



**SFHEA Case Study Exemplar**

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| <p><b>7.2</b><br/><b>Written Case</b><br/><b>Study Title:</b></p>   | <p>Staff development leading to innovative practice in mathematical writing</p> |
| <p>Learning mathematics, and being a mathematician, is partly about being able to communicate with other mathematicians and be understood by them. As such, it is important that students are able to write their mathematics well. However, students often arrive at university without an understanding of how to do this. They misuse mathematical symbols and do not structure their arguments clearly, and think that writing the correct answer at the bottom of the page is sufficient (Houston, 2009; p.21). At university, it is common for lecturers to assume that by writing mathematics well on the board in lectures, students will come to learn how to do this themselves. However, little attempt is made to make this teaching explicit, even by pointing out to students what is being done right as it is being written, or to link this to assessment. <b>(K1, K3)</b></p> <p>I first came across these ideas in the writing of XXXX, who makes the link between writing well and clear thinking in his book XXXXX (xxxx, 2009). When I started work for the National HE STEM Programme in mathematics curriculum innovation (2010), I approached xxxx to see if he was interested in working to disseminate these ideas further. Together, we organised a national staff development workshop on 'xxxxxx' with three speakers sharing their experience of teaching mathematics undergraduates to write. I provided funding to xxxx for a small project to capture the information shared at the workshop by videoing the talks and making these available online and on a DVD with exemplar teaching resources. The intention of the project was that lecturers teaching mathematics be given access to techniques and materials to develop their students' mathematical writing skills. I distributed the DVDs at the xxxxx Conference (xxxx) and sent one each to all UK university maths departments. The three videos on YouTube have been viewed 743, 554 and 342 times at time of writing. <b>(A5)</b></p> <p>Around the same time, I came to be familiar with screen annotation technology. This can be useful for mathematical writing, as it allows the lecturer to write neatly on screen and capture what was written for students to examine later. I was first introduced to this technology in teaching by xxxx, a lecturer at the University of xxxxx, while I was working there in 2009/10 in a role supporting teaching in mathematical sciences by promoting the use of learning technology. xxxx and I wrote a bid to an internal learning technology fund for £15k for tablet PCs and recording equipment to allow a group of six lecturers to experiment with this technology in their teaching. These ranged from engaged enthusiasts to people</p> |   |

**Comment [PT1]:** This is a clear and well justified, identification of a learning and teaching gap in the specific discipline area that needed to be filled.

**Comment [PT2]:** Leading by initiating and organising national workshops and thereafter disseminating materials nationally aiming to influence and support changes to mathematics teaching.

**Comment [PT3]:** The evidence to show influence and change in practice, is thin, however. People can receive and even watch videos on YouTube but this doesn't evidence any actual changes in practice.

willing to 'give it a go', and I arranged a staff development workshop to promote the teaching methods this technology enabled. (A5, K4)

During the National HE STEM Programme (2010-12), I co-organised with xxxx a series of three national workshops on what he called 'media enhanced teaching and learning', which were largely concerned with screen annotation and lecture recordings. Contributors to these workshops, including xxxx and me, were invited to write articles to share their practice which were published in a booklet I edited, XXXXXXXXXXXXXXXXXXXX: *case studies and evidence of effective use* (xxxx, 2012b). This included contributions from thirteen people working at seven HEIs in the UK, one in Ireland and one in Australia. I contributed a paper reviewing the literature on effectiveness in relation to student learning and contributed to another discussing the opportunity recording technology provided for more active learning environments. I presented talks on this topic at one conference and as departmental seminars at four UK universities. XXXXXX wrote an article in which she described how attending our workshop encouraged her to use this technology, saying: "the workshop gave me the confidence to pilot the Tablet PC and screen casting technology in the 2011-12 delivery of the level 1 module Mathematics for Engineers" (XXXX, 2012). (A5, K2, K3, K4, K5)

In 2012/13, as a lecturer in mathematics at XXXXX University, I was module leader for a first year mathematical methods module. This was principally concerned with students understanding and being able to execute a set of techniques that were used throughout the degree programme. This module came with two sets of teaching materials which had been used at different times. The module had two intended learning outcomes relating to mathematical writing – "Demonstrate understanding of mathematical notation" and "Present simple mathematical arguments clearly and rigorously" – which had apparently never been explicitly taught or assessed. That first year, I took over teaching the module mid-way through term when another lecturer left the university. I developed a teaching style based on writing examples on a tablet PC and saving a PDF document of what I had written for students to view later via the VLE. The second year I taught the module, I had more time to prepare. I wrote a booklet using a 'gappy notes' approach; that is, some writing was typeset and some was left with appropriate-sized gaps. In general, I would type the theory and the statement of each example, leaving the bulk of the mathematical notation to be handwritten so that students get practice at the unfamiliar part. I put the gappy notes on screen during lectures and filled in the gaps as I spoke. I printed booklets of these notes for students, in which they completed the gaps along with me during lectures, or later by viewing the lecture on the VLE. I didn't provide a complete set of typed notes, so that students had to engage with my hand-written mathematics in order to get all the content. (A1, A2, K1, K2, K4, K6, V3)

In addition to leading by example, which I believe to be insufficient for teaching mathematical writing, I produced a chapter of the notes outlining some basic rules for mathematical writing ("write in sentences", "define new notation", "use the equals sign correctly", etc.) backed up with examples of me writing snippets of mathematics badly and well along with explanations. I also designed formative assessment exercises so that, along with the usual mathematics questions, for the first few weeks of term students had to analyse a piece of writing that contained a mistake and reflect on whether writing more neatly could have helped avoid the mistake. Finally, I included mathematical writing in the

**Comment [PT4]:** Further evidence that the candidate is keen to introduce and encourage new and innovative teaching methods. However, the link between this and the aim of improving students mathematical writing is thin. Again the evidence of practice change is left implicit through a lack of any evidence.

**Comment [PT5]:** Once again the candidate shows involvement in work that aims to influence on a national level. There is some (albeit just a single person) evidence of change.

summative assessment for the module. I did this because I believe that if a module has an intended learning outcome, this should be taught and assessed. However, it is unusual for mark schemes in mathematics to include subjective elements such as quality of writing. I decided on a fairly crude method, with the intention that it would be relatively straightforward to execute, whereby I gave each question in my exam a mark of zero, one or two for the quality of the writing, such that around 10% of the overall mark came from this aspect. In the mark scheme, I gave an indication of the basic rules of writing which I had communicated to students in the teaching that would contribute to the mark for writing. I worked with my moderator, who was sympathetic to the aims but initially somewhat uncomfortable with the subjective nature of the marks. After I had marked assessments in this way and the moderator had checked a sample, we convinced ourselves that we agreed sufficiently in how we would have allocated the writing mark that the system was robust. As the students sat a mid-year test and got detailed feedback from this on their writing, we saw a genuine improvement in the quality of the writing by the end of year exam. (A1, A2, A3, A4, K1, K2, K3, K6, V3)

One problem XXXX told me he had identified with his approach to teaching writing was that he felt students considered good writing to be 'something they had to do for XXXX's module, but not otherwise'. The success of my mathematical writing mark convinced my moderator and another member of staff in the department to adopt a summative mathematical writing mark in their modules as well. When I left XXXX, the first year tutor was considering whether it was feasible to apply a writing mark in all first year modules, to encourage students into good habits that might persist. (K3)

**Word count: 1,403**

**Comment [PT6]:** This statement is rather superfluous as it is universally recognised good practice, rather than just their belief.

**Comment [PT7]:** This whole section describes good, varied and innovative practice and some positive evidence of successful outcomes for students, although it is rather descriptive.

**Comment [PT8]:** Evidence here of practice change adopted in a limited way demonstrating influence.

**Comment [PT9]:** Overall, there is enough here to indicate that this person operates at Senior Fellow level. However, it is not very strong evidentially nor reflectively, includes few references to the literature on learning and teaching and thus requires other aspects of the submission (Referee's statements, Reflective Account and second Case Study) to reinforce and add to this evidence.