



Assessment for Learning: Resources for First Year Undergraduate Mathematics Modules

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- *Teaching and Learning Enhancement Call 2014 (Building Digital Capacity)*
- *January 2015 – December 2016*
- [More Information](#) [1]



The next 14 minutes....

1. Our Project
2. Developed Resources
3. Trials and Evaluations
 - Which resources trialled where
 - Evaluation methodology
 - Two specific evaluations

Assessment for Learning: Resources for First Year Undergraduate Mathematics Modules



- give students opportunities to develop their understanding of mathematics
- the design and creation of two types of technology enhanced formative assessment resources for use in mathematics modules



Two types of resources

- Technology enhanced resources (outside class)
 - A suite of interactive tasks
 - Khan Academy Playlists
 - Online 'lessons' designed in Moodle
 - Student screencasts
 - A web inventory of useful existing resources
- Technology Enhanced Audience Response System (in class)
 - UniDoodle

1st phase – student and lecturer questionnaires Spring 2015



Topics

- Algebraic Manipulation
- Logs
- Limits
- Functions
- Calculus

Resources

- Paper Based (*current*)
- Websites and Videos (*request*)
- Own pace & ‘pause and rewind’
- Examples and solutions relating to ‘real life’ or student course

2nd Phase- Trials during 2015/2016



Formative assessment resources	Institutions where trialled
Interactive Tasks (Geogebra)	MU
Khan Academy Playlists	DCU and DkIT
Moodle Lessons	AIT
UniDoodle	MU and DCU
Student screencasts	DkIT



Khan Academy Playlists

- Available via Moodle as a playlist
- Links to videos and quizzes within Khan Academy
- All topics covered
- [DCU Implementation](#)

Interactive Task Geogebra:

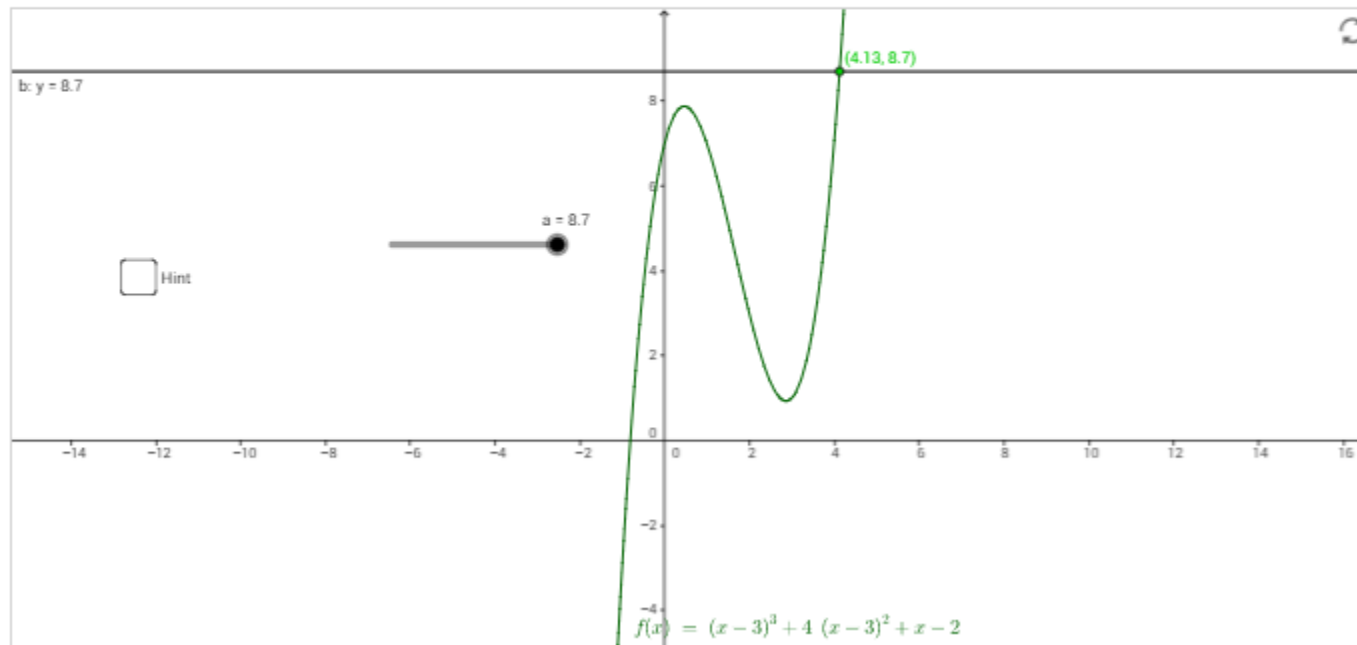
Horizontal Line Test

Audience
Formative
Lessons
Assessment
Concepts
Resources
Mathematics
Online
Tasks
Response
Screencast
Interactive
Apps

[Link to task](#)

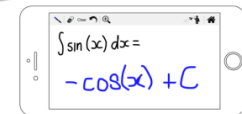
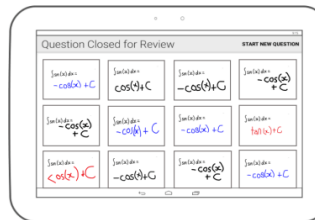
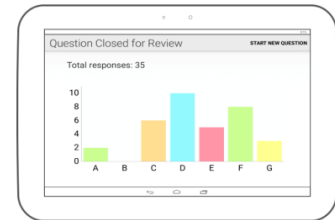
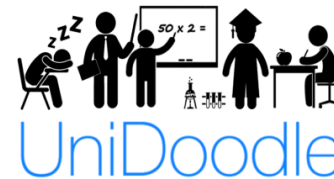
- 1) Is this function 1-1? Explain your answer.
- 2) Are there any intervals for which $f(x)$ is 1-1?
- 3) Is this function onto? Explain why.

Graph of $f(x)$



UniDoodle

- Students use their own phone or tablet
- Lecturers use a tablet and connect to ohp
- Question templates can be preloaded
- Graphing facility for students
- Lecturer selects which answer to display



Moodle Lessons

What are Quadratic functions?



[Screencast on Quadratic functions](#) video/mp4



[What are quadratic functions?](#)



[Geogebra graph of a quadratic function](#)



[Quadratic functions quiz.](#)

Linear Equations



[Linear Equations](#)

Introduction to Differentiation

This section introduces learners to differentiation. A lesson introduces the concept and details the rules of differentiation. The quiz can be taken as a self-assessment to test your knowledge of the topic.



Evaluation of Resources

Mathematics Education Research

- ... to understand mathematical thinking and the ways of teaching and learning

AND

- to use this to improve teaching and learning

[2]

Technology Learning Evaluation Framework

- Utility & Usability
- Learning experience
- Linking formal and informal learning

[3]

Mixed methodology to gather the data



Quantitative

- Exams or tests
- Written questions or tasks
- Quizzes
- Usage
- Questionnaires (ask the students!)

Qualitative

- Task Based Interviews (Think Aloud)
- Interviews (focus group)
- Interviews (lecturers)
- Questionnaires (ask the students!)

Triangulation

[4]



Developing the questionnaire

- Based on Likert scale questionnaires from similar projects
- 5 main dimensions
 - Mathematical Confidence (before and after)
 - Engagement with the resources
 - Learning from the resource (student view)
 - Usability (how easy/difficult was it to use)
 - Background (HL or OL, gender)
 - Open Questions (some targeted)

[5-7]

Student Survey – tailored Likert scale questionnaires



Dimension	Full Questionnaire (48 items)	Shorter Format Questionnaire (29 items)
Confidence when learning mathematics	7	5
Impact on Engagement	8	8
Impact on learning	15	10
Usability	12	2
Student background data	5	3
Open Question	1	1

What did we find out?



Students who used the resources are positive and their mathematical confidence increased

- Anonymity and engagement in UniDoodle
- Revision for Moodle Lessons
- Sliders in Geogebra
- Quizzes in KA



Engagement was low and initial survey too long (DkIT)

- Purpose not always clear (Geogebra tasks)
- Didn't need it (KA)
- Pen size in UniDoodle



Other Evaluations

- Usage statistics
- Diagnostic test results
- Module grades
- Quiz as part of CA
- Interviews

Overall set of evaluations.... Next slide

Resource	Student Questionnaire	Number of Responses	Other data	Other
Interactive Tasks (MU & DCU)	14 q's Online	46 Students (10% of cohort)	Usage	Task based think aloud (5 students)
Khan Playlists and Mastery Challenges (DkIT)	Semester 1 48 q's Paper based	115 (65% of cohort)	Usage & DT's and module grades	Student Focus Group Interview September 2016
	Semester 2 29 q's Paper based	37 (52% of cohort)		
Khan Playlists (DCU)	2 part (13 q's) Paper based	1 st Part 108 (<50%) 2 nd part 34	Usage	
Moodle Lessons (AIT)	29 q's online	12 (46%)	Usage & Quiz	
UniDoodle (MU & DCU)	42 q's Paper based	110 (<50%)	Pre and Post Autumn	Lecturer Interviewed

DkIT – 2nd phase implementation



- Khan Academy Mastery Challenges (embedded)
 - 10% of the grade
- Recommended by lecturer (approx. 3 sets per semester)
- Lecturer can see usage and grades
- Lecturer can adjust teaching accordingly
- [Link to DKIT Khan Mastery Challenges](#)

DkIT Evaluation of Khan Academy

Data	DT1 (Start Term)	DT2 (5 Weeks)	KA Usage (1)	Survey (1)	KA Usage (2)	Module Mark	Survey (2)
Number of students (Total 175)	133	140	24	115	71	71	37

Data across the year

- 104 sat both DT1 and DT2

New Questions

- What's happened with the grade?
- How did KA effect this?
- Why did they use the resource this time?



Module mark				
Exam (60%)	Tutorials (10%)	In class test 1 (10%)	In class test 2 (10%)	KA Mastery Challenges (10%)



Interactive Task Further Evaluation

- Do the Interactive tasks really work?
 - Misconceptions
 - Understanding
 - Wording
- How to encourage greater use?
 - Purpose
 - Ease of use
 - Inputting functions (most used)

Think Aloud Task Based interviews



Think Aloud

- What goes on inside the students head?
 - Verbal Analysis
 - Protocol Analysis
- Talking and thinking can be difficult!

[7,8]

Tasks should be

- Accessible
- Rich Representational Structure
- Free problem solving
- Explicit criteria for major contingencies
- Interaction with learning environment

[9]

Mathematical Tasks that develop understanding



- Example Generation
- Conjecturing/Generalising
- Visualisation
- Evaluating Mathematical Statements

[10]

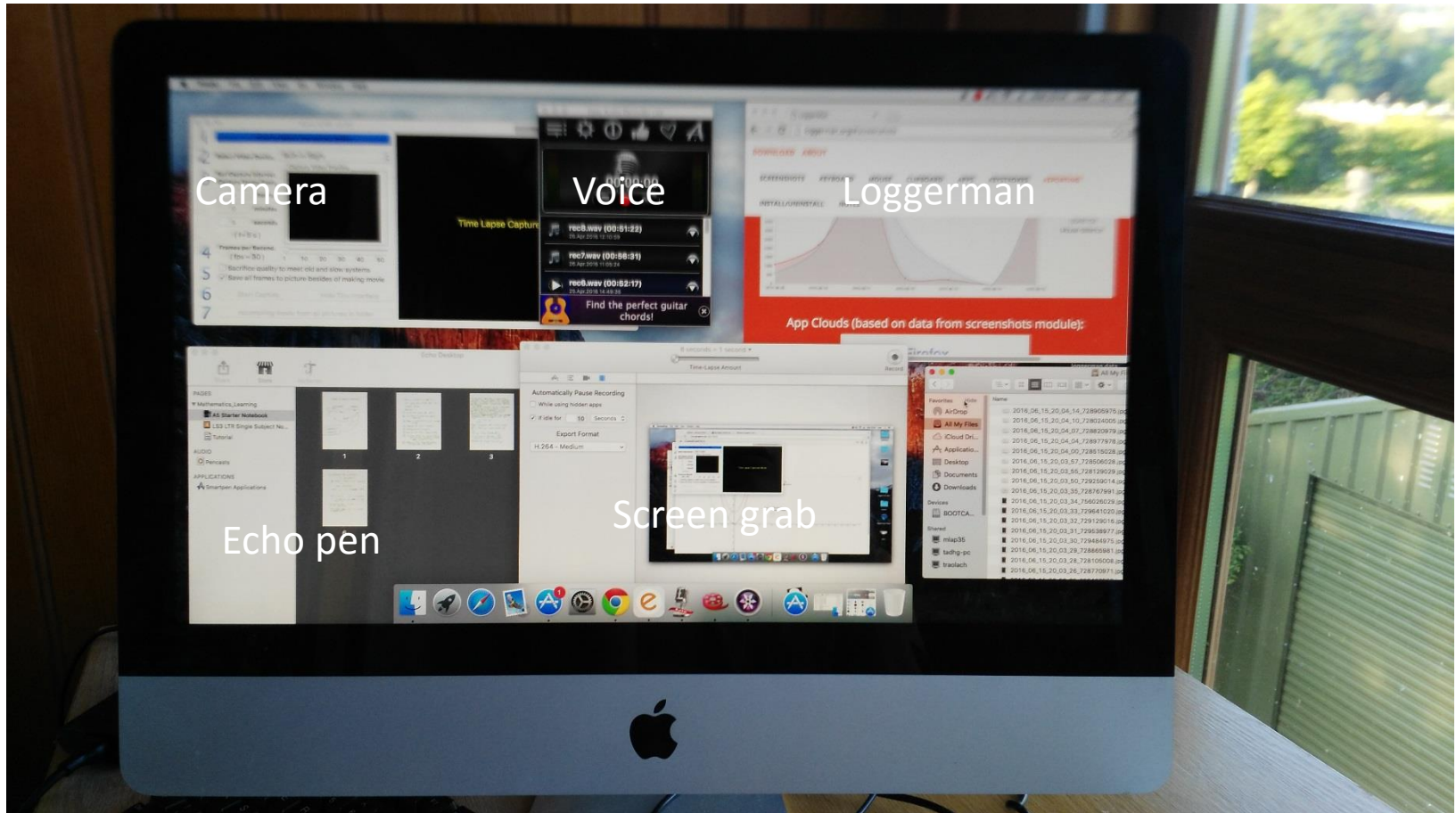


Structure of the interview

- Pre test on Functions
 - Written artefact
- Series of interactive Geogebra tasks
 - Vertical Line Test, discovering patterns and relationships
 - Sliders to change value of a in $a.f(x)$, conjecture
- Post Test
 - Changes to initial answer

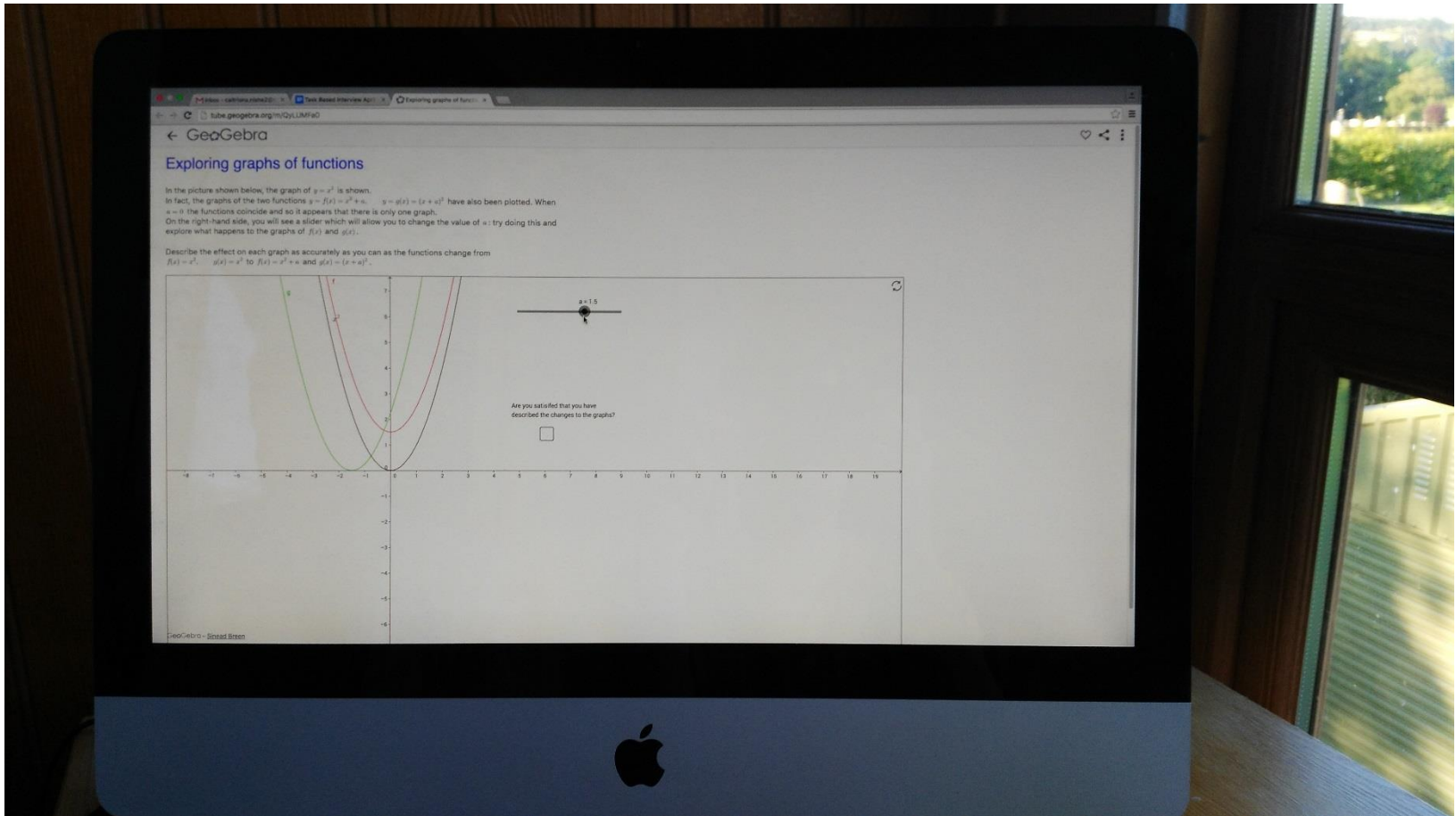
Recording the data

Audience
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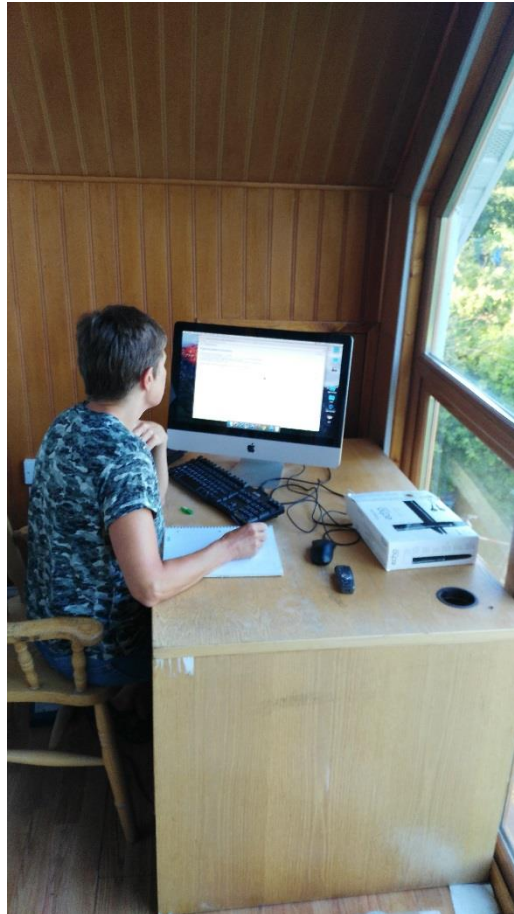
Student View

Audience
Lessons
Assessment
Formative
Concepts
Resources
Mathematics
Online
Response
Screencast
Interactive
Apps



Student Comfort!

Audience Lessons Assessment Tasks
Formative Concepts Resources Mathematics Online Response
Screen Interactive Apps



Retake!



What have we found out?

Not new:

- *'I learnt this off from leaving cert, I should remember this'*
- Silences for high cognitive load

Language

- *'ahm the point at which f of xoh what's the word for it when it ah goes from negative to positive put it that way ahm'*

Learning

- Using the slider (talking & facial expressions)
- *'there would always be two points of intersection..oh ah there is only one point of intersection ahm'*
- Revise answers (correctly) after (echo pen recording)



Next Steps

- Inform further development
 - DkIT – Khan Academy Mastery Challenge
 - Reduce CA elements
- Interactive Tasks - Inform for the In-depth analysis
 - 59% found the sliders useful
 - purpose and objective not clear
 - Clearer instructions on the Geogebra itself
- UniDoodle – Fine tune for further dissemination
 - *‘It's more fun than a normal lecture, gets you more involved.’* Student 46
 - *‘could make size of pencil ink even smaller’* Student 4
 - Lecturer – ‘time consuming to prepare’

Think Aloud---interview process



- All one package for the PC
 - Video
 - Echo Pen
 - Audio
 - Screen
 - Mouse
 - Keyboard

Currently Under Development

Did I cover the 3 points?



Go raibh maith agaibh

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