Middlesex University London

Digital pedagogy in a world of digital poverty:

the Middlesex iPad project

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BACKGROUND: MDX

Index of Multiple Deprivation

OFS 2019/20	
IMD Quintile 1	23.9%
IMD Quintile 2	34.3%
	58.2%

Free School Meals Eligibility

OFS		
2019-20	40.2%	2nd in sector
2018-19	42.6%	2nd in sector
2017-18	43.7%	2nd in sector

Laptop Loan scheme

2020/21: next day courier delivery!

Free printing

BACKGROUND: GENERATION Z

2018 Ipsos Thinks: *Beyond Binary: The lives and choices of Generation Z*

Children from poorer families

- "spend more time online"
- "less likely to be using the internet for learning"
- "less likely to develop certain [digital] skills"

Children in better-off households

- "spend higher quality time [online], helping them… prepare for the future"

To encourage digital inclusion we need to consistently encourage the educational aspect of the digital world

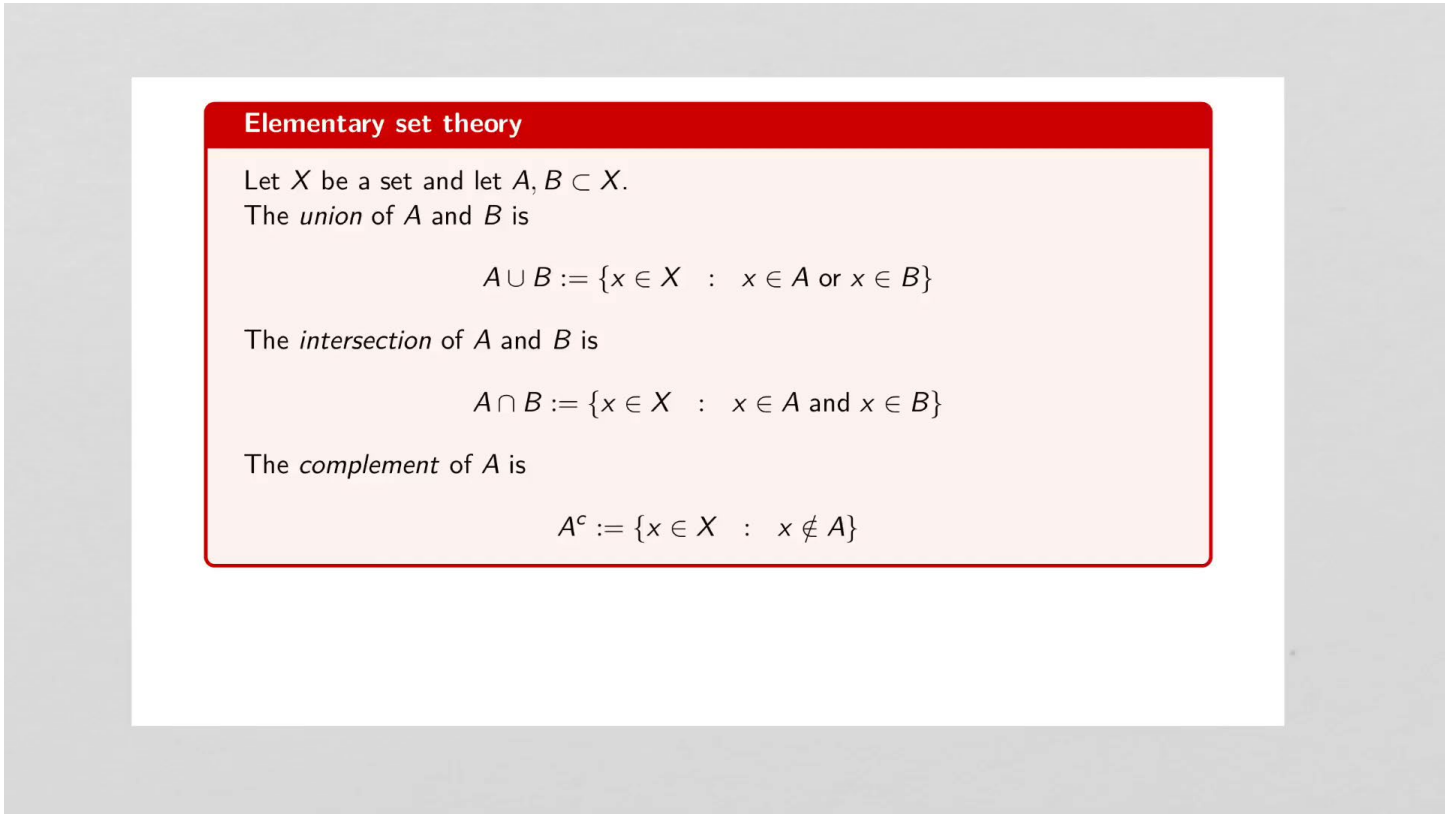
STAFF USING IPADS

Phased in from Sep. 2018

Goals:

- Make richer, more interactive content
- Distinguish “content” from “commentary”
- Record all lectures and conversations
- 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

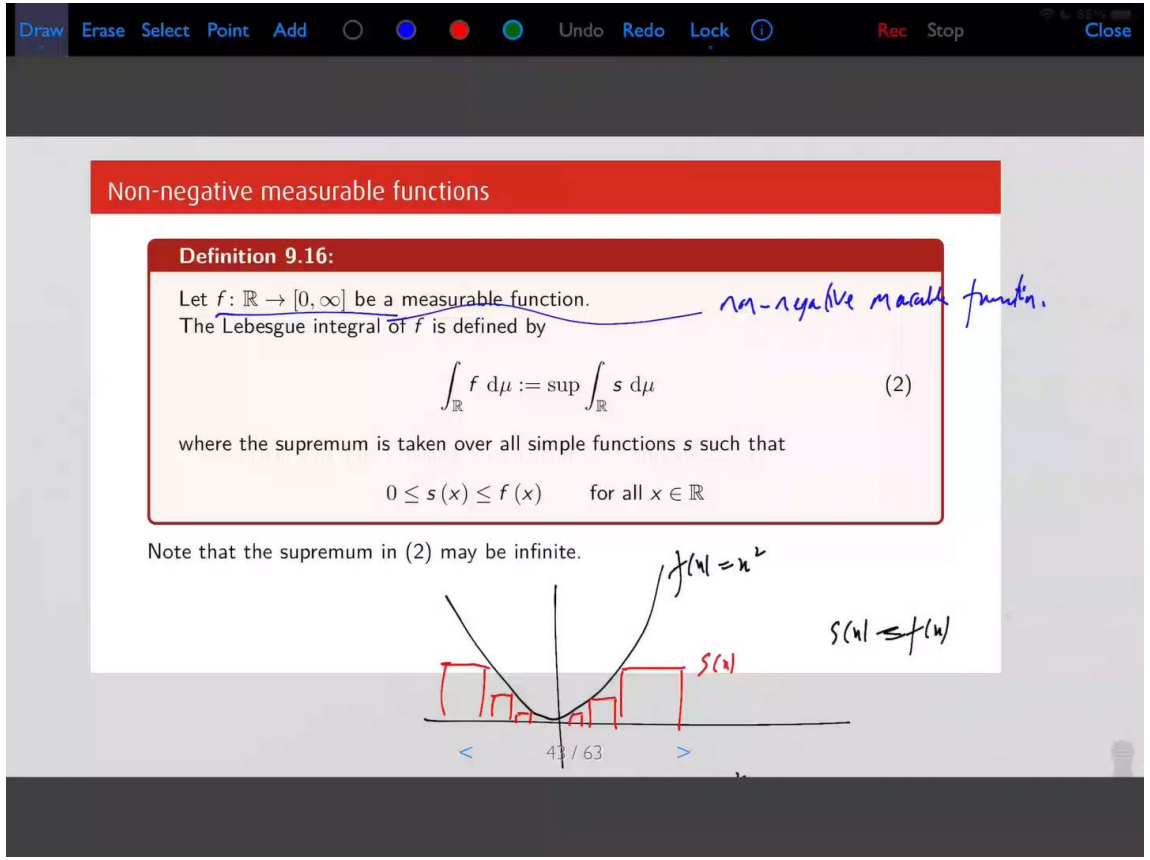
Wireless connection to projector

- 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)

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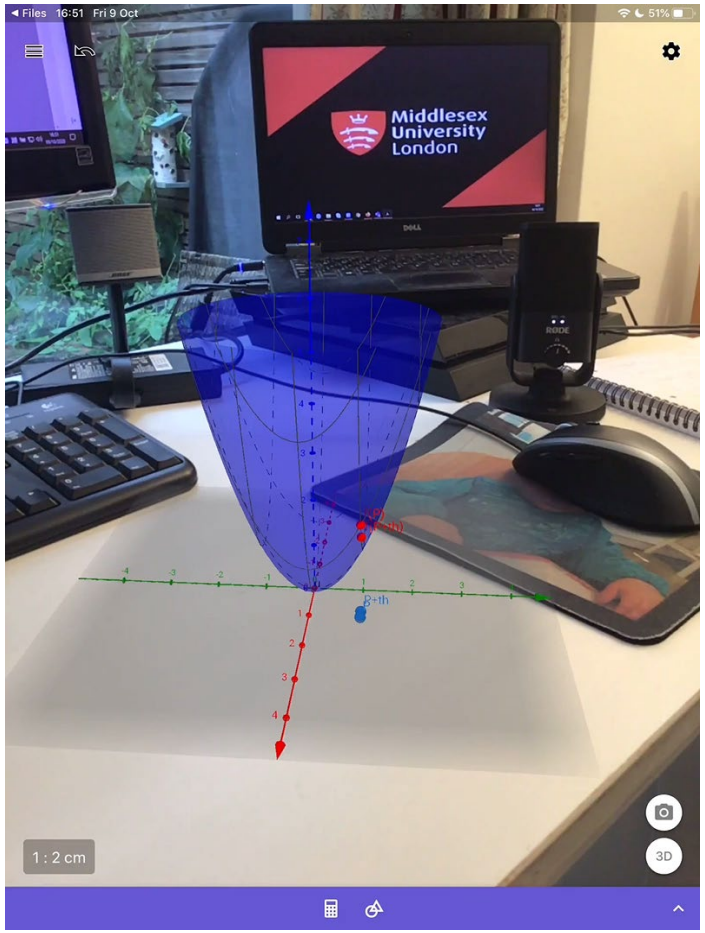
DIGITAL PEDAGOGY FOR DIGITAL POVERTY

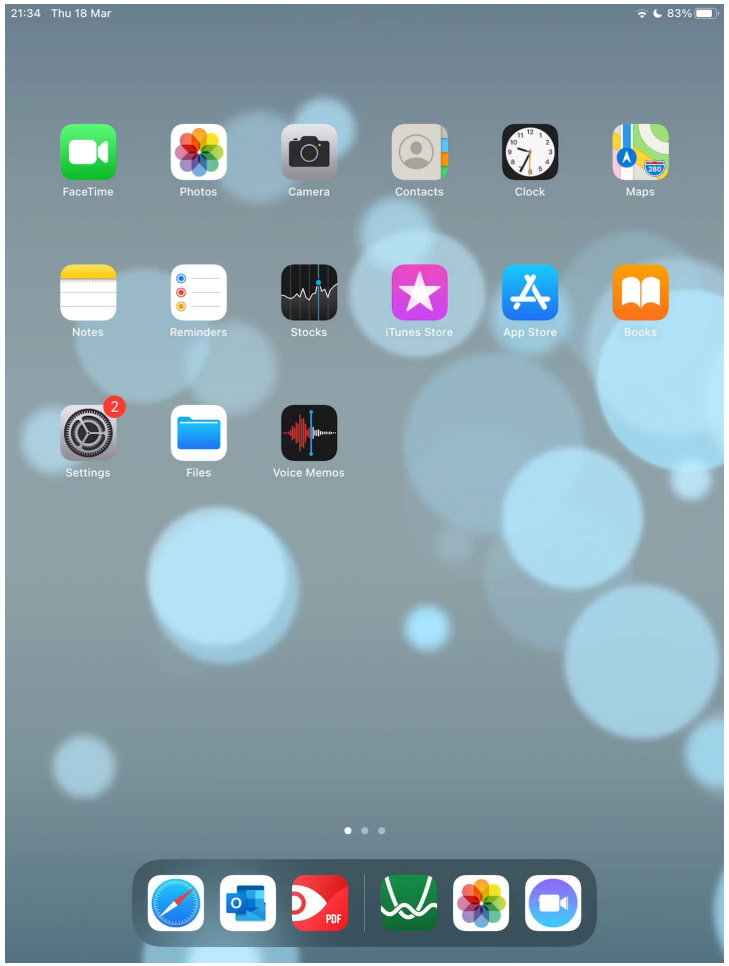
SWITCH TO POWERFUL APPS IN LECTURES



Augmented reality (Geogebra)

All part of the recorded lecture

FEEDBACK

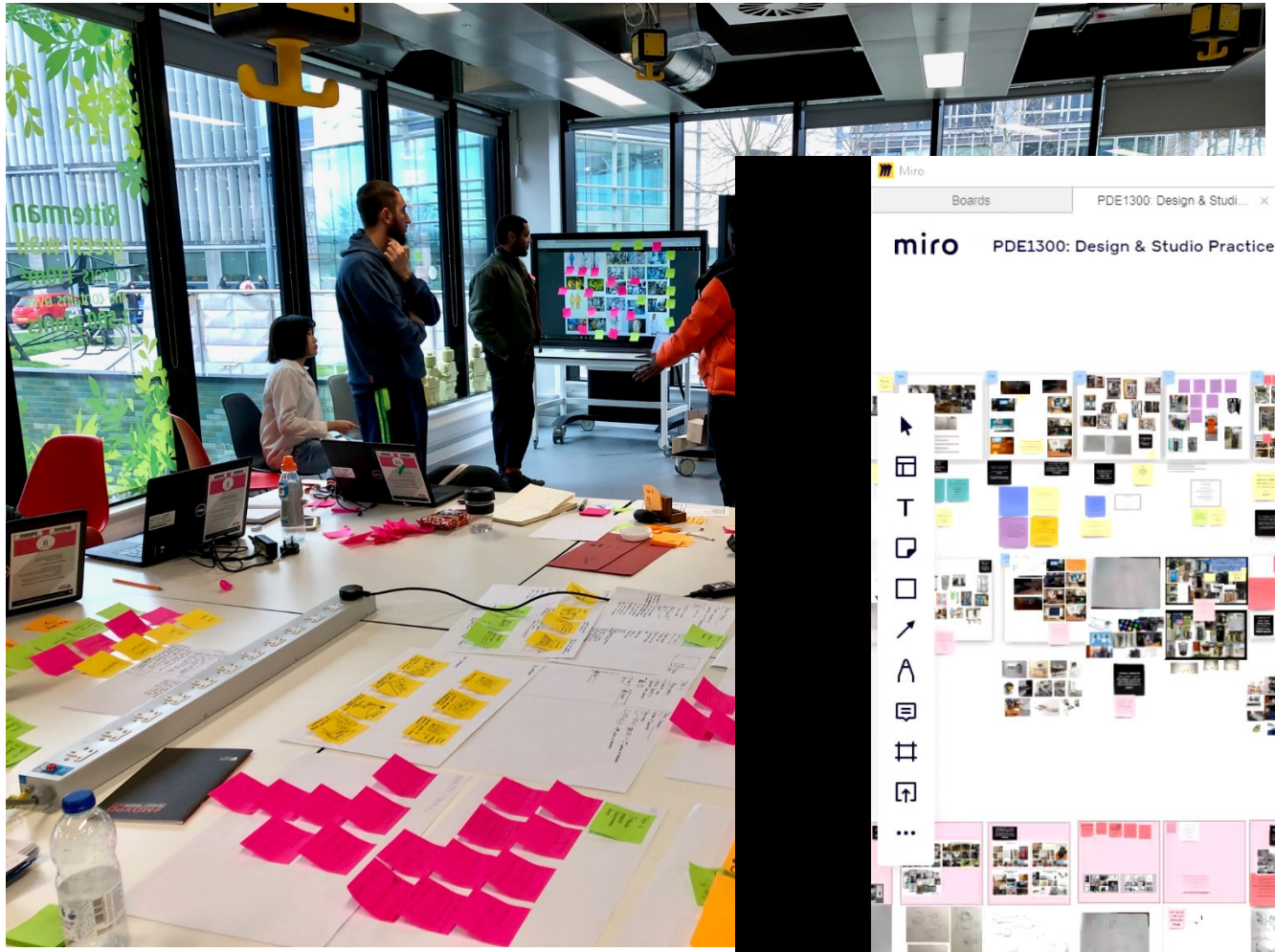


- Students save draft work in shared OneDrive folders
- Staff add
  - typed
  - handwritten
  - audio

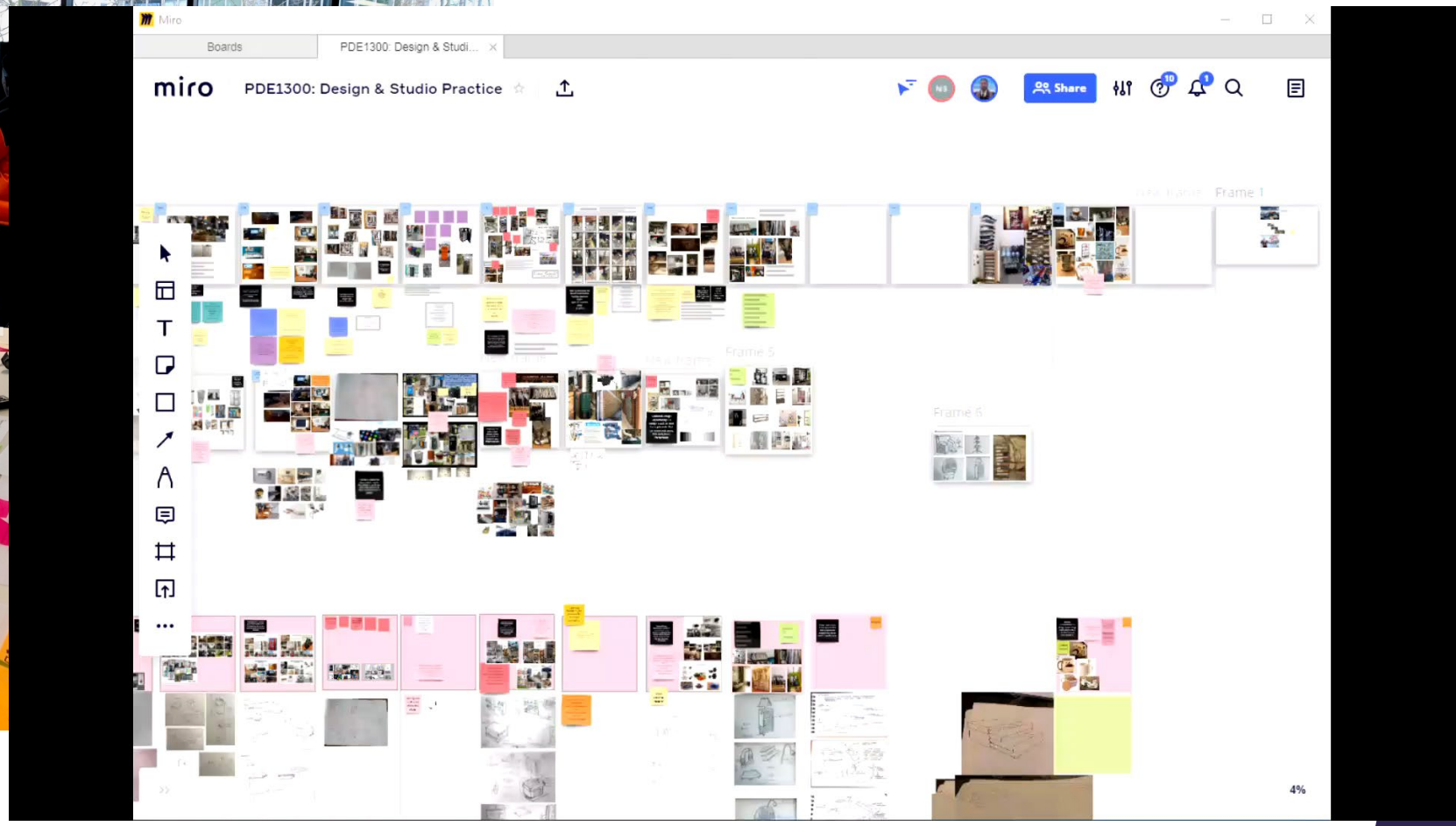
  comments that are automatically synchronised.
- Optional: automatically email students

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

PROBLEM-SOLVING SPACES



Product Design Engineering Studio



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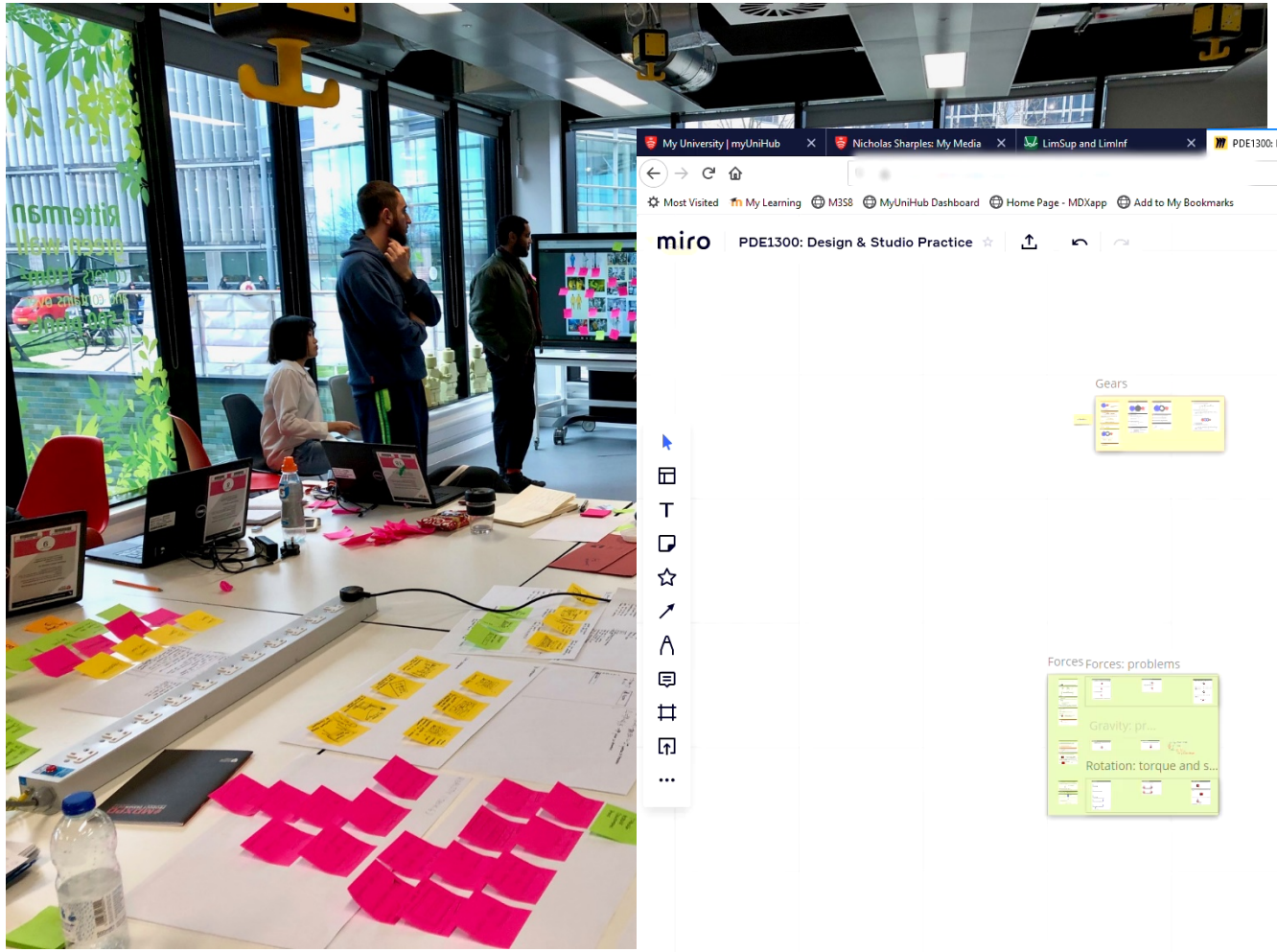

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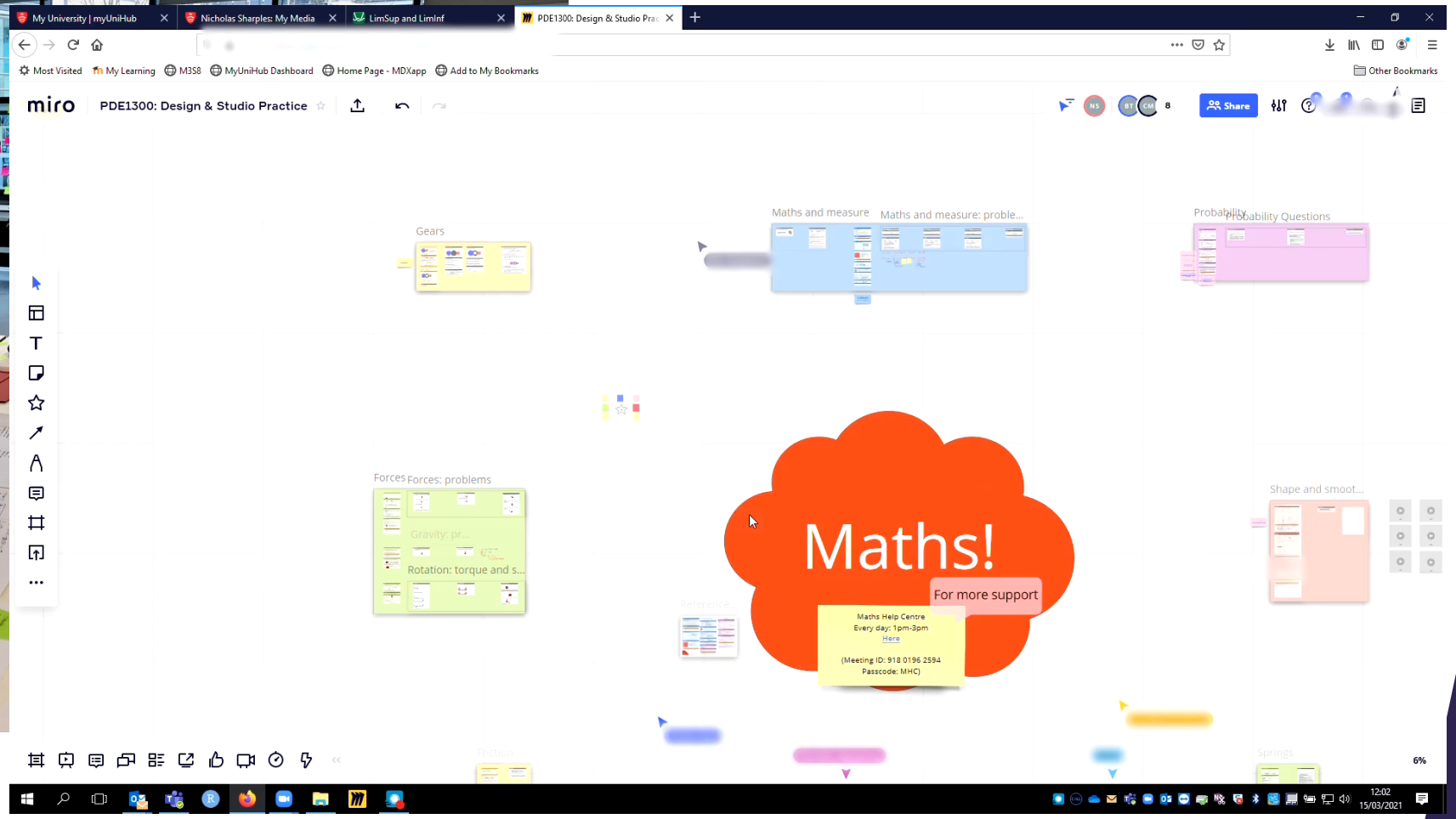
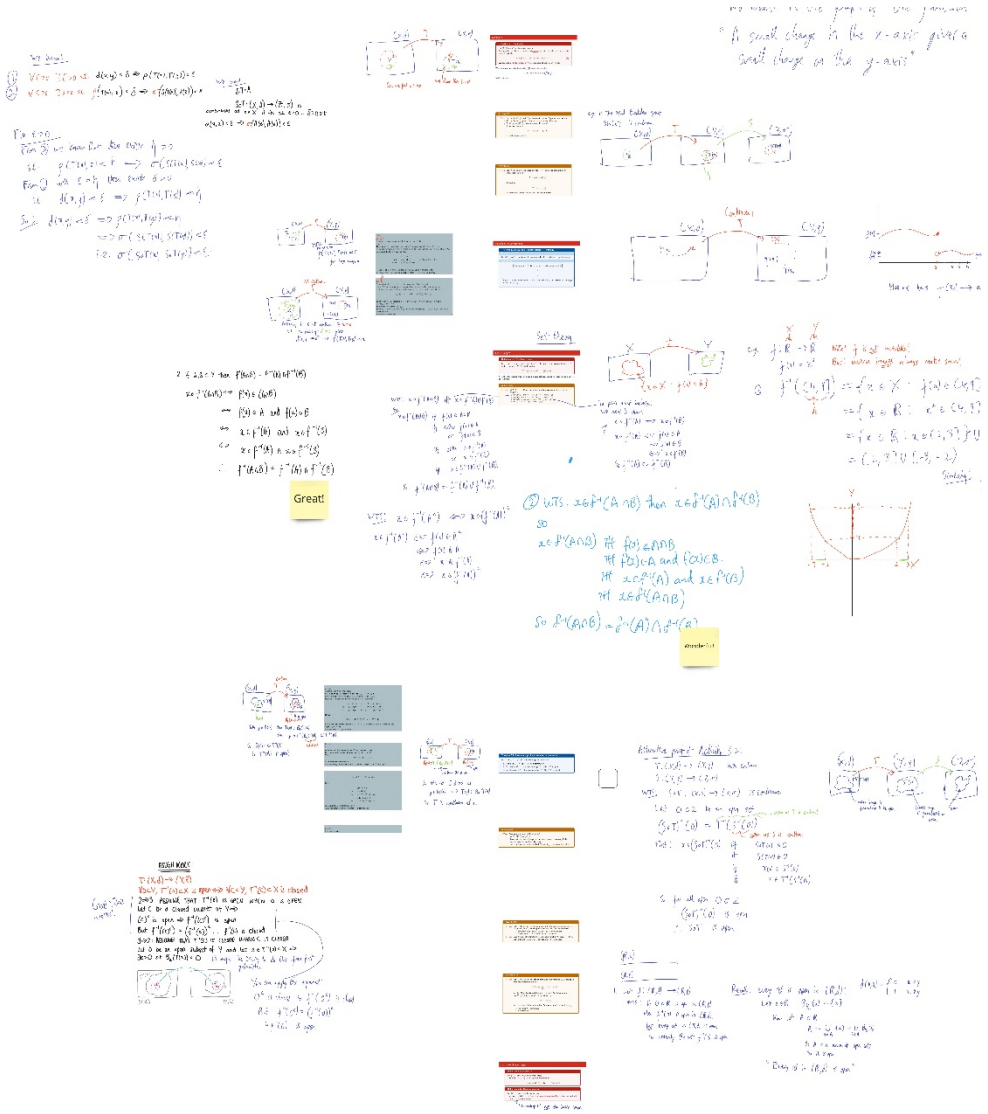


PROBLEM-SOLVING SPACES

- Developed in conversation with
  - BA Product Design
  - MA Creative Technology
  - School of Arts & Creative Industry
- Now used in most maths modules
- Persistent, on-demand collaborative spaces.
- Blended mode:
  - Lectures
  - Group work
  - Individual work



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

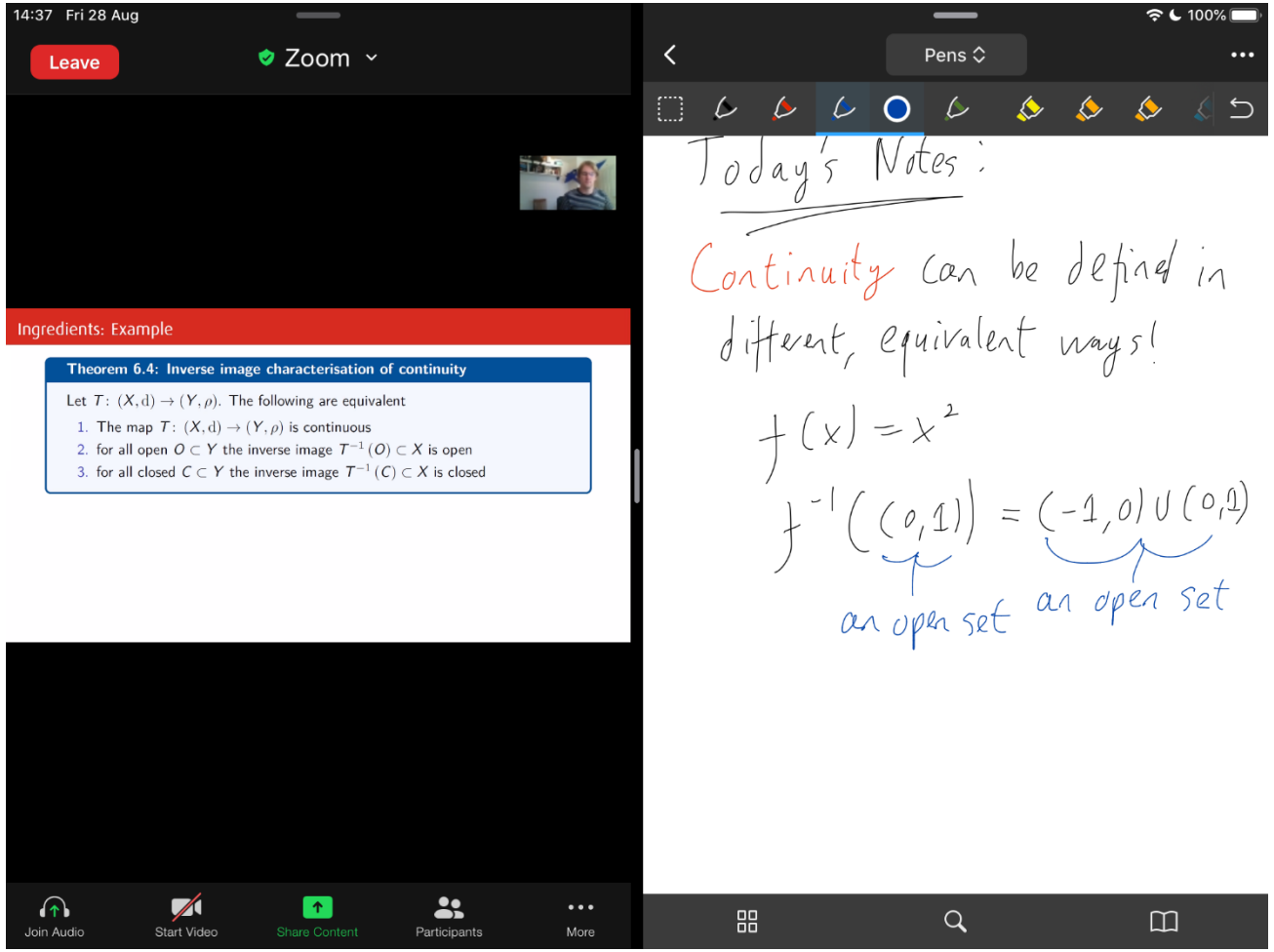
- have the tools required to support their mathematical learning
- can engage and interact in learning sessions
- can share written mathematics
- can collaborate on mathematical problems

WHAT WE CAN DO

- Collaborate
- Communicate
- Feedback
- Widen participation
- Equality of access and experience

common hardware platform

ACCESS LECTURES!



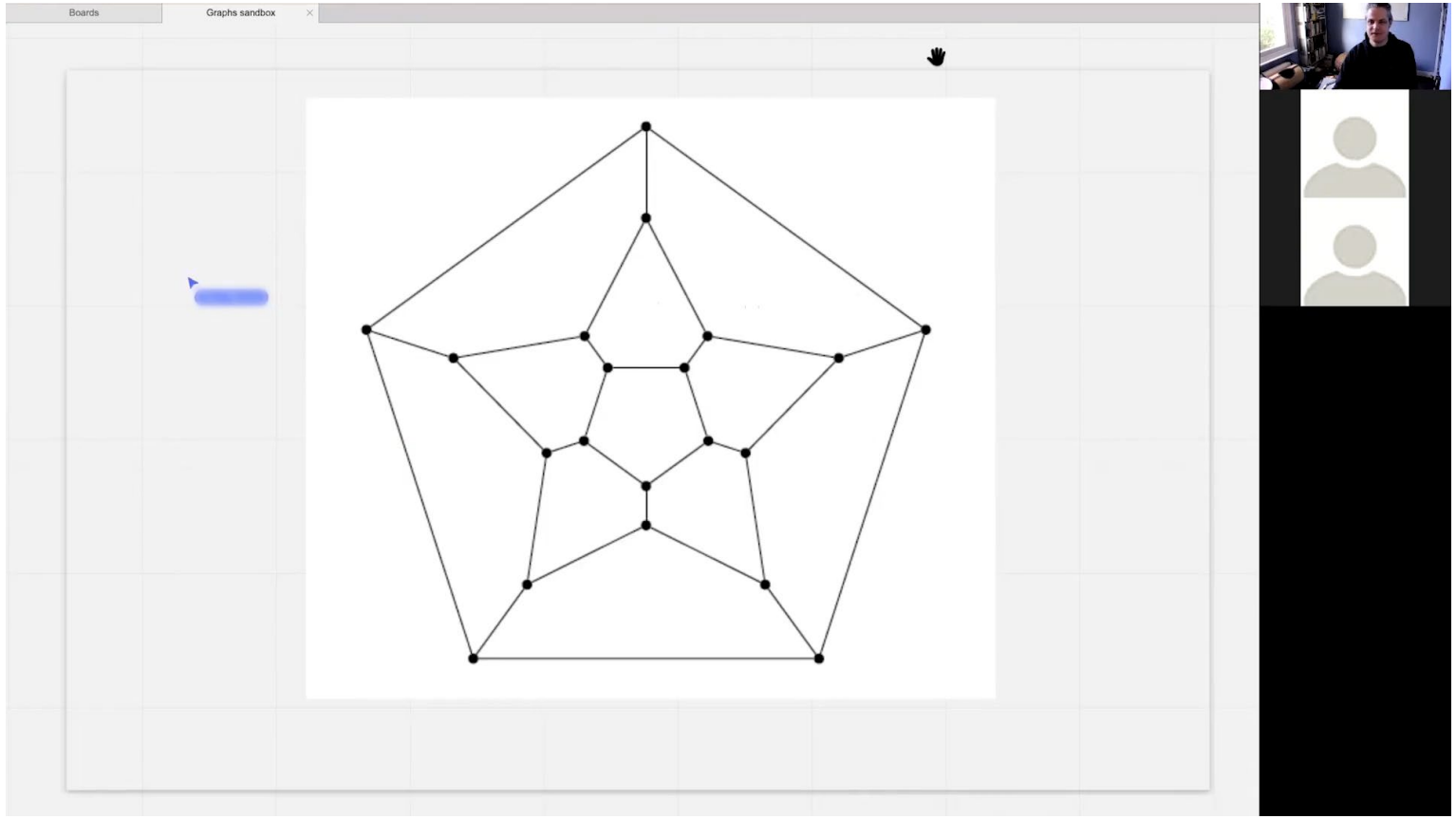
Digital poverty

- 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

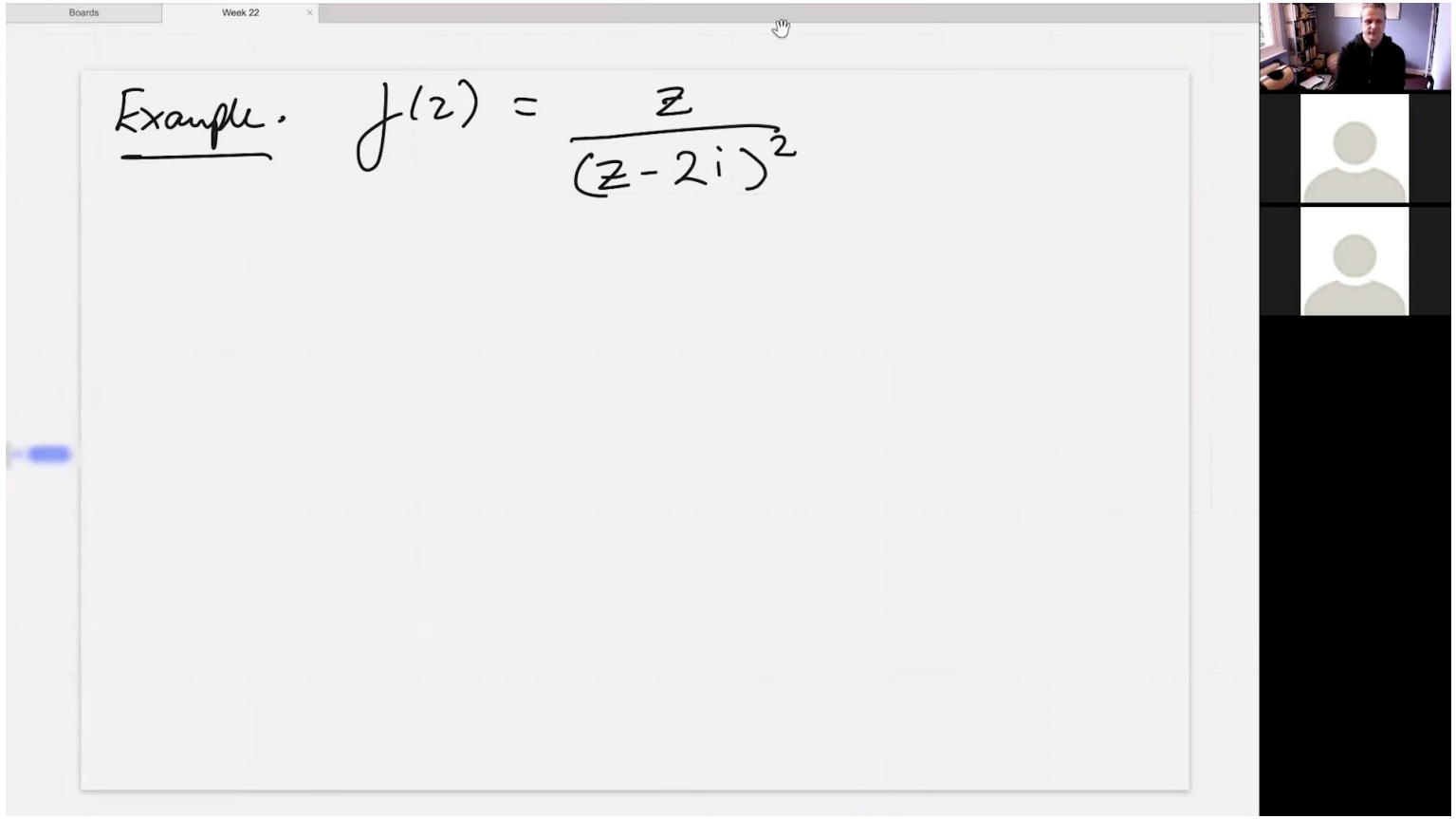
But internet connectivity could still be a problem…

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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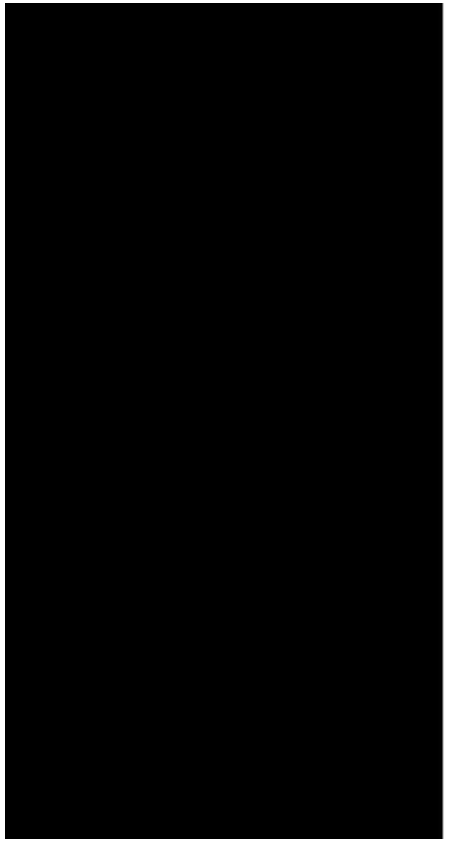
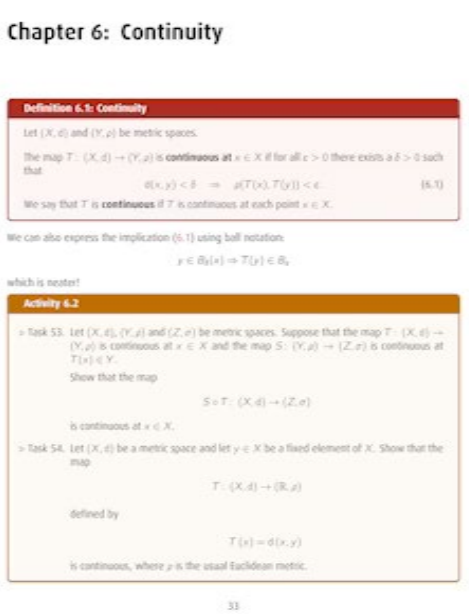




Chapter 6: Continuity

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

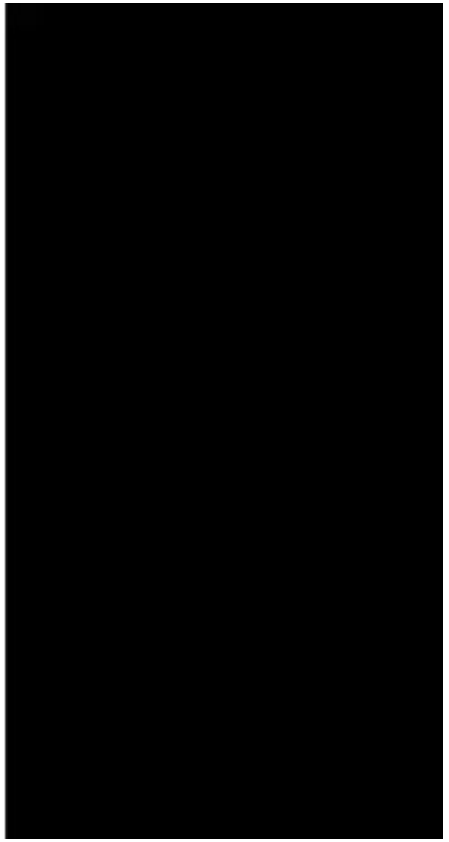
  $$T : (X, d) \to (\mathbb{R}, \rho)$$

  defined by

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

  is continuous, where ρ is the usual Euclidean metric.

33



- iPads allow handwriting on a persistent, collaborative space for each lecture/topic/problem
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STUDENT VOICE

Survey sent to iPad recipients February 2021

- UG and PG students response $n = 17$

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

COURSE DESIGN

Now:

- Students access and contribute to lectures using their iPads
- Some work is being completed by iPad
- Most feedback is being given by iPad

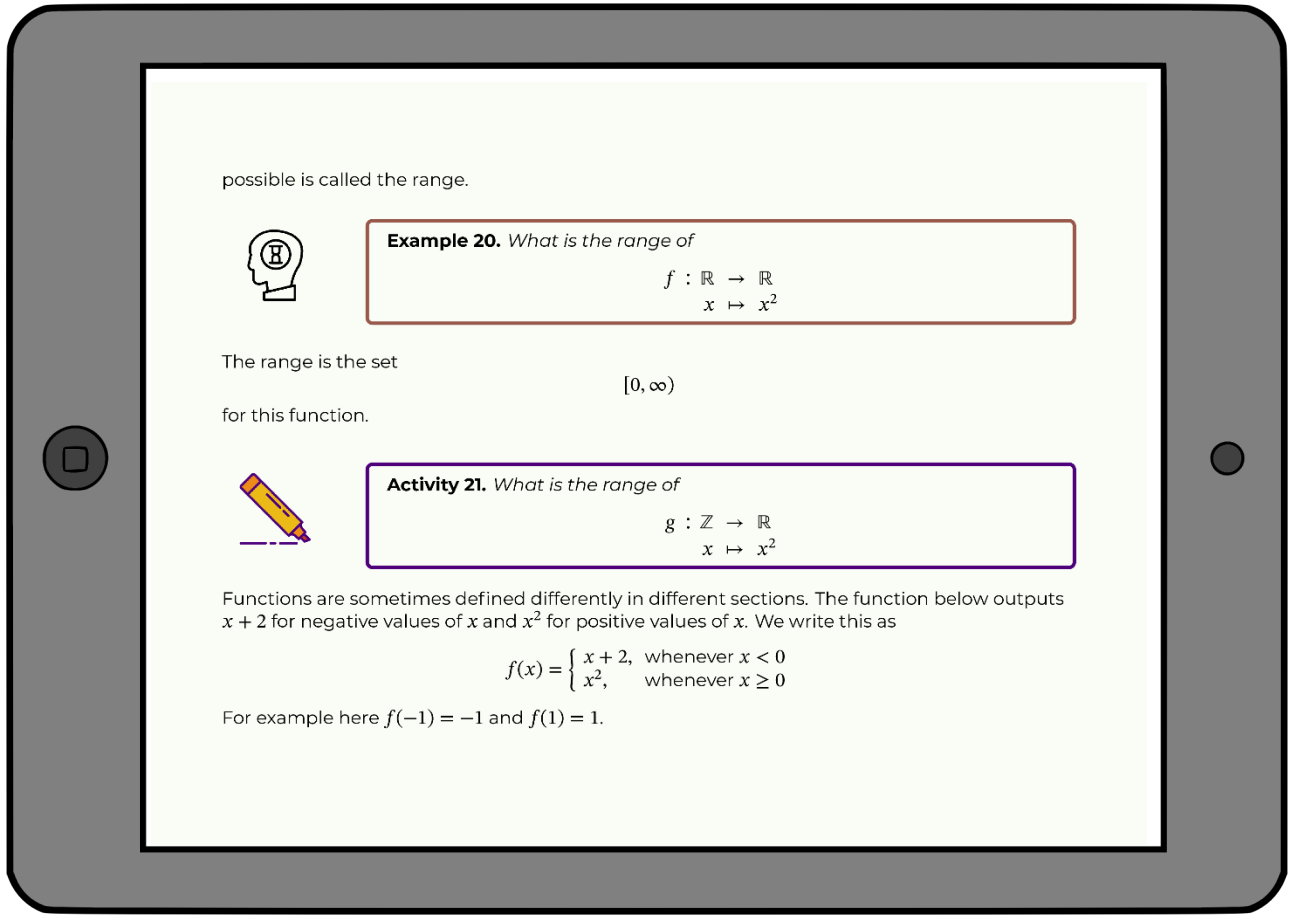
Next:

- **all** work can be completed by iPad
- **all** feedback is given by iPad
- Reference materials in an iPad accessible format

WORK DIRECTLY ON THE VLE

- Each student sees a personalised folder per module
- Staff see all student folders
- Edits are automatically shared
- Staff notified when student edits a document
- Student notified when staff leave feedback

WORK SHEETS



possible is called the range.

Example 20. *What is the range of*

$$f : \mathbb{R} \to \mathbb{R}, \quad x \mapsto x^2$$

The range is the set

$$[0, \infty)$$

for this function.

Activity 21. *What is the range of*

$$g : \mathbb{Z} \to \mathbb{R}, \quad x \mapsto x^2$$

Functions are sometimes defined differently in different sections. The function below outputs $x + 2$ for negative values of x and x^2 for positive values of x. We write this as

$$f(x) = \begin{cases} x + 2, & \text{whenever } x < 0 \\ x^2, & \text{whenever } x \geq 0 \end{cases}$$

For example here $f(-1) = -1$ and $f(1) = 1$.

Convert material to new format

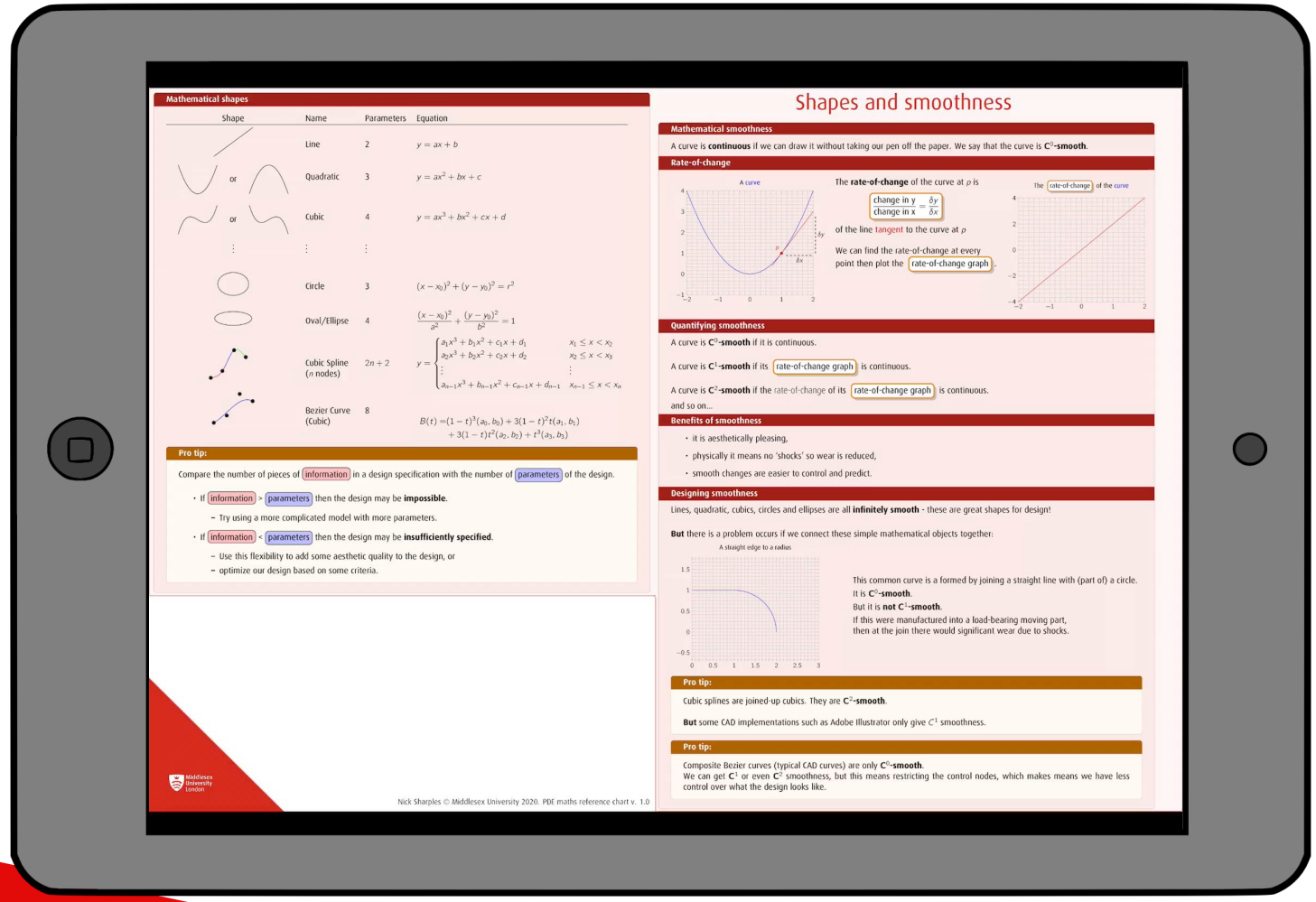
- `LaTeX class files`

  (quick)

- Word/PowerPoint templates

  (more involved)

CHEAT SHEETS



Tablet appropriate reference:
Don't turn the page – Zoom in!

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DIGITAL PEDAGOGY FOR DIGITAL POVERTY

INCLUSIVE APPROACH TO ASSESSMENT

Common platform makes it easier to make students partners in assessment by giving them choices:

“Write a report”	or	“Make a video commentary”
“Show your work”	or	“Add an audio explanation”
“Critique an article”	or	“Record a critical commentary of a peer’s work from the shared folder”

- Reduces benefit of having better equipment at home
- Reduces need for reasonable adjustment

SUMMARY

- iPads for students
  - improve access and widen participation
  - encourage collaboration
  - encourage feedback-seeking behaviour
  - equality of access/experience
  - inclusive assessment

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

QUESTIONS?

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APPS/SERVICES LIST

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