

EXPERIENCES OF USING AUDIO FEEDBACK ON ENGINEERING MATHEMATICS MODULES

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Abstract: This paper summarises the authors' experience of giving audio feedback to first and second year engineering students studying mathematics modules. The work covers a five year period, during which audio feedback has been provided for in-class tests, and has been distributed via the virtual learning environment. Feedback has been collected from the various student cohorts informally, via module questionnaires and through targeted focus groups. The focus groups have demonstrated that students value the audio feedback, finding it personal, informative, memorable and motivating. Audio feedback continues to be provided for students studying engineering mathematics modules at Edinburgh Napier University, and the authors continue to investigate its impact.

Keywords: Feedback, Audio feedback, Focus groups.

1. Introduction

The main purpose of the Engineering Mathematics modules at Edinburgh Napier University is to explain the underpinning mathematical techniques, in areas such as calculus, series and vectors, which are required by the engineering modules. These modules, which might be described as methods modules, are assessed by class test and final examination. Marking this type of work has always resulted in written mathematical feedback for questions, with indications of errors or better ways of solving the question being detailed throughout the script. In addition, audio feedback has been provided for the past five years.

Using audio files to give formative feedback to students is a developing area. The use of audio files to give formative feedback to students on their draft assignment submission has been explored by Brearley and Cullen (Brearley and Cullen, 2012). They offered this feedback to a class of 40 students and had 25 students utilising it. The students valued the feedback, but some would have preferred it to have been written. Various other Higher Education institutions have been exploring audio feedback. For example, Leeds Metropolitan University had a project entitled "Sounds good" which investigated whether digital audio could be used to give students quicker and better feedback on their work (Rotheram, 2009). Findings were that the students were "overwhelmingly positive" about receiving audio feedback and liked both the personal nature and the detail provided. Ekinsmyth (Ekinsmyth, 2010) and colleagues from the geography department at the University of Portsmouth experimented with digital audio assessment feedback and found that students felt hearing feedback was more effective and memorable than reading it. Conversely, McGregor (McGregor et al, 2011) experimented with audio feedback on a group of students studying Business Management and found that although the students liked receiving the voice mails and listened to them more than once, there was no discernible effect on their performance in the assessment.

Giving summary feedback on maths tests as individual audio files was first investigated at Edinburgh Napier University in September 2010 (Durkacz and Mowat, 2012). This work demonstrated that the students find it useful to have both detailed feedback throughout their script and an overall summary of their performance as an audio file. It is clear that the audio feedback has a powerful impact due to it being vocalised, personal and private. The indication from the students is that this makes it more memorable.

2. Methodology

The steps required to produce the audio files and distribute them to the students remain the same (Durkacz and Mowat, 2012). Focus groups have been run at the end of each module in order to investigate the students' experiences of receiving audio feedback on their work. Details of these two parts of the work are given in the sections below.

2.1 Developing the audio files

During the marking process a short summarising paragraph, comprising about four or five sentences, describing the student's performance and highlighting any areas that need revision are noted down. The paragraphs are then read out loud and recorded as digital MP3 files, which are uploaded to the PC and labelled appropriately, before being made available to the students via the Virtual Learning Environment. The students are able to access the audio files before the marked scripts are returned, to encourage them to listen to the files.

In order to encourage the first cohort of students to listen to the audio files, no indication of the overall mark for the piece of work was included. Following feedback from these students, it was decided that it was useful if the first sentence of the audio file gave an indication of the overall performance on the test. Further feedback indicated that the students would prefer the files to be slightly longer, and with more detail, which has resulted in the expansion of the audio summary to four or five sentences.

Feedback over the first three years indicated that even with the graded initial sentence, it would be better to also include the mark for the piece of work at the end of the file. This has been included over the past two years. It has also been suggested that referring to a question simply by its number is unhelpful, as the students do not keep the test question papers. Recently efforts have been made to refer to particular questions by their content, or to repeat the question in the feedback summary.

2.2 Facilitating the focus groups

Focus groups have been used at the end of each module to gather students' opinions and perceptions of their feedback (Krueger and Casey 2009). All students have been encouraged to take part, though ultimately they self-select to attend. It is usually the case that about a third of the cohort participate, and these are necessarily the more engaged students. The sessions are facilitated by a colleague from a central University department who is not previously known to the students and is experienced in facilitating group processes. Participants are encouraged to share their views openly and honestly. It is emphasised that there are no wrong answers and that a mix of views is welcome. The discussion starts with an exploration of students' experiences of feedback across a variety of contexts before focusing on their response to the audio feedback they have received within the module, covering aspects such as content, length, convenience, accessibility, tone and impact on learning.

One feature of the focus groups is the presence of the first author who is responsible for giving the audio feedback to students. On the one hand, this could be argued to compromise the frankness of the discussion. On the other hand, it has provided an opportunity for a meaningful staff-student dialogue, enabling shared reflection on the experience and an authentic exchange of views which has led to several important enhancements being made to the feedback process.

3. Audio files and Feedback

Over the past five years, over 900 audio files have been produced. As a result of feedback from the first cohort of students, graduated sentences were introduced at the beginning of the audio files. The purpose of these sentences is to set the scene for the feedback, and to give some indication of the students' performance. The sentences are illustrated in the following figure:

Percentage Range	Opening sentence
0 - 14	An extremely poor piece of work
15 - 29	A very poor piece of work
30 - 39	A poor piece of work
40 - 49	A fair piece of work
50 - 57	A reasonable piece of work
58 - 64	A good piece of work - well done
65 - 79	A very good piece of work - well done
80 - 99	An excellent piece of work - well done
100	A perfect piece of work - well done

Figure 1 Graduated sentences

The following figure illustrates the evolution of the audio file, from its initial very short paragraph via a more detailed paragraph which mentions specific questions by number to the more detailed summary now provided.

A fair attempt. When calculating the determinant it is the leading diagonal elements multiplied together minus the off diagonal elements.

An excellent piece of work – well done! Question 5b was asking you to evaluate the partial derivative of z with respect to x – you didn't need to find the second derivative. You made some errors in the second derivatives in question 8 and hence incorrectly classified the stationary points.

A very good piece of work – well done. In question 1 you could have just used the $\cosh(x)$ function on the calculator. In question 3 you did not need to convert your answer to exponential form after you had differentiated. You need to revise the chain rule. In the small changes question you had an incorrect minus sign in the small change equation – you add the various components. In the stationary points question you had the correct quadratic in y but you should have used the quadratic formula to solve it – the rest of the question was fine.

Figure 2 Examples of Audio Feedback

In response to feedback from the students, the audio files now describe the type of question, where possible, rather than simply using the question number. The final mark is also always included at the end of the audio file, as requested by the students. The following figure gives two examples of the further development of the audio files:

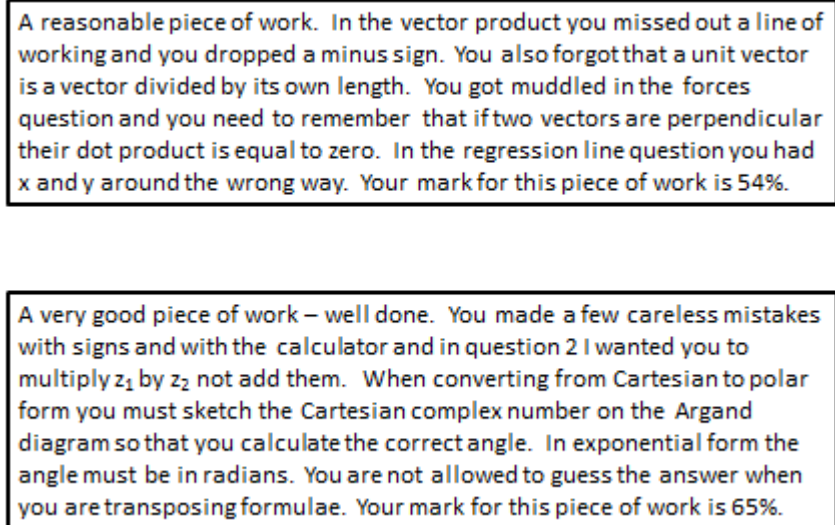


Figure 3 Further Examples of Audio Feedback

4. Analysis

Nine focus groups have been run since the beginning of this work, and in each case the recording of the conversation has been transcribed into a text document. Interestingly, the first focus group was facilitated by the first author, who was of course known by the students. This was the least successful focus group as the students did not see the point of explaining the audio feedback to the person who produced it in the first place. All subsequent sessions have been facilitated by the second author, who is not known by the students, and the discussions have been more insightful. In this section some of the themes which have come out of the focus groups are explored, and illustrated with extracts from the transcriptions.

In every focus group, the students have said that a strength of audio feedback is that it is personal and private. In response to questions about the type of feedback that they would prefer to receive, they almost always say that they would like a one-to-one session with the lecturer. It is clear to all the students that this is not possible, given the class sizes, and they feel that the audio feedback is a good compromise. In the words of one of the students “I was quite surprised because I was expecting just a mark and then it was a lot of comments about my test. I think it’s very nice because it’s personal. You feel like it’s more personal. Very good, yeah.”

Another factor is that the audio feedback is something different, and therefore of more interest. Initially the students felt that it sounded like an odd idea, particularly since it wasn’t available on other modules. Now it has become a more established feature of the maths modules, and students have written on module questionnaires that they were hoping to receive some audio feedback. Students have also indicated that they find audio feedback boosts their confidence. It certainly seems to be the case that it is a more motivating way of delivering criticism or suggestions for improvement, without appearing overly negative.

Another common theme is that the spoken voice has more impact than written feedback has. Students feel that the audio files are more memorable and that verbal praise has more impact because it has a personal touch. The students all listen to the audio files more than once and some listen more frequently: “I’ve listened to mine a couple of times before I got the paper back, when I got a really good grade, I listened to it about three times, right after each other, because I was so pleased! Oh, did she really say that?! And I pressed it again!” A further development with regard to the use of audio is that students with dyslexia find it more accessible. For example: “I actually really love them

because it's a case of, as I was saying before, with the dyslexia thing, so if you're bringing it out but for me it was brilliant to just hear where I'd gone wrong." This student went on to say that the impact was that you had an audio marker in your head, given by someone that you know and that you respect.

A more surprising theme is around the engagement of the lecturer with the individual students, and the impact that this has on them. The fact that the lecturer is not simply marking the work but is also creating an audio summary is seen as extra effort, and it is appreciated as such. A very interesting comment was that "It is a big class and you can...it might only be a brief message, but, like you say, you know that the time that she's actually taken to do it and it just shows that extra bit of effort that you put in, kind of, lead from example really, Kate's putting that effort in, then we need to as well." The idea that the students would themselves find the effort put in by the lecturer motivating had not been considered. Another student commented that "I think that that's the point with audio feedback though is that it feels like your lecturer has a little bit more invested in how you're actually doing." Another student felt that the time spent by the lecturer writing and recording the audio files made the student feel more important. They also said that the audio feedback contains more emotion than written feedback and that this is important.

As already mentioned, feedback from the students has resulted in changes to the format of the audio files. Initially, the mark for the work was not included in the audio file, but following several focus groups when the students requested this, the mark is now given in the final sentence. The students also requested more detail in the audio files and a description of the question, rather than just a reference to the question number. One comment was: "They could maybe make it a bit maybe longer than a few sentences, that would really help and maybe in a wee bit more detail." and another said "I think just when you're referring to certain questions if you say the question number and then what kind of question it was, the Cramer's law question or whatever, that, so when you've got your paper you can see, oh, it's question four, the Cramer's law question, you can see exactly where she's referring to". Both of these suggestions have now been taken on board. A further development as a result of the focus groups is that the students are now given their test script back to keep. This took a little while to organise, as scripts are needed for external examiners and for accreditation visits. The solution is that a sample of scripts is photocopied and then all the original scripts are returned.

Also as a result of the focus group sessions, a further use of audio files has been piloted. One of the mathematics modules has a final examination which is worth 50% of the module mark. There is a set of specimen examination questions which are made available to the students for revision. Following focus group discussions a set of "Revision sound bites" has been developed. Each question in the set has its own audio file which contains a hint on how to start the question. For example:

8. Differentiate the following with respect to x :

(a) $y = 4 \sinh(2x) + 3 \cosh(3x)$

(b) $f(x) = 3 \cosh^2(4x)$

(c) $y = 4 \cos(3x) \sinh(2x)$

(d) $y = 2x \cosh(x)$

Revision soundbite transcription for Question 8

Part (a) Differentiate using the formula book. Part (b) Chain rule. Part (c) Product rule. Part (d) Product rule.

Figure 4 Example question and revision soundbite

The students have found the revision soundbites very useful, and have explained that they are clues for the different questions, which they will be able to use during the vacation revision period. One comment was "It was just that like, when I was really stuck and kind of not knowing what to do, I could just listen to it and it would kind of jog my memory." Another student said that hearing the lecturer's voice was a good thing and made them feel as if they were back in the lecture room.

5. Conclusions

This work has demonstrated that the students find it useful to have both detailed feedback throughout their script and an overall summary of their performance as an audio file. Feedback from the students has confirmed that, whilst they would prefer individual sessions with the lecturer after each test, an audio file is a good compromise. They find the spoken word more memorable than a typed paragraph. The enthusiastic reception of the audio files by the students, and their willingness to participate in focus group sessions to give their views, demonstrates the value of this work.

Feedback from the students via the focus groups has been and is being used to improve the content of the audio files, and to adjust their length. As a result, the audio files are now more detailed, include the mark in the final sentence, and where possible describe the question being discussed rather than just referring to it by question number. The development of the revision soundbites was inspired by discussions with the students. The focus groups have given very interesting insights into the student perception of the feedback, with regard to the importance they attach to the time and effort being expended by the lecturer to produce the audio files.

There is no denying that it is time-consuming providing audio files for a group of students. However, it is valuable not only for the students but for the lecturer concerned. Rather than simply marking each question in isolation, it is also necessary to look out for related mistakes, particularly good solutions, or errors that have come from an incomplete understanding of earlier work. This results in feedback being given at two levels; detailed feedback as appropriate throughout the script and overall summary feedback. This is the fifth consecutive academic year in which audio feedback has been provided for engineering students studying maths modules, and it will continue to be provided for as long as it is seen to be useful by the students.

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