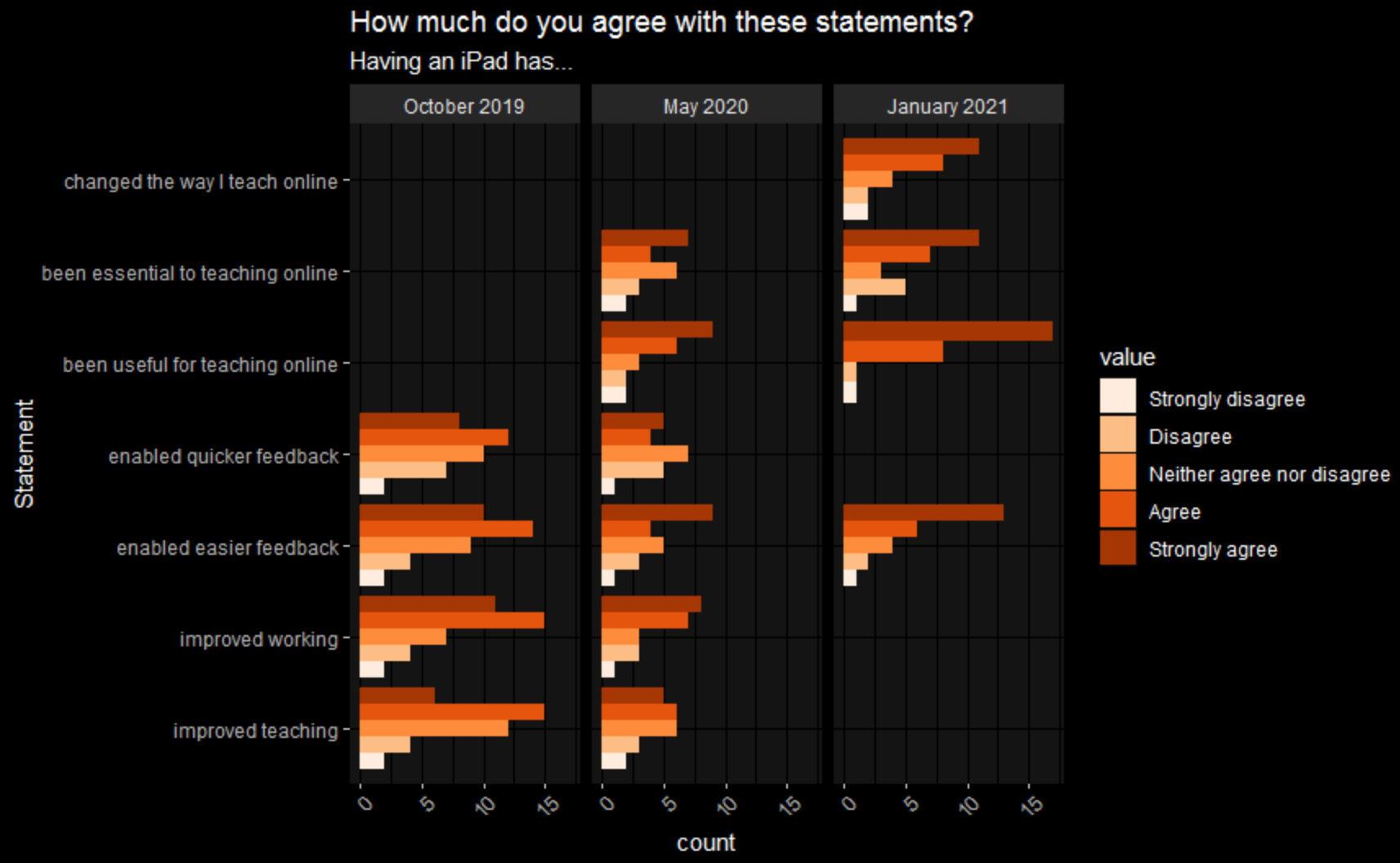

SUMMARY

- iPads for students
  - improve access and widen participation
  - encourage collaboration
  - encourage feedback-seeking behaviour

- iPads for staff
  - enable richer, more interactive maths content
  - record lectures for later review
  - handwriting distinguishes “content” from “commentary”
  - quicker, higher-quality feedback

WHAT NEXT?

- iPads now embedded in department teaching practice:
  Previously sceptical staff now love iPads for teaching on and off campus
- Want: iPads for more students (by programme)
- Tighter integration with iPads for teaching, feedback, and communication with students

APPS/SERVICES LIST

- Vittle Pro (Whiteboard + recording lectures)
- Desmos (Graphing calculator)
- Geogebra (Graphing calculator with Augmented Reality)
- Miro (Online collaborative whiteboard)