

Using audio to support student learning

ROSSITER, J A, NORTCLIFFE, Anne <<http://orcid.org/0000-0001-6972-6051>> and MIDDLETON, Andrew

Available from Sheffield Hallam University Research Archive (SHURA) at:

<http://shura.shu.ac.uk/14474/>

This document is the author deposited version. You are advised to consult the publisher's version if you wish to cite from it.

Published version

ROSSITER, J A, NORTCLIFFE, Anne and MIDDLETON, Andrew (2010). Using audio to support student learning. In: EE2010: Inspiring the next generation of engineers, Aston University, Birmingham, 6-8 July 2010. (Unpublished)

Copyright and re-use policy

See <http://shura.shu.ac.uk/information.html>

Enter your paper number – P9

Using audio to support student learning

J A Rossiter¹ (J.A.Rossiter@sheffield.ac.uk), **A L Nortcliffe**² (a.nortcliffe@shu.ac.uk) and **A J Middleton**² (a.j.middleton@shu.ac.uk.)

¹University of Sheffield, UK

²Sheffield Hallam University, UK

Abstract: This paper illustrates student and academic approaches to using audio to support the learning of the learner. It illustrates the evolution of the student learner autonomy from the students recording and attending lectures to engaging and recording a wide variety of ephemeral experiences from self-feedback to lab' sessions. The paper in particular considers and demonstrates the practicalities of students and tutors recording lectures, and finally upon reflection questions as to whether either is a practical solution to capturing learning opportunities in a lecture.

1. Introduction

The Special Issue on learning technologies (2009) of the engineering education journal highlights that there is a growing recognition that technology can and should be used to enhance learning. It is also recognised that humans have several senses and cognitive routes to memory recall, therefore learning can be improved by engaging more of these senses; for example, it has been shown that making written notes increases recall (Intons-Peterson and Fournier 1986). This paper focuses on the potential of audio to enhance student learning and, specifically, to what extent audio notes can be generated efficiently to support student learning.

1.1 Audio notes

Academic generated feedback has been shown to be an effective and attractive feedback method that can encourage greater learner engagement in the feedback process. However, it is difficult to scale for large student cohorts without significantly increasing the academic's workload (Nortcliffe and Middleton 2009a). Typically the academic generated feedback model is also narrow in focus as it captures only the academic's perspective and omits the students' view and reflections of their learning experience.

In addition the production of educational audio is often discussed in the context of lecture recording. Research, however, has indicated that students tend to seek out and listen to brief chunks that they believe are of most relevance to them, to aid reflection and re-clarification (Williams and Fardon 2005, Russell and Mattick 2005 and Law 2005). In response to this, attempts have been made to record key concepts and other important points as chunks (Fidler et al 2006), to provide more accessible learning resource. Analysis of students' listening habits of audio lecture recordings by McKenzie (2008) noted that students rated the listening to lecture recordings post lecture as effective as the live lecture in meeting their learning needs.

However, there are concerns in providing such audio lecture provision. The reduction of student attendance in lectures has been the experience at Monash University (Buxton 2006) although for others there has been little or no impact on attendance (Williams and Fardon 2005, Russell and Mattick 2005, Law 2005). Asynchronous digital audio can also be beneficial to some students with disabilities (Nortcliffe and Middleton 2006), and to international students, because it provides them with more opportunities to engage.

The second concern is the practicality of audio recording. For many institutions lecture recordings cannot be automated (as at University of Western Australia, (Williams and Fardon 2005)), so the effort required by the academic can make using audio prohibitive both in terms of cost and time. Moreover, as with audio feedback, audio lecture notes capture only the academic's words and perspective, although this has obvious value to disciplines that are largely based upon conceptual knowledge such as Engineering.

In addressing the opportunities offered by audio, and the challenges, it is useful to focus on how the student's recall of knowledge, which invariably fades with time (Waterfield, 2006), can be developed; digital audio has been shown to be useful in supporting the learner's personal articulation of ideas, as well as their receipt of knowledge (Nortcliffe and Middleton 2009a).

It was suggested, therefore, that students would benefit from recording post lecture discussions and reflection, with or without their peers or academic in attendance as a method to supplement their learning. This method would be quick and easy for any student and negates the need for input by the academic, and institution infrastructure. The approach offers the opportunity to capture otherwise ephemeral experiences, allowing the learner to re-engage with the learning conversation and feed forward their subsequent reflection into their learning. The process gives the student learner more autonomy and reduces the need for them to seek further clarification and confirmation, something that has been confirmed in audio feedback conversations recorded by academics (Nortcliffe and Middleton 2007). Audio notes have the potential to make the similar valuable impacts on learning as written notes (Intons-Peterson and Fournier 1986).

1.2 Individual generation of audio notes

In the previous academic year, the authors ran a pilot project to encourage students to generate their own audio for learning. This work has been published in the subject centre journal recently (Rossiter et al 2009), although not yet disseminated at the subject centre conference and hence the paper/presentation will give some time for a discussion of this. The key findings were that there are many imaginative and useful ways of learning from student generated audio and most significantly, these offer new ways of learning not available without recorded audio.

Nevertheless, it is not clear what effect that the offer of a free MP3 player had on student engagement with the initial project. The next step is to help encourage a culture change whereby new students can be sufficiently persuaded of the benefits to purchase and use their own recording device. This paper looks at the success in encouraging students to do this and the potential for facilitating a culture change in the community.

Many other creative and informal learning applications for using the recorders were discovered by the students in the original project; however most participants used the devices to record lectures. This was perhaps unsurprising given that lectures are central to this discipline and were found to be an important initial influence in attracting student participation. However, given the student interest in lecture recording there is a need to investigate and evaluate how this can be better supported technically and in terms of policy.

1.3 Summary

This paper makes three key contributions. Section 2 gives an overview of the 2008-09 project which investigated how student generated audio can be used to enhance learning. Section 3 looks at the potential for culture change in the student body, that is encouraging students to purchase and use their own recording device and section 4 looks at the impact of academics recording all lectures and making these available via podcast. The paper finally draws conclusions from all results and in particular discusses the future roles of students and academics in audio lecture recordings.

2. Learning through student generated audio

In 2008-09, the authors ran a project across their two institutions with a main aim of encouraging students to generate audio recordings for learning purposes (Rossiter et al 2009); a summary of this is useful background to this paper.

Students were offered a free MP3 player as an incentive to participate and were asked to record various scenarios, some suggested and some on their own initiative, and to participate in a project evaluation. Unsurprisingly, even for those with a free MP3 player, active participation was not universal, but nevertheless the majority of the students were able to get into the habit of recording some things and many students became very active, recording several items or more each week. Moreover, what was especially pleasing for the authors was the rich diversity of uses the students had found beneficial. Much of the usage was beyond any initial suggestions and thus demonstrates that once students have engaged in the culture change required, they are prepared to be proactive in identifying what is most beneficial.

2.1 Summary of usage arising from student evaluation 2008-09 at University of Sheffield

This section gives a list of usage that students tried and/or found beneficial.

Lectures: Students found it useful to listen to lectures again, particularly in the case of lecturers with strong accents.

Guest lectures: Audio is particularly helpful when the lecturer is not available to question later.

Group work: Recording group work saved a group member having to take minutes etc.

Lab sessions: Recording feedback given at lab sessions.

Feedback from tutors: recording one to one conversations, especially where this was too long to recollect easily. *“The only thing you might want to listen back to is the solution or explanation for a particular problem that you asked a tutor about.”* *“Tutorials, someone explaining something so that we can record it and then do the problem again then we can listen to it and see what exactly they said.”*

English as a 2nd language: Students can record a lecture if they are having difficulty understanding and then listen back later and check any difficult words in the dictionary. *“When you hear it over and over again you know exactly what they are saying. If you miss some words when they are explaining because of the language barrier, then you can hear it again and understand what they are saying.”*

General usage: (i) Presentation preparation - recording and listening back to themselves. (ii) Small group discussions in tutorials. (iii) Clarification about assignments that had been shared with peers and using this information used to organise their approach to the assignment. (iv) The need to carry the recorders with you all the time so that you can use them whenever you need to. *‘If you are in a stressful situation you can record a conversation and then replay it later on to help you’.* (v) Staff with strong accents. (vi) Sharing recordings with peers who have missed lectures. (vii) Listening back to recordings and correcting misconceptions: *‘Sometimes at first you get the idea wrong and when you hear it twice or three times it tells you have made a mistake and changes what you are thinking.’* (viii) To enable additional more focussed notes than in lectures; *‘It might be useful to record going through an essay with a tutor about where you went wrong and what you could improve on for next time. In ACSE we do mark several assignments face-to-face so this would be possible.’* (ix) Listen to recordings to improve your knowledge of a topic. *‘For me, my instant recordings are just like references so if I’m not [sure], it does help my learning if I read through my notes on what the lecturer has given me [and] I can hear the recordings back many times. It will give me more insights into what I’m actually reading about.’* (x) Listen back in a targeted way, by searching for specific sections. (xi) Some indicated it was easier to memorise from the spoken word than from written sources. *‘Also, ... I tend to remember things, memorise things, more easily when I am listening to them. So sometimes I am just reading something and when I am playing I’m trying to memorise.’* (xii) To produce revision notes in preparation for exams. (xiii) When finished studying a topic, a summary of main points could be recorded. (xiv) Recording introductions to new topics/areas of study and creating a spoken glossary of new terminology and concepts. (xv) Listening to recordings of maths problems when working through the same or similar problems on your own.

Students felt that *‘it is important to try out new ways of learning.’* There seemed to be an enthusiasm for experimenting with different possible uses of the audio devices to enhance learning. A summary from one interviewer was that everyone was very positive about the project. The students would definitely recommend their use by next year’s level 1 students and advised that future students should, *‘use it as much as possible and have it with them all the time so they can record. Have it in their pockets because sometimes, if it is in your bag and you’re having corridor conversations, it’s hard to reach in.’* Indeed one student commented that they felt lost when they mislaid their recorder and were overjoyed when they found it again.

2.2 Summary of usage arising from student evaluation 2008-09 at Sheffield Hallam University

Initial results of the project indicated that the majority of the students primarily used the devices to audio record lectures (Rossiter et al 2009). However as the project progressed the students’ perceptions changed and multiplied into more creative and constructive ideas (Nortcliffe et al 2009), for instance from the making of personal audio notes to the generation of ideas. By the end of the year students reported that the recording of feedback was the most common use of the devices for learning (Nortcliffe and Middleton 2009b), alongside other beneficial usage highlighted here.

Assessment: conversations with tutors relating to an assessment, *'It's been especially brilliant for an assignment workshop ... where [Lecturer] goes through every point of the assignment on the blackboard ... when I come to do the assignment I can listen back to it [and apply the learning]'*

Feedback: recording tutor and peer conversations about the assessment and generic class feedback in the classroom, *'There was something about the essay assignment that I wanted to clarify and I wanted to have a recording of [the conversation with the tutor] and have it there for me to use again. I could have used a pen and paper, but this was quite useful and quite discrete.'*

Personal reflection and self-assessment: recording to support reflection on the learner's study or project progress and making notes on improvements, solutions or further ideas, *'I've used it to write my dissertation when I've had ideas and put it beside my bed and when I've woken up and I've had an idea and I must do that... write this bit like this.'*

Tutorials, seminars and project supervision: the recording of discussions helped to clarify the learning following the conversations, thereby increasing understanding and knowledge, *'I think it could be good in tutorials. I find it really helpful when it's information aimed directly at me. I'd be able to listen back to that conversation within the tutorial and take on it board more' 'It's useful with your supervisor because your supervisor will tell you stuff and you're not having to write stuff down all the time. You've actually got a record of it without having to [interrupt the conversation].'*

Lecture recording and lecture revision notes: There was a mixed response to the usefulness of lecture recording as the acoustic quality was variable. However, for some, the act of recording of lectures increased student engagement as it allowed them to pay more attention than if they were having to make notes. Lecture recordings were also valuable learning resources that enabled students to check their learning, improve their written notes and create an alternative revision resource, *'[I] listen later [to the lecture] whilst reading through and adding to my existing notes or the lecture slides, which has helped.'* *'Knowing that the lecture is being recorded allowed me to concentrate more fully on what the lecturer was saying rather than rushing to get it all written down.'* *'I recorded the lectures, those that I needed to record, that I thought I wasn't going to understand. Then... I listened to that as I was walking around as a way of trying to revise the subject.'*

Group work: recording group discussions, ideas, solutions and decisions to confirm the assignment of tasks, and understand the group's approach, aid reflection and individual contributions or improve provide feedback to peers. *'I used it in one of the groups for group discussion. I was able to play it back later and remember extra little bits that I missed and I can attach it to the speakers in the car and play it through.'*

Self Feedback: recording oneself performing a task, later re-listening to reflect on one's performance and provide oneself with feedback. *'When I've got role play meetings for course work, then you can listen to yourself and get feedback rather than just the tutor giving you feedback. You can listen to yourself and see where you think you've gone wrong.'*

Personal notes and idea notes:- making recordings of idea generation or brainstorming activities in group work situations and other opportunities inside and beyond the formal curriculum in the form of 'reminders' and professional notes for future use. Often these are characterised by their accessibility and convenience over written note making approaches, *'I use it for just little things when I'm walking around if I haven't got a pen or when I'm reading a book.'*

As the year progressed students' use of the device to support their learning and learner autonomy evolved from recording and attending lectures to taking responsibility for capturing otherwise ephemeral but relevant conversations, *'It opened my eyes a little to taking control of my learning rather than just turning up to a lecture because I'm supposed to.'*

2.3 Summary

The original projects demonstrated that student generated audio recordings do have a significant potential to enhance learning and that these recordings may be from a wide range of scenarios. The students recommended that future students should be encouraged to use them. However, it was also clear that the recording of lectures would be best done by a single person, the academic, giving a better quality of recording available to all.

Academic staff have an ongoing need to guide students in how to make the most of their recording capability. One minor caveat is the need for protocols and staff buy-in. Although technically students are allowed to make recordings on campus, staff need to ensure they do not discourage this.

Conversely, students need to be made aware that there are intellectual property rights and ethical issues involved and that ownership of the recording they make is not simple. More to the point, in terms of the student's digital literacy, there is a professional development opportunity to be explored in the making of audio notes.

3. Changing student culture

The key question the authors wanted to ask this year was whether, without the initiative of a project or free hardware, students could be encouraged to take up a new means of learning, especially where that involved individual expense in obtaining a recording device. Also, the encouragement to begin recording was relatively low key, being given in just a few short snippets spaced throughout term by one lecturer.

On a secondary front, there was also an attempt to collect some data from year 2 students at University of Sheffield, that includes those who had participated in the 2008-09 project but who had had no further encouragement since then to actively record audio. The intention here was to discern whether their earlier experiences had indeed been significant enough to engender a longer term change in practice.

3.1 Student comments from year 1 University of Sheffield students 2010-11

This section gives a summary of year 1 student comments taken in December 2009. It should be noted that these students were not part of the project discussed in section 2 and thus all they received was occasional encouragement from the author to consider recording and re-listening to things; it was implicit that they had to acquire their own recording device. Student received a one page flyer/summary of the previous year's project findings to give them some encouragement to get started.

From the author's perspective the large number of comments from a class of about 65 (some given below) and high student participation demonstrates that a culture shift is possible and today's generation seem ready to give this a go and reap the benefits.

Many student comments focused on the recording of lectures and these are given in the Recording Lectures section.

Questions

- Have you recorded anything yourself this term for learning purposes? [58% yes, 42% no]
- Are you planning to start recording things? [41% yes, 44% undecided, 15% no]
- For those who have recorded things, have you found the process beneficial? [32% yes, 44% NA, 5% no, 19% unsure]

Student Quotes

1. *'It is very good in the process of preparation of presentation'*
2. *'They are helpful, but I believe that tutors should encourage more students to start this good habit and its better if tutors kept reminding their students about recording lectures. Video recording should be introduced as well. Some Universities welcome video recording as long as they are not published elsewhere.'*
3. *'I think that recording something and then sit and listen to it and take your time is very helpful for the student and helps him to understand the subject better'*
4. *'I think it is useful so I plan to do it for the next semester.'*
5. *'Recording encouraged which is good.'*
6. *'Personally I would rather take notes than listen to an audio recording, but it can be helpful'*
7. *'I don't record lectures but it's quite useful to record tutorials when a tutor works with you through a particular problem.'*
8. *'Good for summary and reflection.'*
9. *'Good Idea, however I can't record anything clearly! I can never hear the audio back later!'*
10. *'It was very helpful for the acs 108 essay'*
11. *'Encourage audio recording earlier in the semester.'*

3.2 Student comments from year 2 University of Sheffield students 2010-11

The cohort who took part in the 2008-09 project only comprised a third of the students taking the particular 2nd year module discussed in this paper and moreover only half of that cohort had actually received a free recorder. Thus for most of the class the active use of audio was new and they had no previous encouragement either to generate their own audio or to access lecture recordings.

Consequently extended [survey](#) questioning ~~on the~~ [student's on student](#) generated audio would have been inappropriate, ~~therefore and~~ only a few simple questions were asked. The responses were collected using an electronic response system at the end of a more technical quiz given towards the end of term in a lecture..

- 10% have recorded things already and 21% are planning to record things themselves.
- Of those who have recorded things, 50% found this beneficial.

3.3 Summary

There is definite evidence that a sizeable number of students are taking the initiative and recording things, even without the enticement of a project or free device. This would only be case if the benefits made it worthwhile. A small amount of staff encouragement seems to have been sufficient to get them started although some students have suggested that more encouragement would not go amiss.

4. Recording lectures

The project in 2008-09 made it clear that while many students had got into the habit of recording lectures, it was madness for several students to record independently on crude recording devices in relatively poor positions when the lecturer could make a single high quality recording. Responding to this comment one author acquired a suitable recorder and lapel microphone so that he could record each lecture and distribute this via podcast. This section gives a summary of the efficacy of this policy and student responses to it.

4.1 Practicalities of recording lectures

The authors have found that it is relatively straightforward to record lectures particularly once the approach becomes habitual. Drawing from the authors experience of recording lectures, the following are the authors' top ten tips to successful academic lecture recording;

1. use a reasonable quality recorder.
2. [Select recording bit rate that ensures reasonably good sound quality, but not compromise manageability of file sizes, i.e. not to large.](#)
2. use a lapel microphone (that is if the device can take an external microphone) to ensure a consistent audio quality of recording.
3. ensure no item of clothing or jewellery inadvertently bounces on and off the microphone during recording, as this reduces the quality of the recording.
4. if using a lapel mic, ensure the mic is plugged into mic socket (not earplug socket, easy error to make) and if using a mic with [an](#) on/off switch, remember to switch the lapel mic on.
5. keep it simple, don't edit the audio recording post lecture, as this only increases the workload unnecessarily.
6. regularly charge the device to ensure full capacity for each day's activities. However, if the device uses removeable batteries then carry a spare set of batteries and ideally use rechargeable batteries.
7. get into the habit of carrying and using the device, so ready to use the device at any opportunity.
8. work with the institutions technical support to ensure the VLE or website has sufficient capacity for all the podcasts, both in terms upload file size and [server](#) system capacity.
9. use the pause button during periods of silence or student activities. This will reduce file sizes, ensure recordings are more accessible to the listener and minimise the need to fast forward.
10. practice good radio presenting, i.e. if drawing on the board describe the drawing as you record, as this will enable the listener to co-ordinate the recording to sections of their own written notes.

Comment [AN1]: I have made a few tweaks here

4.2 Student comments from year 1 University of Sheffield students 2010-11

These comments were collected as part of the end of semester student questionnaires on all modules. The participation rate was about 90% of the cohort (all present for an assessment that day).

Student quotes

'The department should record some professionally as I have noticed that all lecture rooms provide sound systems and sound enhancing capabilities that could easily be used to record the lecture.'

'I feel it would be beneficial if more lecturers could record their lectures and upload them.'

[Numerous students mentioned this]'

'Happy with podcast section on MOLE.'

'I think lecturers should record the lecture himself/herself. After all we cannot record very clear because we are too far away from lecturers.'

'I think recording the lectures is very helpful because by hearing them again you can understand better'

'If there are some videos on the mole, it will be more helpful.'

'I hope there are some records of important lectures next year.'

'Though I've not recorded any of the lectures, I've listened to lecture podcasts on ACS111 and ACS123 and I think that it's really helpful.'

'I don't really like audio. I think video would be of much more help cause then you can see what the lecturer is doing and don't get bored to quickly'

'It is very useful when I want to review my class.'

'It would be useful if the department provided recordings for all lectures as it is sometimes difficult for students to produce a clear recording from a seat in a lecture theatre whereas those taken by lecturers are often clearer through the use of lapel microphones such as in ACS 111'

4.3 Student comments from year 2 University of Sheffield students 2010-11

The reader is reminded as in section 3.2 that the students who were aware of the project from 2008-09 form only about a third of the cohort answering this questionnaire.

- 66% found the podcasts useful although 30% did not care.
- 37% found them useful for reflection and clarification whereas 43% had not yet tried to use them.

Student written comments were positive about the concept but two interesting issues were raised by several students.

1. They noted that it was not always easy to match the audio to the slides, especially if you had missed the lecture. Part of this problem will be due to students missing linked hardcopy of anything that is handwritten on the OHP and the computer demonstrations used in the lecture.
2. Other students proposed that a video of the lecture would be far more effective.

These results are consistent with the findings of Mentzer et al (2007) that is audio lecture notes are not a substitute for attendance as the students miss the extra layers of learning provided in the live experience, i.e. visual clues and interaction. Podcasts and vodcasts are useful as a complementary learning resource therefore that reinforces what happened and extends the opportunity for the learner to engage with it. The benefits of lecture recording is dependent on many contextual factors, even when used in conjunction with lecture slides, but notably, it is not a substitute for lectures (Parson et al 2009).

4.4 Reflection on Academic Audio Provision

The majority of students say they appreciate the recording of lectures, however, it is also clear that they can identify room for improvement; for example, why can't there be video as well to allow proper synchronisation of voice and slides or other demonstrations? Some students want all staff to provide good quality recordings of lectures, yet this does not take into account the different styles and methods of delivery by staff or the capacity of the institution to deliver this, or indeed the time required for both staff and the students to review the recordings.

5. Conclusions

An earlier project demonstrated the potential benefits of students recording audio for learning purposes. This paper adds to that, showing there is evidence that students are prepared to purchase and use recording devices for learning purposes, highlighting the benefits they have found.

For each student, the development of audio notes evolves over time. In this study audio notes often began with the recording of lectures and then extended to the capture of ephemeral conversations,

feedback and personal notes. This evolution is similar to authors Middleton and Nortcliffe's personal experience of audio recording which has moved from self-generated audio lecture note provision, to audio feedback, and then onto a blend of provision, (Middleton and Nortcliffe 2009). Some encouragement is needed from academic staff to get this moving, but not a lot. Thus staff can help students become better learners with minimal effort and so need to find opportunities to spread this message.

When it comes to recording lectures, there is clearly a ground swell of student opinion that thinks this should be the norm and hence one battle to consider next is how or whether institutions can offer support to this approach. There are a number of benefits for students in developing and providing audio lecture notes (Nortcliffe and Middleton 2006), therefore there is still a need for the development of quick, easy and practical methodologies for both staff and institutions given the constraining cost of institutional development, staff time, equipment and other infrastructural resources. Furthermore, there is every prospect of such development being further constrained in the UK (Mandelson 2009). There is also anecdotal evidence that some staff would resist the practice of lecture recording and some students would demand video recordings of lectures, believing these to be even better as revision aids.

However, the technology to deliver lecture recording is not widely accessible yet, and so in practice, there is a trade off between quick and easy versus high quality productions (Parson et al 2009). The future may involve a more practical partnership, and arguably more engaging approach, that involves encouraging the students in recording five minute lecture summaries immediately after the lecture capturing the key learning points and sharing this resource with their peers as supplementary learning resources.

Finally, readers may also be interested in whether there is evidence that the introduction of more audio resources has improved student performance. For the results of early 2010, there is definite evidence that student performance is markedly better than the previous years on the modules discussed in this paper. However, the authors would apply caution in linking student performance to just one causal effect as in practice there is a strong interaction between many factors and modules are rarely delivered the same from one year to the next; students performance is linked to the whole package of delivery rather than individual components. Hence, the best evidence of efficacy of a single component is often students' comments.

References

- Buxton, K., Jackson, K., deZwart, M., Webster, L. and Lindsay, D. (2006) Recorded lectures: Looking to the future, *23rd annual ascilite conference: Who's learning? Whose technology?* 11,3-6th December 2006, Sydney, Australia
- Cowen, T. (2005). Should professors podcast their lectures on-line? Available from http://www.marginalrevolution.com/marginalrevolution/2005/10/should_professo.html [accessed 27th January 2010]
- Fidler, A., Middleton, A. and Nortcliffe, A., (2006) Providing added value to lecture materials to an iPod generation. 6th Conference of the International Consortium for Educational Development, June 2006, Sheffield, UK
- Intons-Peterson, M. J. and Fournier, J. (1986) External and internal memory aids: when and how often do we use them? *Journal of Experimental Psychology: General*, 115(3), 267-280
- Law, E. (2005) Promoting understanding using virtual learning environment, International conference on engineering education, 1, 806-811, July 2005, Gliwice, Poland
- Mandelson, P. (2009) Higher education Funding 2010-11, Letter to Tim Melville-Ross Chairman of UK Higher Education Funding Council. Available from <http://www.bis.gov.uk/wp-content/uploads/publications/Mandelson-Letter-to-HEFCE-Dec09.pdf>, [accessed 27th January 2010]
- McKenzie, W. (2008) Where are audio recordings of lectures in the new educational technology landscape? ASCILITE 2008 Melbourne: hello! where are you in the landscape of educational technology? 628-632 November 30 - December 3 2008, Melbourne, Australia
- Mentzer, G. Cryan, J., Teclhaimanot, B. (2007) 'Two Peas in a Pod? A Comparison of Face-to-Face and Web Based Classrooms', *Journal of Technology and Teacher Education*, 15(2) 233-246
- Middleton, A. and Nortcliffe, A., (2009), "iGather: learners as responsible audio collectors of tutor, peer and self reflection" A Word in Your Ear - Audio Feedback Conference: <http://research.shu.ac.uk/iti/awordinyourear2009/>, Sheffield, UK

- Nortcliffe, A. L and Middleton, A. (2006) Audio Lecture Notes - supplementary lecture materials with added value, NADO News The Official newsletter of the National Association of Disability Officers Ltd, Summer 2006
- Nortcliffe, A. L. and Middleton, A. (2007) Audio Feedback for the iPod Generation, In Proceedings of International Conference on Engineering Education, Coimbra, Portugal
- Nortcliffe, A. and Middleton, (2008) A three year case study of using audio to blend the engineer's learning environment **Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre** 3(2)
- Nortcliffe, A. L. and Middleton, A. (2009a) 'Understanding effective models of audio feedback' in Rajarshi Roy (ed.) *Engineering education perspectives, issues and concerns*. Shipra Publications, India
- Nortcliffe, A. and Middleton, A. (2009b) Student Audio Notes Project: lessons from autonomous use of MP3 recorders by students to enhance their learning, To be published by Centre for Promoting Learner Autonomy at Sheffield Hallam University, Small Project Scheme, Projects commenced 2008/09
- Nortcliffe, A., Rossiter, J.A. and Middleton, A., (2009) Students using digital audio interventions to enhance their learning experience, HEA annual conference, 30 June to 2 July 2009, Manchester, UK
- Rossiter, J.A., Nortcliffe, A., Griffin, A. and Middleton, A., (2009) Using student generated audio to enhance learning, **Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre** 4(2)
- Russell and Mattick (2005) Does streaming of a lecture result in empty seats? ALT-C 2005: exploring the frontiers of e-learning – borders, outposts and migration, September 2005, Manchester, UK, Special issue on Learning technologies in engineering education, engineering education, (2009) **Engineering Education: Journal of the Higher Education Academy Engineering Subject Centre** 4(2)
- Parson, V., Reddy, P., Wood, R., Senior, C. (2009) 'Educating an iPod generation: undergraduate attitudes, experiences and understanding of vodcast and podcast use', *Learning, Media and Technology*, 34(3) 215 – 228
- Waterfield, J., West, B., Parker, M. (2006) Supporting Inclusive Practice. In M. Adams and S. Brown (eds) *Towards Inclusive Learning in higher education: Developing curricula for disabled students*, London: Routledge, 79-94
- Williams, J., & Fardon, M. (2005). On-demand internet-transmitted lecture recordings: attempting to enhance and support the lecture experience, ALT-C 2005: exploring the frontiers of e-learning – borders, outposts and migration, September 2005, Manchester, UK

Copyright © 2009 J.A. Rossiter, A. L. Nortcliffe and A.J. Middleton listed on page 1: The authors assign to the EE2010 organisers and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to the Engineering Subject Centre to publish this document in full on the World Wide Web (prime sites and mirrors) on flash memory drive and in printed form within the EE2010 conference proceedings. Any other usage is prohibited without the express permission of the authors.