Blended Feedback:

Delivery of feedback as digital audio on a computer programming unit

Suzy Atfield-Cutts and Sheridan Jeary

Software Systems Research Centre, Bournemouth University,
Fern Barrow, Poole, Dorset, BH12 5BB, UK

satfieldcutts@bournemouth.ac.uk
sjeary@bournemouth.ac.uk

Abstract

Traditionally students are taught in a classroom, lecture theatre, or laboratory, by staff. They are encouraged to question, discuss, and participate in learning activities maximizing learning potential and to engage in dialogue as a means of monitoring understanding. Staff use a variety of technological aids to assist in the learning process and thus provide a blended learning approach, offering a diverse student body greater opportunity to engage.

However, feedback on assessments is still largely delivered as the written word and students are thus treated as distance learners with no requirement to acknowledge receipt or understanding. They are given comments, which they are expected to interpret and action independently.

This work begins to explore the use of audio feedback alongside the traditional written word to understand how blended feedback could assist novice programmers in learning computer programming. A pilot study is conducted as a first step with mixed results. Audio feedback was popular with students and 80% would prefer audio feedback in future although 60% felt that it would not improve their future learning.

1.0 Introduction

Traditionally students are taught in a classroom, lecture theatre, or laboratory, by staff. They are encouraged to question, discuss, and participate in learning activities to maximize learning potential and to engage in dialogue as a means of monitoring understanding. Staff use a variety of technological aids to assist in the learning process thus providing a blended learning approach, offering a diverse student body greater opportunity to engage.

However, with regard to feedback, expectations of students' ability to work independently are very high. Students commonly receive written comments on assessed work, usually without opportunity to clarify meaning. Based on their own comprehension and interpretation, they are expected to determine the best course of action to improve future work.

This work is the first part of an investigation into the potential benefits of delivering audio feedback, as well as the written word, to see if it improves the usefulness of feedback for novice programmers. The paper is divided into 7 sections. Following the introduction, section 2 is a brief literature review and background to feedback in general. It is important to be mindful of the objectives of feedback and the lessons already learned. The third section is a review of the work done to date on feedback as audio. The fourth section describes the context of the problem to be studied, followed by the case study. The conclusions in section 6 are followed by consideration of future work in section 7.

2.0 Background of Traditional Feedback

The academic community does not underestimate the considerable value and significance of feedback. In fact Fleming [1 & 2] argues that marking student scripts is one of the '*most significant quality events in the lives of students and academics*'. Although many articles claim that feedback continues to be under researched [1, 2, 3 & 4], others claim significant progress [5]. Yelland [6] counted articles on feedback produced over recent years and finds it to be a growing area.

Evans' [5] thorough and comprehensive literature review of the last 12 years found many case studies. Most consist of surveys, with an empirical case study at the heart of the matter, followed up with template analysis or other thematic coding of qualitative results. Evans [5], Mutch [7], Rae & Cochrane [8], and Jonsson [9] found only a small number of students took part in case studies. The majority were drawn from specific disciplines and the time scale was always less than a year. There are some exceptions. Handley et al's [4] work, on a draft and rework structure, covers 12 case studies of up to 329 students and Carless' [1] work

included a survey returned by 460 staff and 1740 students in eight universities in Hong Kong.

Students often regard feedback as the reward for an investment of time and emotion which can result in a sense of achievement [10]. They comprehend the cyclic nature of feedback but have concerns which sometimes provoke emotional reactions and can hinder learning and development [7]. There are five broad aspects to the student perspective to consider which are frequently commented upon by authors of case studies:

- Timeliness

To facilitate the cyclic process feedback must be given with time to apply learning to the next task [4]. Learning to feed forward is a skill useful in Higher Education (HE), and beneficial into employment [5]. It is a skill many UK students have as the school system offers opportunities to rework assessments and resubmit them as the norm. However, feed forward opportunities are limited and not traditionally considered in HE. They are available by coincidence more often than by design. Handwriting & Clarity

Handwritten feedback causes reading difficulties [11]. Handley et al [4] found a quarter of their participants disliked handwritten feedback calling it "*scribbles which are difficult to read and circles without meaning*". However, annotation on a script makes connecting comments to referenced work easier.

- Discourse

Lack of comprehension in written feedback is a frequent complaint sometimes caused by language used by the marker being specific to the discipline or to education [1] or by misinterpretation [7 & 8]. A brusque attitude may be unintentionally conveyed due to brevity of comments, in turn caused by the time pressures on staff due to large cohorts. Crews & Wilkinson [12] found audio helped students better understand what had been done incorrectly. Modern students are more used to information conveyed as sound rather than as written words, reflecting the increased use of technology in their lives, and perhaps mobile phones and mp3 players in particular [11].

- Confidence

Students have often moved their whole lives to begin their HE program, or are managing additional stress on top of a previously full life. Due to their age and maturity, change of lifestyle, and/or displacement from home, students are at a point in their lives when even the most level headed is emotionally vulnerable. The alien culture of academia can cause feelings of isolation. Cramp [2] recognises that first year students are particularly vulnerable. Yelland [6] illustrates that all students are vulnerable when talking about a group of post graduate students.

"So these students had all completed a first degree; they had had a lot of experience in receiving and working with feedback, and they were also working within the education system and were committed to it; they were learning to be producers of feedback themselves. Yet even they were very vulnerable to loss of confidence resulting from negative comments'.[6]

Students believe, trust, and indeed expect, that instructors know how to construct useful feedback which leaves their self-esteem at least intact, if not lifted.

- Maturity

It is vital that students value feedback [7]. Students' '*intellectual maturity'* and life experience may affect how receptive they are to feedback, and their '*ability and willingness'* to act upon it may affect performance [5].

Many claim that students would prefer feedback in a face to face meeting with staff since they crave discussion [11]. Mutch [7] says this is a luxury few students are afforded. Rae & Cochran [8] offer a cautionary tale suggesting that discussing feedback face to face can become confrontational.

There is nothing more rewarding for staff than students doing well. Staff frustration is born from students taking action that is detrimental to their learning potential. For instance, leaving work until the last minute before a deadline [4] or exhibiting a lack of intent to learn and only doing enough to pass [8]. Some students find self-managed or independent learning, a step too far to grasp, certainly at the start of their time in HE [8]. Students require explicit instruction in managing all aspects of academic life so they are equipped to work within the system. It should be part of an induction to the academic community which will not only enable their academic development but build confidence and a sense of belonging. Many academics can see the potential in assessment being a mutual process including input from students [3]. A learning theory which values the student voice is 'co-construction' [2].

In the national context, HE institutions regard for the National Student Survey (NSS) [13] increases just as the student awareness of getting the best value for money also increases. The Guardian [14] University Guide league table provides the data required from the NSS [13] to demonstrate how a) the percentage of final-year students satisfied with the teaching they received and the b) the percentage of final-year students satisfied with overall quality are, without exception, greater than c) the percentage of final year students satisfied with the quality of feedback and assessment by lecturers. This potentially shows a lower satisfaction with the feedback received than with other aspects of the course and teaching. This disparity between satisfaction in feedback and in other areas has been highlighted by many authors in their research, such as Yelland [6] and King et al [15].

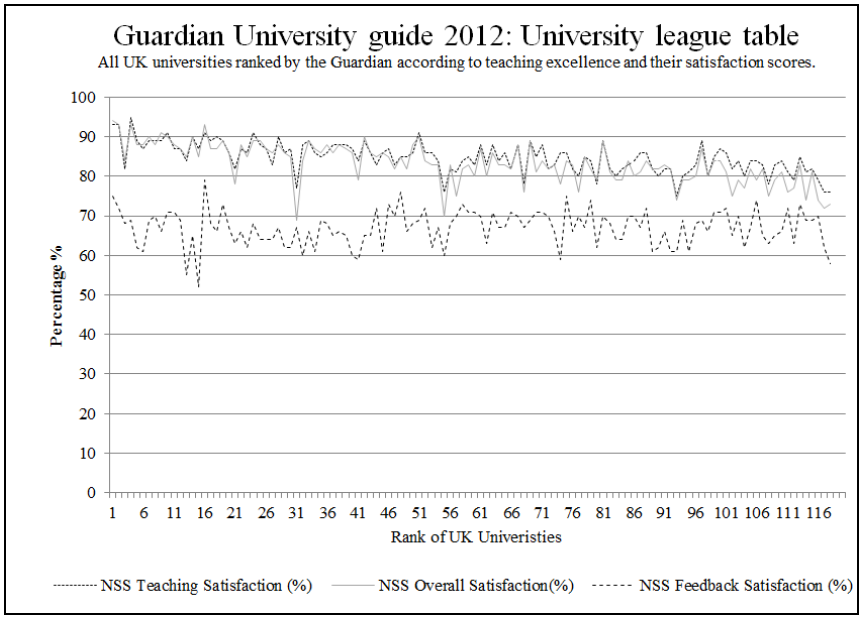

Figure 1: Guardian University Guide 2012 - University League Table

3.0 Background of Audio Feedback

Audio feedback pre dates the digital age yet still most case studies testing feedback as audio are small scale, such as King et al [15], Merry & Orsmund [11] and Nortcliffe & Middleton [16].

In 2008 the Joint Information Systems Committee (JISC) funded a project called 'Sounds Good: Quicker, better assessment using audio feedback'. It involved experienced teachers from a variety of disciplines and educational levels. Digital sound files containing feedback to students were delivered by VLE, email and mobile devices [17].

There are three commonly recognised benefits of audio as feedback:-

1. The Non Verbal Element

The voice conveys far more complex and subtle meaning than written words [18 & 19]. Non-verbal information available from audio is lost in the written word. Rotherham's [17] participants noted extra clarity from the non-verbal element of audio communication.

2. Personalisation

The personal touch of audio feedback was found by Rotherham [20] and Merry & Orsmund [11]. Rae & Cochrane [8] discovered the use of names in audio added to personalisation of feedback.

3. Volume of feedback

Providing assessment feedback is labour intensive [10 & 15] and time consuming [1 & 20] particularly if hand writing is still the norm [18]. Current research states that in the same time it takes to produce written notes a greater volume of audio feedback can be recorded. This usually results in greater depth and detail [9, 11, 15, 17 & 21].

4.0 Context

VLE's and the plethora of mobile devices commonly available to students, particularly those on a computing course, means audio files are a well-tested format which is available anywhere, anytime. [11, 12 & 23]. Some studies used email as a delivery mechanism where limitations on space sometimes caused problems [11 & 21]. VLE's appear to be more generous with upload limitations and are potentially more reliable and still just as accessible. On a Computing course where all staff are familiar with technology, the skill level required should be a minor, if not insignificant, issue.

A number of studies also discuss the effect of modern day increased cohort sizes [2, 4 & 10] and commonly high student-staff ratios [17]. On the undergraduate Computing framework at a British University cohorts are regularly around 200 students on the first year. This is an increase of over 50% in the last ten years. With so many pieces of work to mark a marking team is essential. One of the authors is a member of a marking team where each member of the team marks approximately 50 pieces of work per week and the compulsory assessment turnaround is three weeks from the hand in date to returning work to students.

Traditionally feedback for programming units on the Computing course was on paper. Marking programming code on paper works well as code can be annotated directly. However, it is a long process to illustrate a better version of the code where the overall architecture requires comment and example. This entails either handwriting or typing the whole idea out from scratch and printing it out to include with the feedback.

Modern Computing students do not expect to have to deal with assignments on paper. Since the introduction of online feedback students have been able to find their assignment specification on the VLE. For the last two years all assignment submission and return of feedback for the programming unit has also been via the VLE.

Currently the marking team copies the code from the submitted file into a development environment to enable running the code. They then work through a set of marking criteria and marks for each section are entered on to a spreadsheet to calculate the overall mark. The marking criteria and the grade calculator spreadsheet are essential enablers of consistency across the marking team. The comments are pasted back into a feedback section on the VLE including the overall mark. The overall mark is additionally pasted into another text box on the VLE.

It is relatively simple to draw attention to parts of code by copying them into the feedback text. Writing example code is simple and can be pasted into the feedback. Since the student work is already available as a starting point there is opportunity for placing example code next to submitted code for comparison. There are a lot of software applications open at the same time during the marking process (VLE, development environment, spreadsheet marks calculator, criteria in the word processor) however, the staff using the applications are all used to managing such environments.

It became clear that the programming unit marking team were writing the same comments on work for the same students week after week, and students were not engaging with feedback. Other studies also recorded similar observations [10], and that students only cared about the mark given, [7 & 21] or indeed that students didn't even collect their assignment [1, 4 & 7]. The question of the extent to which students were reading and engaging with the feedback naturally arose.

5.0 Pilot Case Study

To find out whether audio feedback could be useful to Computing students taking a programming unit a pilot case study was carried out using Yin [24] as a guideline. A case study can be a useful when a situation needs to be explored in its real life context. The unit of analysis was an individual first year Computing student at a British University carrying out a programming assignment. The aim of the study was to determine the efficiency and effectiveness of student engagement with feedback distributed as MP3 files via a VLE.
The propositions were:

1. That audio feedback is considered friendlier
    a. Through additional nonverbal cues missing from text alone and by avoiding a brusque feel that may arise from staff writing at speed.
2. That students are able to make sense of difficult explanations by listening to inflection in the voice.
3. That audio feedback creates a more positive feeling about feedback for students who had requested face to face feedback, especially if spoken by an avatar.

4. That it is possible to include more detail as most people speak faster than they write [25].

Firstly a survey was carried out amongst the entire cohort of 200 students that were having their assignment marked to gauge student perception of the unit and current feedback methods, and 52 responded. It was important to gauge their attitude to the unit, in case this was reflected in the results rather than the attitude to feedback.

Looking at the questions that queried the attitude to the unit, 45% of students felt they were keeping pace or racing ahead of the unit delivery and only 5 students out of 52 respondents felt they were getting left behind. When asked about their grades students were even more positive. 82.3% of students felt their grades were ok or good. Therefore, it was unlikely that any negative attitude to feedback was being tainted by the attitude to the unit.

The next five questions were specifically targeted at finding out how students felt about the feedback on their programming assessments. When asked about how useful students found their feedback many found it at least some use and 49% found it helpful or very helpful.

All students claim to read more than just the grade and 85% claim to read most or all of it in detail. Nearly 95% claim to learn something at least some of the time and to apply what they have learned from their feedback at least some of the time.

Finally students were asked what they would like to see change about their feedback and 22 students commented. Positive comments included "*the feedback is nearly always tailored to your code when necessary and extremely useful at explaining something when I've messed something up*" and "*I love my feedback and appreciate the time it takes to write it*." The most common criticism was that students wanted more detail, some even asking for one to one consultancy with staff. Apparently consistency is perceived as an issue, which was to be expected across a marking team, even with safeguards in place.

5.1 Implementing the Case Study

The written assignment feedback stayed in place so that it became the notes for the audio recording. The audio was recorded using 'Audacity' [26] software. Students were divided into two groups:- a) to receive feedback via embedded audio player and b) to receive audio feedback via avatar. The decision about which students would receive which format was made on implementation issues i.e.: the limited recording duration permitted by Voki.com [27] without charge or using the full classroom application.

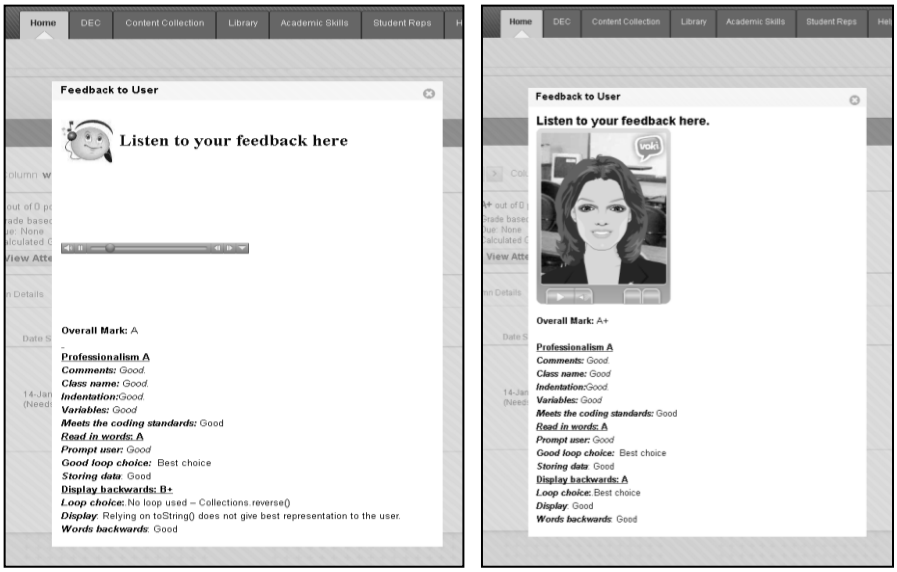

Figure 2: Student feedback pages as they appear in the VLE (LEFT) where feedback is via embedded mp3 player and (RIGHT) where feedback is via Voki [27] avatar

From the student perspective, the audio is available at the top of the feedback page in the VLE. For students receiving audio via embedded mp3 player on the feedback page within the VLE, a picture of an emoticon-style face listening through headphones was inserted on the page to highlight its presence. For students receiving feedback via avatar, all audio files were uploaded to the Voki website [27] and linked to the avatar. These are then linked to the student feedback pages on the VLE so that they appear to be embedded on the page. See figure 2 above.

A post study questionnaire was carried out with all participants. The response rate was disappointing and thus needs further work in order to improve the quality of the results.

Of the respondents who had received embedded audio, all found their feedback easily. Most of which said they would like audio feedback in future. When asked if audio could ever replace written feedback half of the respondents wanted to keep the written version as well. One preferred only written feedback on the basis that it was unnecessary to go through the whole piece to find important points, which you have to do with audio. One asked for a video "*with your cursor highlighting problems as you talk through what we did wrong and right*". The review of feedback was believed to be more thorough using audio feedback, and that feedback was more likely to be applied to future work by 75% of respondents.

Of the respondents receiving feedback via talking avatar, some struggled with web browser compatibility. This may have contributed to less than half of respondents

wishing to receive feedback via avatar in future. Of those who preferred only written feedback two expressed contentment with what they were used to.

"I am usually very receptive to feedback in the first place"
"I am comfortable with the written feedback given."

Half of avatar recipients prefer it to written feedback, claiming it improves the chances of reviewing the feedback, but 60% claimed it would not improve the chances of applying learning to future work. Although it was suggested that students might enjoy selecting their own avatar, none did so.

Of the original propositions it has been possible to show that proposition 1 is true, as the students perceived the audio feedback as friendlier. It has not been possible to demonstrate the students ease of comprehension, as in proposition 2, without further work. Proposition 3 considered specifically if there had been a positive impact if feedback was delivered by talking avatar. This did not appear to be the case, however, the experience may have been tainted by implementation problems and therefore warrants further investigation. The proposition that it is possible to deliver more detailed feedback using audio than written word requires a different style of production of the audio. In this case the text was used as a basis for the audio and there was a natural inclination to elaborate. This did not necessarily result in more detail perse, but it may have resulted in a more encouraging tone rather than sticking to the exact words of the written version. It is possible that more detail is delivered when no notes are used for the audio recording.

6.0 Conclusions

Obviously the outcomes of this study require further work. The reason for lack of access outside of the campus needs identifiable recipients to work out the specifics of the technology causing problems. The browser compatibility issues need further investigation. The respondent numbers in both post study surveys are very small. The opportunities to discuss with students why they select the answers they have would be very useful. Due to the timing of the case study in this case, further post study investigation was not possible.

This pilot case study has revealed some issues which need addressing in order to remove other variables for more robust results. It was run late in the academic year precluding essential follow up tasks. Therefore, to gain useful results it is essential that this case study is re run earlier in the academic year. Early deployment, when students are potentially more enthusiastic, may result in greater student contribution.

From the staff perspective, the time consideration involved in the creating of the audio was small and the technology was easy to use, as per Emery & Atkinson

[25]. Rotherham [20] claims that giving students richer feedback will save time in the long term as students take more notice of the feedback, and need less repeated feedback, and require less critical feedback in future as their work improves. Audio feedback should therefore be viewed by staff as a long term investment.

It is clearly useful to students to have audio feedback when accompanied by written word. How the audio is best delivered requires further investigation. These results are interesting but not of the volume or rigour required to base decisions for the future upon. Therefore, the work reviewed here is merely the very beginning of a long journey, studying just one aspect, towards helping students realise their potential.

7.0 Future Work

Apart from the conduct and implementation of the study itself there are other considerations which may become part of future work.

The single biggest challenge is to determine if audio feedback really improves the students' performance [23]. Comparing previous feedback with new work to see if feedback has been fed forward and the effect on student grades might be included in future work. Nortcliffe and Middleton [16] found no improvement in the average student grade in comparison to previous years. The same applied in their 2008 work with a Software Engineering project. Yet Starbuck & Craddock [21] claim student performance improved 8-12% with audio feedback. Jonsson [9] and Evans [5] suggest there is a major need to investigate students' strategies for using feedback.

There has to be some consideration of the 'novelty factor' [11, 4, 20 & 22] and only long term trials can determine its influence. Some say students would cease to listen carefully if they received too much feedback as audio [18].

There is the opportunity to evolve the feedback process into a continuous dialogue which has the potential of monitoring student response and offering further guidance [5]. This sounds ideal but has practical obstacles in terms of staff time however, as the advantages may exceed the disadvantages.

Accessibility has not even been contemplated in this work as in other articles. Rotherham [20] tells of a dyslexic student who said that it was easier to listen than to read. Therefore the impact of audio feedback on students with additional learning needs requires investigation.

There are many case studies available and all with their own contexts and variables. A comparative study of these may produce interesting and useful results. Many studies included production of a set of guidelines which could also be compared and evaluated for effectiveness.

Another media option to compare audio delivery to is video or screen capture during marking. Crews & Wilkinson [12] maintain a preference by students for incorporation of visual, auditory, and e-handwritten feedback.

The likely next steps in this work are:-

- To re run the case study with the next cohort of students feeding forward the lessons of this pilot case study to make it more robust to improve the quality of the result.
- To perform follow up activities with students to investigate reasons for survey responses.
- To compare student feedback to their next piece of work, looking for the application of feedback in future work.
- To compare guidelines for such work resulting from other case studies to see if they may be applicable in this case, with the potential for evaluation in practise.

In the past the only practical means of conveying feedback has been in person or by written word. Now that communication technology has advanced and become commonly accessible we, as academics, should be challenging ourselves to respond in any way which helps student learning, rather than constraining ourselves by tradition. Professionals in HE are in search of the way to "*deliver the ultimate experience for our students*" [28]. It's a long journey but research which challenges tradition and tests technology is essential in moving forward.

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