Chapter 14

Screencasts in Mathematics:
Modelling the Mathematician

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ABSTRACT

A screencast is a video recording of a computer monitor display, together with voice-over. This teaching technique has multiple advantages including the ability to model the thought processes of a mathematician in a context in which content may be repeated at will. Anecdotal evidence suggests that screencasts can be a very effective teaching tool, especially for providing model answers. Here, screencasts are discussed from a pedagogical and curriculum perspective using student feedback statistics as data. Specifically, screencasts offer a teaching resource that has value for many traditionally difficult groups of students. For example, poorly engaged students are well-served, as the barriers for participation are low; and high-achieving students benefit from the directed narrative. All students valued the ability to view material multiple times at will. The chapter concludes with some observations about how the overall learning environment might be improved in the context of undergraduate mathematics.

INTRODUCTION

In the teaching of undergraduate mathematics, one commonly stated aim is to explicitly model mathematical thinking, that is, to provide an example of a working mathematician. This is relatively easy in the discipline of mathematics because, uniquely, a mathematics lecture involves the lecturer actually *doing* mathematics, rather than merely *talking* about it. In this chapter I will discuss the issue of specimen answers in the context of modelling.

BACKGROUND

The educational value of a traditional lecture has been questioned many times in the literature on various grounds by Biggs and Tang (2011), Bergsten (2007), and others. Criticisms of the lecture format include: the tendency to turn the audience into passive listeners rather than active participants; the dishonest presentation of mathematics as a linear predetermined progression rather than a "social activity coloured by creativity and struggle"; and poor comprehension of the material by the audience.

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Mathematics, however, appears to be qualitatively different from other subjects in the sense that the essence of a mathematics lecture is a mathematician *doing*, rather than *talking about,* mathematics. Consider, for example, a lecture on survey engineering. This will comprise the teacher discussing, explaining, and perhaps illustrating various aspects of surveying. At no point does a lecturer actually perform any action that might be described as surveying: he does not even go outdoors.

It is also interesting to observe that, when a mathematics lecturer does talk *about* mathematics (for example, mentioning the history of the subject), such discussion is invariably short, and presented "for interest"; it stands out like a sore thumb; the students stop writing. They know that it's not real mathematics, it's just the lecturer making light conversation by way of a break. Hartley and Hawkes (1983) – a standard mathematics textbook – illustrates this perfectly. Chapter Five opens with a gentle and chatty introduction: "a *module* . . . turns up in many seemingly unlikely guises . . . such an apparently all-embracing object will suffer from some of the defects of great generality . . . the reader's progression will be from the specific to the general and back to the specific again". The chapter introduction culminates in a sharp "Now down to work!" and the style immediately reverts to the default: formal, axiomatic mathematics.

Thus, during a mathematics lecture, the mathematician actually *performs* genuine mathematics. The teacher will actually prove mathematical statements and explicitly creates (or at least verifies) knowledge in front of the students as part of a live performance. It is worth noting that the process of mathematical proof used in a lecture is *identical* to that used by a professional mathematician. It is also worth noting that, when performed correctly, the audience members will perform genuine mathematics along with the lecturer in the sense that they actually prove mathematical statements.

One might characterise lecture-style proof as being more familiar to the lecturer than the proofs used in research, but the idea is the same. The criteria for acceptance are identical. It is here that Bergsten's (2007) criticism of lectures as pre-formed linear sequences becomes evident; genuine mathematics research as a process is generally characterized as being frustratingly iterative and bedevilled by confusion and other cognitive impairments.

It is a common philosophy of teaching (Shulman 2005) to model the behaviour of a mathematician; this is made easier by the fact that mathematics teaching is, at least in theory, perfectly aligned in the sense of Biggs and Tang (2011). Consider Cauchy's theorem, a crucial requirement for many branches of modern mathematics; its proof is regarded as the highlight of many undergraduate courses in complex analysis. The Cauchy's theorem component of a course will have the following features:

- Learning objective: prove Cauchy's theorem.
- Teaching activity: prove Cauchy's theorem.
- Assessment task: prove Cauchy's theorem.

While the above exhibits perfect alignment, observe that an additional alignment exists: the Teaching Activity, if properly performed, involves the *student* proving Cauchy's theorem. This is a good example of functioning knowledge for a mathematician (Biggs & Tang, 2011, p. 162).

In most subjects, controlled examinations are not aligned with high-level learning objectives (Biggs & Tang, 2011, p. 227) and place the student under strict time constraints. This has led to suggestions that where learning objectives include the need to work under pressure, conventional examinations are more suited to performance assessment. However, observe that a *mathematics* examination is arguably a peculiar type of performance assessment: an examination question