

Building cognitive bridges in mathematics: exploring the role of screencasting in scaffolding flexible learning and engagement

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Supporting numeracy in STEM disciplines

- ▶ There has always been, and always will be, need for reliable, supportive and expert learning support for students in numeracy, mathematics and statistics across a wide range of disciplines in universities.
- ▶ Like language, mathematical skills and thinking underpin cognitive skills in other areas, and tertiary study demands that such skills be used confidently and promptly in new and sometimes taxing contexts.

Rationale: Strategic support for mathematics

- ▶ The past two decades have seen increased funding pressures and staffing constraints in mathematics and statistics for tertiary students
- ▶ Learning support in mathematics and statistics is a critical component in the totality of enabling student learning and avoiding preventable student attrition
- ▶ Flexible, 24X7 support essential
- ▶ Use of technologies for access and self-paced learning

Aim of this paper

- ▶ To present a case for screencasting as a supplementary resource
- ▶ To demonstrate examples and evidence of a successful initiative
- ▶ To profile student feedback on their use of MathsCasts
- ▶ To show the learning from MathsCasts
- ▶ To outline future research directions

Research Questions

1. What active learning strategies do students employ while interacting with the videos?
2. How important is the flexibility of the videos for learners, what devices are used to view the videos and, where are they watched?
3. How do students integrate MathsCasts into their studies to help them with mathematical knowledge and skills?

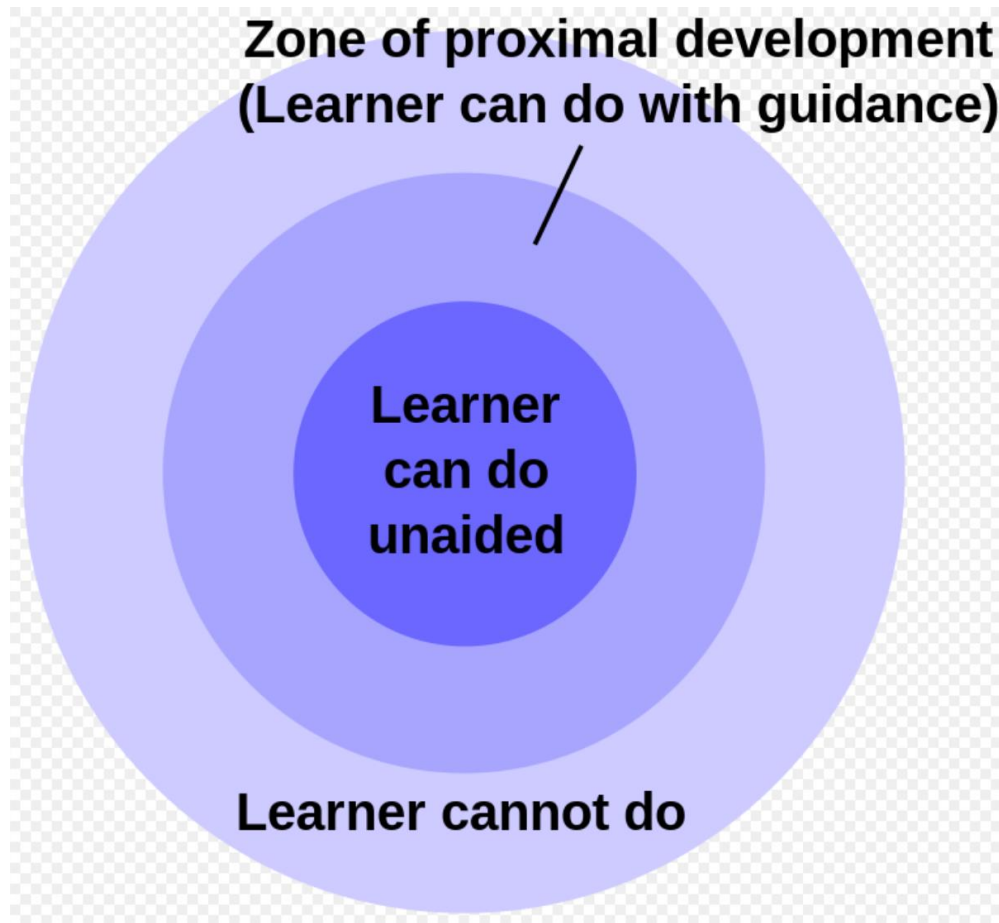
What is a MathsCast?

- ▶ Short screen video with narration
- ▶ Created with Camtasia Studio on a tablet PC
- ▶ Handwritten explanation of a mathematical concept
- ▶ To provide 24/7 mathematics support to students
- ▶ About 450 available as open educational resources
- ▶ Via iTunes U, or <http://commons.swin.edu.au> search for MathsCasts, or on YouTube, search for Swinburne MathsCasts
- ▶ 1.5m hits
- ▶ Used offline in Pakistan and in South Africa for free education

Pedagogical definition of MathsCast

- ▶ Flexible extension to an existing physical and virtual learning environment
- ▶ Worked examples, concepts explained
- ▶ Performance modelled by experts
- ▶ Pedagogical scaffolding: procedural, cognitive
- ▶ Engagement of learners in different modes (visual, auditory)
- ▶ Personal, timely, focussed, accessible resources

Vygotskyan learning framework



SAMR Model

Transformation

Redefinition

Tech allows for the creation of new tasks, previously inconceivable

Modification

Tech allows for significant task redesign

Augmentation

Tech acts as a direct tool substitute, with functional improvement

Substitution

Tech acts as a direct tool substitute, with no functional change

Enhancement

SAMR Model



Types of interactivity enabled

Type of interactivity	Description	Example
Dialoguing	Learner receives a response to input	Seek help from screencast, click on a hyperlink to get additional information
Controlling	Learner determines pace and/or order of presentation	Use pause/play key or forward (continue) button while watching a math cast
Searching	Learner finds new content material by entering a query, receiving options, and selecting an option	Seek information on a maths problem or procedures
Navigating	Learner moves to different content areas by selecting from various available information sources	Click on a menu to move from one Mathscast to another

Context of the student survey

- ▶ Engineering Mathematics 1 and 2 students
- ▶ Quantitative and qualitative data
- ▶ Anonymous

1. Active learning strategies while interacting with the videos?

- ▶ How do you watch MathsCasts?
- ▶ n=30, multiple answers possible

Answer Choice	Number of respondents (percentage)
I usually watch a complete Mathscast from start to end.	21 (70%)
I skip sections by fast-forwarding to concentrate on sections that are most helpful.	10 (33%)
I rewind to watch some sections again.	16 (53%)
I pause playback to think about an explanation.	11 (37%)
I pause playback before an explanation to attempt the maths myself.	7 (23%)
I watch an explanation then try the problem myself.	16 (53%)

2. How important is the flexibility of the videos for learners, what devices are used to view the videos and, where are they watched?

- ▶ Where and when do you watch MathsCasts
- ▶ N=28, multiple answers possible?

Answer Choice	Number of respondents (percentage)
When I'm off campus.	25 (89%)
When I'm on campus.	9 (32%)
When I'm in the library on campus.	9 (32%)
When I'm travelling.	2 (7%)
While I'm eating.	3 (11%)
While I'm watching TV.	0 (0%)
While I'm listening to music.	4 (14%)

3. How do students integrate MathsCasts into their studies to help them with mathematical knowledge and skills?

- ▶ Accessed MathsCasts when, how and how often?
- ▶ N=30, multiple answers possible

Answer Choice	Number of responses (percentage)
I watch all Mathscasts that are made available for my unit.	10 (33%)
I watch only the Mathscasts on topics I find difficult to understand in my unit.	21 (70%)
I watch Mathscasts from other units if they cover topics relevant to my unit.	5 (17%)
I watch Mathscasts from other units out of interest.	3 (10%)
I watch Mathscasts when I'm studying.	15 (50%)
I watch Mathscasts to help me work out assignment problems.	20 (67%)
I watch Mathscasts before the topics are explained to me in lectures.	3 (10%)

3. How do students integrate MathsCasts into their studies to help them with mathematical knowledge and skills?

- ▶ Accessed MathsCasts when, how and how often? (part 2)
- ▶ N=30, multiple answers possible

Answer Choice	Number of responses (percentage)
I watch Mathscasts after lectures to see another explanation of working a problem.	11 (37%)
I watch Mathscasts when I prepare for a test.	16 (53%)
I watch some Mathscasts more than once.	19 (63%)
I watch Mathscasts together with other students.	1 (3%)
I watch Mathscasts by myself.	25 (83%)
I discuss the Mathscasts I've watched with other students.	4 (13%)

From a 2015 survey of a blended second year unit (yes, this is a plug for my other presentation)

Mathematics-specific comments:

- ▶ Difficulty continuing to work through mathematical concepts if there are steps that weren't understood.
- ▶ Importance to understand all steps in a solution to be able to reproduce such a solution: 'the annoying part is you do not understand what you are watching and you will spend one hour to watch them all, and if you don't understand, it will be one useless hour'.

To teach mathematics effectively in blended mode, additional support mechanisms need to be made available to students who are stuck, e.g. through specialised face-to-face or online support.

Where is the learning?

- ▶ Evidence that screencasts support independent learning
- ▶ Enable students to study flexibly off campus.
- ▶ Students actively engage in mathematics tasks while they are viewing (e.g., pause the video before watching an explanation, try the problem themselves after watching)
- ▶ MathsCasts are integrated into students' learning routines.
- ▶ Students are quite strategic and focussed in the timing and purpose of their viewing, with the majority preferring to use them for assignment preparation, fine-tuning of their knowledge for tests and for review of complex topics.
- ▶ Ask different questions in maths support

We have shown that students engage actively with MathsCasts and that MathsCasts can act as cognitive bridges to extend understanding and develop mathematical competencies.

Future Research

- ▶ **How do we get learners to self-regulate their learning?**
- ▶ Active learning strategies
- ▶ Draw benefits from flexibility, time management learning anywhere, anytime, anyhow.

- ▶ **But what about those who do not have self-regulatory skills?**

Future Research

- ▶ **Recommendations for scaffolding**
 - ▶ prompts, cues, hints, links
 - ▶ partial solutions, guides and structures
 - ▶ procedural scaffolds
 - ▶ Fostering student planning and goal setting
 - ▶ Enabling transfer of skills across disciplines

- ▶ **How to support students who are “stuck”? Face-to-face support?**