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Law, Bobby

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Screencasts: Enhancing Coursework Feedback for Game Programming Students

Bobby Law
Dept of Computing, Communications and Interactive Systems
Glasgow Caledonian University
Glasgow, Scotland
Email: robert.law@gcu.ac.uk

***Abstract*—Feedback is an important part of learning and, as such is vital for students to develop and progress throughout their academic life. Programming can be an abstract concept that students find challenging to comprehend therefore good feedback is important to their progress and their motivation to continue programming. This paper will discuss the process of enhancing coursework feedback for Game Programming students through the use of screencasts. The hypothesis being that game programming by its nature is audio-visual thus, providing feedback using an audio-visual medium should increase the students perception of their feedback such that it is perceived to be clearer, easier to comprehend and personalised.**

***Keywords*—Screencasts; Feedback; Software Development.**

I. INTRODUCTION

The United Kingdom's (UK) National Student Survey (NSS)[1] is a survey for final year students at all of the UK's publicly funded Higher Education Institutions (HEIs) and is administered by Ipsos MORI. The NSS comprises of 27 questions across eight categories attempting to capture the students learning experience. The NSS acts as a barometer of student satisfaction and thus, is an influential survey giving the student body a collective voice. The data from the survey is publicly available and is used by prospective students when choosing their potential University.

This survey has a number of different sections, one of which is Assessment and Feedback. The perennial view from students suggests that there is scope for improvement with regard to Feedback. Comparing all eight categories it can be seen that Assessment and Feedback is continually at the bottom. This would suggest that there is still room for improvement. Table 1 shows all the sections of the questionnaire and their corresponding percentage satisfaction rating. It is noticeable, from Table 1, that satisfaction with Assessment and Feedback is between 5 and 14 percentage points behind 7 of the 8 remaining categories suggesting that the students'impression of feedback and the instrument of feedback delivery have not met entirely with the students'expectations [2][3].

Viewing the statistics on a nation by nation basis against the UK average creates an interesting picture of how students in each of the four nations differ in their perceptions of the level of feedback they receive. Figure 1 shows a comparison of all four nations. Working in an academic institution in Scotland the picture painted is somewhat alarming with Scotland six points below the UK average [4]. The Assessment and Feedback section of the survey is comprised of five questions; two relating to assessment and three relating to feedback. The feedback questions are shown in Table 2. The questions in Table 2 emphasize the students'desire for expeditious, clear and detailed feedback [5].

The remainder of this paper is organized as follows: Section II will provide an overview of the author's rationale for the use of screencasts within the feedback process; indicating the nature of the cohort and the subject area studied. Section III will provide information about pedagogical issues related to screencasting, Section IV offers an introduction to the technologies available for screencasting. Section V presents an overview of the screencasting process, while Section VI reflects on the informally gathered feedback from the student cohort. Section VII discusses issues encountered by the author during the creation of the screencasts. Section VIII attempts to derive conclusions based on the synthesis of Sections III, IV, VI and VII. Section IX offers ideas for future work.

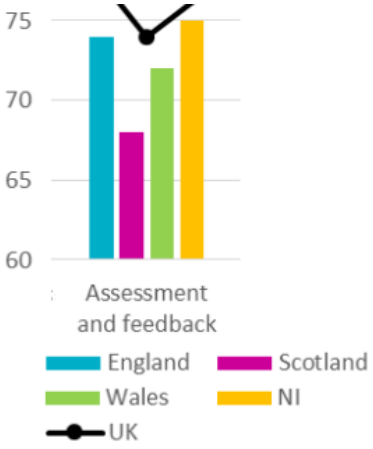

Figure 1. Assessment and Feedback results 2016 by nation

TABLE I. PERCENTAGE SATISFACTION ACROSS CATEGORIES FROM NSS QUESTIONNAIRE

Categories	2015	2016
The teaching on my course	87	87
Assessment and feedback	73	74
Academic support	82	82
Organisation and management	79	79
Learning resources	85	86
Personal development	83	82
Overall satisfaction	86	86

TABLE II. EXTRACT OF FEEDBACK QUESTIONS FROM NSS QUESTIONNAIRE

Feedback Questions asked as part of NSS
Feedback on my work has been prompt.
I have received detailed comments on my work.
Feedback on my work has helped me clarify things I did not understand.

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II. RATIONALE

Teaching programming, and in particular, game programming it can be difficult to offer students feedback on coursework submissions that are not either too generic and brief or ultimately too verbose and overcomplicated. Getting the balance of written feedback correct can be a daunting task. Thompson and Lee [6] suggest that feedback is "a pedagogical tool to improve learning by motivating students to rethink and rework their ideas rather than simply proofread and edit for errors." . Interestingly, Thompson and Lee [6] quote Notar, Wilson and Ross that "feedback should focus on improving the skills needed for the construction of end products more than on the end products themselves". This particular observation is very apt for teaching programming concepts and programming languages as the feedback given is in the context of the students programming skills rather than their end product, in this case their game. The feedback is intended to improve the students ability to produce structured, economical code and illustrate the necessary skills for debugging program code.

The author teaches game programming modules at various levels within the undergraduate programme BSc (Honours) Game Software Development. It would seem natural for game programming students who primarily work with a very audio visual medium to receive feedback for their programming coursework as an audio-visual screencast. It was therefore decided to implement a trial with a second year cohort undertaking the module Game Programming 1. This module was chosen as it was a core module for both the Game Software Development students and the Game Design students. The module introduces students to coding using C++ and OpenGL with the emphasise on the production of a 2D game prototype. The module had approximately 70 students participating in it with a near even split of Game Software Development and Game Design students.

The coursework required the students to create a game of their choosing. The coursework specification provided the students with a number of requirements that had to be met and a marking scheme was provided as a guide to the aesthetic appearance of their game and the functional aspects of the underlying code.

III. PEDAGOGICAL ISSUES

So what is a screencast? For the purposes of this paper a screencast will be defined as a recording of the current content of the computer screen with an audio narration providing relevant commentary, i.e., feedback [7]–[9]. As part of their learning it is important for students to receive feedback on any of the work that they produce.

Race [10] identifies a number of common formats used to disseminate feedback to students: handwritten, word processed, model answers/solutions, rubric proformas, oral feedback, email and computer marked assessment. These methods can be issued individually or as general feedback based on the performance of a cohort or group.

Race [10] suggests five attributes of feedback: Timely, intimate and individual, empowering, open doors not close them and manageable. Timely feedback is a goal that is highly desired and greatly prized, but, can be dictated by class size or other commitments. Intimate and individual feedback should reflect the student's own submission. Empowering feedback is harder to achieve, as it is a balancing act between positive feedback and a critic, warts and all, of the student's submission. Open doors, not close them refers to the use of language within feedback and the expectation this can set for the student and the feedback they receive for their next submission. Manageable, is viewed from the perspective of both the student and the lecturer, i.e., the effort expended by the lecturer to produce the feedback and the volume of feedback received by the student could cause them to miss something important [10].

Using the written word to provide annotated feedback to students can be taken out of context [9] and therefore the benefit of the feedback can be lost. Worse still, the feedback taken out of context can be misconstrued as a criticism of their work [8] rather than a pointer to improvement. The loss of visual and aural cues, which aid understanding [11], from the written feedback process is therefore something that screencasting can help combat.

As part of Evans [12] "12 pragmatic actions" for effective feedback, one suggestion is for students to be presented with an early assessment opportunity such that they can receive early feedback, which, can be built upon prior to final submission.

It has been mooted that audio-visual screencasts can create for the Lecturer the concept of "social presence" and "an opportunity for conveying positive encouragement through intonation." [8]. This ability to use intonation to emphasize important [2] aspects of feedback make the use of screencasts a benefit for the student. Couple this with the ability to hear the feedback in the manner the Lecturer intended it and the loss of the visual and aural cue associated with face to face feedback are somewhat restored. The volume of information that can be presented to the student via the audio aspect of screencasts is far larger than written feedback alone and in a shorter time period [2][13][14].

Galanos et al. cite the use of screencasts as a method of giving a student personalised feedback by recording the lecturer debugging the students program code while commenting on it [15]. Also suggested is the use of an attached webcam to offer "picture in picture" of the lecturer while debugging the program code, helping to offer that personal touch [15].

It has been suggested that screencasts can aid the student's understanding of their feedback by negating the need for continual cross-referencing between feedback and assessment and secondly the use of conversation style feedback rather than a more formal written academic feedback [8]. It has also been suggested that students find it clearer to "understand the marker's reasoning" [7] and comments [16] when presented in a screencast.

Clarity of feedback is important to students [17]; they do not want to receive feedback that could be deemed "vague, unclear and confusing" [18]. Thus, the audio-visual nature of screencasts can help enrich the feedback pinpointing unambiguously exactly what is being commented on[18]. The promptness or timeliness of feedback is another concern for students as evidenced by the low scores in the National Student Survey[4]. Hope suggests that educators are under an "obligation to provide meaningful feedback within a reasonable timeframe"[2]. Mathisen proffers anecdotal evidence from the field that screencasts can provide more feedback and can be produced in less time[18].

It has been mooted by O'Malley that one of a quartet of criteria needed for feedback to be effective is for it to be personal [19]. Screencasting offers the student personalised feedback that is tailored to their submission [8]. Chewar and

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Matthews state that the use of screencasts to provide feedback allows for more detailed, accurate and robust feedback [20]. Thomson and Lee also suggest that feedback given through the use of screencasts has the capacity to motivate and boost the students engagement with their learning [6].

IV. TECHNOLOGY

There are a number of different combinations of hardware and software that can be used to create a screencast. The following sections will describe the hardware and software used by the author to create feedback screencasts.

A. Hardware

To capture good quality audio it is advisable to refrain from using the built-in device microphone but instead opt for a headset or external microphone [2][21][22]. The benefit of using a headset is the consistent distance from the mouth [23] and the ability to position it slightly below the mouth to minimize the noise of breathing [21].

B. Software

A number of software packages are available and these range from desktop applications to web based applications which, in turn, vary in price from free to hundreds of pounds [23]. Software used for this paper was Screencast-O-Matic a web based application offering a limited version free. The free version allows up to 15 minutes of recording, recording from screen and webcam, the ability to publish to YouTube and the ability to save in popular formats such as .MP4, .AVI and .FLV. It is relatively easy to use [9] and has a very handy countdown before recording begins.

V. RECORDING SCREENCAST FEEDBACK

Although the screencast in this instance is being created in response to an unknown entity it is still important to apply the rules of creating instructional screencasts by planning [23]. Planning is very important as there will be a number of areas that will require feedback. For the game produced by the students the coursework feedback was broken into the following areas: aesthetics, game play, code structure and compilation. Each of these areas was broken down further with key points: aesthetics covered the games look and feel and interface design; game play covered the ease and enjoyableness of the game, responsiveness of game objects to keyboard/gamepad interaction; code structure covered neatness, use of the fundamental programming building blocks, use of language features, data structures, and the object oriented paradigm; compilation covered the programming compiling and the appropriate use of compilation switches.

Unlike recording a conventional educational screencast there is no need to produce a script [24] as the coursework submissions will not be predictable and a script can depersonalize the feedback and make it feel unnatural [3]. Armed with the marking scheme and the aforementioned plan the process of creating the screencast could be started. A number of considerations were taken into account before commencing the screencast process:

- Determining a location which has a low level of background noise [21] and little chance of being interrupted.
- Use a good quality headset, positioning the microphone slightly below the mouth [21].
- Switch off any software that activates pop ups such as email, Facebook or instant messenger as these could end up being recorded [3].
- Use and stick to the devised plan for consistency.
- Speak naturally and positively [24] making good use of intonation [2].
- Use of the pause button [23] at the end of each section to allow time to gather one's thoughts prior to the start of the next section.

During the recording process all mouse movements and clicks are visible to the viewer as a large coloured circle that will change colour when the mouse button is clicked. This is exceptionally useful for giving the student unambiguous and precise feedback on their user interface design and layout pointing out what is considered good and what needs improving.

The neatness and compactness of the actual code itself is an important aspect of any programming thus, the screencast gave the author the ability to highlight selected code within the Integrated Development Environment (IDE), in this case Microsoft Visual Studio, offering an audio narrative explaining clearly any deficient code and a visualisation of how the code could be reworked in order to make it neater and more efficient. Good examples of student could also be highlighted and the student commended for its use.

For student submissions that did not execute a debug process could be illustrated that would hopefully allow the student to solve a similar problem if encountered again. This ability to show a debug process in operation is a valuable process that merits a role out to all students as the ability to debug code is a valuable skill.

Most of the screencasts were between 5 and 10 minutes in length depending on the game produced and the exhibited programming ability of the student, which is in keeping with the surveyed literature. The feedback screencasts were then subsequently compressed into a .zip file and returned to the student via e-mail.

VI. STUDENT FEEDBACK

Initial feedback from the students was, on the whole, positive and helpful with regard to refining the screencast feedback process. Comments were elicited from students in an informal manner. Students were asked to write a short paragraph giving their initial impression of receiving feedback in this manner. As all students received both written feedback and feedback in the form of screencasts this allowed the students to compare and contrast the two forms of feedback proffering their thoughts. From the respondents, the overwhelming feeling was the sense of personalization and tailoring of feedback to their needs. Students were also receptive to the visual code analysis they received indicating that they understood more readily the need for well written, neat and compact code. Although, anecdotal, the quotes from students help to articulate their view of screencasts for feedback.

> *"... felt like the feedback was personal to my work."*
>
> *"I could see what Bobby was talking about and this helped me better understand how my code could be improved."*
>
> *"Helped me with debugging especially break points."*

Based on this positive feedback an depth and more rigorous case study will be undertaken in the next academic year to provide a quantitative measure of the worth of screencasting

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as a delivery mechanism for feedback.

VII. Issues

From the perspective of the lecturer there are some issues that need to be addressed. Firstly, the time taken to prepare the screencast feedback does not necessarily equate to the actual time of the screencast that the student will observe. This is not, necessarily, due to the screencast being edited but the time taken to record the screencast itself. Although, in Section V, a key piece of advise is to plan and prepare for the screencast by using some form of rubric, the application of this rubric can leave the recording having a staccato and unnatural feel. A solution to this is to pause the recording after each section and compose oneself before recording the next section. This will add time to the process but will prove worthwhile in the long term.

Secondly, choosing a suitable location to record the screencasts is imperative as interruptions not only break the lecturers concentration but also can be inadvertently recorded thus, requiring the recording to be edited or, worse still, to be scrapped. A quiet location devoid of interruptions is not always possible in a busy University. It is not an insurmountable challenge but definitely something to be aware of prior to starting any recordings.

A third issue is the size of the recorded screencasts with regard to the required disk storage. The size is dependant on a number of factors including: video codec used, screen size being recorded, and resolution of recording. For example a screencast recorded using the H.264 video codec for YouTube with a definition of 720p, a resolution of 1280x720, 25 frames per second and lasting 5 minutes will require approximately 1.73 gigabytes of disk space. Thus, for a cohort of 70 students, approximately 121 gigabytes of disk storage would be required. This leads to a secondary issue with the delivery mechanism used for distributing the recordings to the students. Distribution by email can be a problem as there may be a restriction on the maximum file size that can be attached to an outgoing email. If this is the case then an alternative method will be required; this could be by uploading the file to a Managed Learning Environment (MLE).

All of the aforementioned issues are solvable with a bit of careful planning and preparation prior to embarking on the recording process.

VIII. Conclusion

Results from this pilot project suggest that screencasts could be potentially of benefit to both students and staff. If so, this would go along way to addressing the students perception of feedback as highlighted by the UK's National Student Survey.

Reflecting on the creation of the feedback screencasts, it is an interesting exercise to return to the five attributes of feedback, as defined by Race [10], and attempt to analyse, albeit subjectively, if screencast feedback can be thought of as improving the attribute.

Timely feedback can be considered as a property of the turnaround time from student submission of coursework to the lecturer returning feedback to the student; to this end screencasting has no influence on this attribute. Intimate and individual feedback is an interesting attribute; screencasts can help to achieve this attribute, especially for programming, as the student will receive feedback on their programming code, hearing and seeing the lecturer discuss various aspects of their game's code. Empowering feedback is a balance between providing positive feedback and being able to critic the student's work in such a manner that they feel engaged and enthused to progress and push forward. Screencasting feedback can provide the student with the necessary aural and visual cues to afford them the understanding of what is good with their work but also, in a positive manner, how their work can be improved. This is especially good for programming as it is important for students to understand that code that works can still be improved to make it more efficient and that this is a learning process and not a criticism. Open doors, not close them is a delicate area but with a judicious use of appropriate language and the correct vocal intonation the student can be presented with aural cues and, to a certain extent, visual cues that will allow them to synthesise the intended tone of the feedback. Finally, Manageable, as noted by Race[10] has two aspects: the level of work involved for the lecturer and the volume of feedback given to the student. With regard to the level of work involved for the lecturer this may fluctuate depending on the cohort and the quality of their submissions, therefore, it is possible that it could add somewhat to the lecturers overhead for producing feedback. However, for students, they should have a targeted and enhanced quality of feedback which should not overburden them but provide the important aspects of the desired feedback they need to progress and improve.

The increased feedback that can be crammed into a 5 minute screencast is more personal, clearer and less ambiguous than traditional written feedback. The student can play and replay the video as many times as they like and the feedback will always be viewed as it was intended. The time to produce the screencasts varies by student submission but on the whole it was surprisingly quick in comparison to written feedback of the same depth.

IX. Future Work

The intention is to repeat the screencast feedback in the next academic year. The number of students undertaking the module will, again, be in the region of 60 students and should offer a suitable number for judging the timeliness of producing feedback screencasts. The hypothesis is that the experience from this first large scale implementation will lead to a more effective and quicker production process for each screencast and the students will benefit from clear, concise and helpful feedback. The module is 12 weeks in duration and students will be asked to submit work at the end of week 8 and also at the end of week 12. Screencast feedback on their week 8 submission will be returned by week 10, which, should allow for the students to benefit from the feedback prior to their final submission in week 12 [12]. After receiving the feedback screencasts the students will be surveyed to ascertain a better representation of their feeling towards this feedback mechanism. Screencast feedback will be returned approximately 10 working days after week 12 submission and should serve to inform the students of their programming progress. The intention is to survey the students again at the end of the module in an attempt to better understand their opinion of screencasts as a means of delivering feedback. The survey will attempt to elicit the students perceptions of the screencast feedback based on the categories of engagement,

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quality and quantity of feedback, helpfulness and comparison to written feedback.

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