Effects of primer podcasts on stimulating learning from lectures: How do students engage?

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Abstract
A number of factors can influence learning from lectures such as students’ prior knowledge, their motivation, the instructional design, the lecturer and so forth. Instructional aid techniques such as preparing class notes, giving quizzes (either planned or spot quizzes) and the like can be used to maximise learning. This study uses two well-documented tools for learning from text—advance organisers and higher order questions—adapted for use with podcasts. Student evaluations of their experience of being primed for lectures with podcasts are described. The findings show that audio advance organisers and questions experienced by students have a positive influence on learning, because they help students bridge the conceptual distance between new and prior knowledge, better understand the topics in the lectures and stimulate thinking more deeply about the lecture’s content and the possible applications of the subject of the lecture.

Introduction
Well into the 21st century, lectures are still the dominant form of teaching in most institutions of higher learning. The exact benefit from a lecture is hard to predict. Some students prepare for them, whereas others expect to “learn it all” from the instructor during the lecture. Some students already have knowledge of the lecture topic, whereas others lack background knowledge and profit poorly from the new information. Also, instructors use lectures for different reasons. Some use them to rehash what was in the required readings, whereas others use them to broaden and deepen the readings. All of this means that lectures are seldom as effective as they could be.

The constructivist view of learning emphasises the role of active cognitive processing in learners. A number of techniques can be used to enhance this learning from lectures. Mayer (2001, 2005) identifies three cognitive processes that enhance meaningful learning, namely selecting (ie, paying attention to incoming information), organising (ie, building a coherent cognitive representation) and integrating (ie, connecting new knowledge with prior knowledge). Ohlsson (1995) contends that for optimal learning, a learning design should be created around certain learning activities that he calls epistemic tasks. These are tasks that are meant to stimulate the learner to describe, explain, predict, argue, critique, explicate and/or define. Learning is expected to be maximised as a result of organising knowledge and engaging students in these learning activities.

In the research described in this article, a cohort of undergraduate psychology students were exposed to pre-lecture (ie, primer) audio podcasts, throughout one semester. The purpose
of these primer podcasts was to provide students with common background information as well as a scaffold on which to “hang” the information contained in the lecture. The podcasts invited students to reflect on epistemic questions and answer them at the end of the lectures as a written review activity. This article reports on students’ perceptions of whether and how such primer podcasts and questions affected their learning from the lectures.

Background
Podcasts are quickly becoming widely used to disseminate audio and audio-visual information to a broad populace. Podcasts are digital media files with audio and/or audio and video (enhanced podcasts if they integrate sound and still images; or video podcast, also known as vodcasts) that are made available from a website, can be opened and/or downloaded and played on a computer, or downloaded from a website to be played on a small portable player designed to play sound and/or vision (Salmon & Edirisingha, 2008). Podcasts as a digital technology to distribute instructional narratives have gained acceptance in education in general and in higher education in particular. Lecture recordings are the most prevalent form of podcasts (eg, Copley, 2007; McKinney, Dyck & Luber, 2009), but their use as supplementary or additional materials in the form of post-lecture summaries, interviews, discussions and reminders are also found (Baker, Harrison, Thornton & Yates, 2008; Carvalho, Aguiar, Carvalho & Cabecinhas, 2008). Student-generated podcasts have a special place in research, as they highly engage students in their learning, promote deep learning and reflection (Chan, Lee & McLoughlin, 2006).

Researchers report an overall positive impact of instructor-generated podcasts on learning, specifically in terms of affecting student motivation and engagement (Carle, Jaffee & Miller, 2009; Edirisingha & Salmon, 2007), of enhancing better understanding of the material (Lee & Tynan, 2008), especially of conceptually challenging material (Aliotta, Bates, Brunton & Stevens, 2008), and of providing clear instructions (Anzai, 2007; Nie, Armellini, Randall,
Harrington & Barklamb, 2010) and feedback (France & Ribchester, 2008). Podcasts are also reported to positively affect students becoming better acquainted with the lecturer (Fernandez, Simo & Sallan, 2009; Taylor & Clark, 2010).

Generally, these reports about the effects of podcasts agree with findings in earlier research about using audio for educational purposes in the 1980s. Research then showed that the spoken word influences cognition through its clarity of instruction and that it enhances emotional aspects of learning by conveying immediacy and a connection with the teacher (Durbridge, 1984; Power, 1990). Kirschner, Van den Brink and Meester (1991), for example, found that audiotaped feedback on an essay that students were required to write contained more information (approximately twice as much information) cost the instructor approximately half the time to produce as opposed to written feedback and was perceived by students as being more informative, personal and friendly than written feedback. Very much the same is true about podcasts (Nie et al., 2010).

Podcasts, often recorded during an already planned and executed learning event (ie, lecture podcasts) or after such a learning event (ie, as supplementary/additional materials), are principally used by students to fill in gaps in what they have retained from their learning activities (eg, what they heard or should have heard in the lecture) or reinforce what they have retained from those learning experiences (Copley, 2007; Fernandez et al., 2009). Very little research has been conducted on using podcasts to prepare students for what is going to be taught and/or to address their misconceptions on the content before they actually attend lectures. One example of such research is a study by Aliotta et al. (2008), in which two podcasts, targeting difficult concepts in elementary undergraduate physics, were presented to students a few days prior to their lectures. The study found a small yet consistent positive influence of listening to podcasts on students correctly answering conceptual questions.

This study reports on another, though related, use of podcasts to help students better learn from lectures. Podcast advance organisers with adjunct epistemic questions were used throughout a semester to provide students with a scaffold to support integrating knowledge from the lectures and stimulate them to process the new information at a deeper level that is actually applying the new information in new situations.

Advance organisers are instructional aid materials that provide ideational scaffolding (schemata into which more specific information could be integrated) at a higher level of generality, inclusiveness and abstraction for incorporation and retention of more detailed, subsumptive and concrete material that follows (Ausubel, 1968). A basic premise of the functioning of advance organisers is the proper use of learner’s prior knowledge. Individuals often possess concept-relevant knowledge that aids their understanding of new concepts, even for relatively unfamiliar content domains (Hannafin & Hooper, 1993). Specifically in psychology, Thompson and Zamboanga (2003) found that students often have considerable prior knowledge of psychological concepts gained from school, folk theories, media and everyday experience. If, however, this knowledge is incomplete or exaggerated, it could be detrimental to learning (Taylor & Kowalski, 2004; Van den Broek & Kendeou, 2008). Advance organisers serve the purpose of evoking prior knowledge on a given topic and/or creation of a common background (ie, representation of a concept), on which students can build further understanding of the content yet to come (eg, in a lecture). In this way, advance organisers are a tool for enhancing meaningful learning and have been found to positively affect performance on recall and for far transfer tasks (Corkill, 1992; Mayer, 1979). In this study, they are also used as a base to launch higher order epistemic questions.

One of the major purposes of using questions as an instructional aid is to stimulate reflection upon what is presented (eg, said by a teacher, presented in a textbook, etc.), to direct attention to certain information and/or to support the production of new knowledge and ideas from the presented information. Questions placed either prior to what is expected to be learned or directly
after are called *adjunct questions* (Rothkopf, 1966). Such questions are seen as being able to induce *mathemagenic behaviours* (literally, behaviours that give birth to learning; Rothkopf, 1970; see Hamaker [1986] for a review of research on adjunct questions). Recent research on question-prompting procedures shows that questions can induce and stimulate cognitive, metacognitive, motivational, volitional, cooperative and problem-solving activities during learning (Bannert, 2009; Papadoupoulos, Demetriadis, Stamelos & Tsoukalas, 2009). Question prompts have also been found to be effective in scaffolding higher order thinking (Demetriadis, Papadoupoulos, Stamelos & Fischer, 2008; Scardamalia, Bereiter, McLean, Swallow & Woodruff, 1989). The type of questions used here aim to relate to the learner’s thinking process and to involve him/her in carrying out epistemic tasks (Ohlsson, 1995). Hence we called them adjunct epistemic questions.

In a constructivist learning environment, assessment should be integrated into the learning process and measure the qualitative expression of knowledge (e.g., what the learner does with it or how he/she manipulates concepts), rather than measure what is remembered (Tynjälä, 1999). Thus we designed a full-cycle epistemic task that takes into account Mayer’s principles for constructivist learning (selecting, organising and integrating) and using feedback rather than formal assessment. A full-cycle epistemic task is a task that involves a pre-lecture podcast, the lecture itself, a post-lecture review activity (e.g., written answers to the epistemic questions ending the podcast episodes) and finally a short feedback on the review activity. It is important to note here that because this is most probably the first time that the students who took part in this study were exposed to this full-cycle, and specifically podcasting technology in the form of a pre-lecture podcast, it was considered necessary to determine the students’ perceptions and satisfaction with it, which was seen as a major factor of its success. The study, thus, explores solely students’ evaluation of the perceived/experienced effectiveness of the podcasts and epistemic questions as a priming method on their learning from lectures and deeper understanding of the subject. Formulated on the base of the literature, the hypothesis studied was: providing students with both background knowledge on which they can “hang” new information and epistemic questions prior to lectures would be experienced by them as a positive learning experience as they would feel stimulated to (1) engage more deeply with the lecture and understand the content better and (2) reflect on the topics and on what they know about them.

**Method**

**Participants**

Participants were undergraduate psychology students at a mid-sized British university. Gender composition of the respondents in the study ($N = 49$) was similar to that of the complete cohort ($n = 99$) (respondents: 41 females = 84%, eight males = 16%; cohort: 83 females = 84%, 16 males = 16%). The average age of the respondents was 20.04 years ($SD = 1.06$).

**Materials**

The podcasts were about 5 minutes of length and consisted of an introduction to the main theories from the upcoming lecture, summary definitions of core concepts and examples. The epistemic questions ending the podcast episodes were explanatory (e.g., “How could ‘human sense’ explain the finding that children from lower socio-economic status develop cognitively at a slower rate than children from high socio-economic status?”), predictive (e.g., “With respect to Kohlberg’s model, what kind of activities do you think could facilitate moral development?”) or argumentative questions (e.g., “Based on [the research] of development of perception, how would you design a mobile for infants?”).

A paper-based end-of-semester evaluation questionnaire gathered data from the students present at the last lecture ($n = 49$; 49.5% of the students taking the course). A set of Likert-type questions were asked in relation to the perceived effects of the podcasts and another set of Likert-type
questions aimed to grasp students evaluation of the effects of the epistemic questions. Students could place their evaluation of each of the statements on a 5-point scale, ranging from 5 “strongly agree” to 1 “strongly disagree”. Some items related to the perceived benefits of the podcasts were borrowed and adapted from a questionnaire by Edirisingha, Rizzi, Nie and Rothwell (2007). Additionally, students were asked a number of questions to establish to what extent podcasts were a novelty, and how and why students made use of them.

Procedure
The podcasts’ narratives and questions were prepared jointly by the course lecturer and the researchers. The lecturer recorded the podcasts using Audacity (Version 1.2.6), a free sound recording software program. The podcasts were edited to include musical background and saved in mp3 format. They were made available on the unit’s Moodle page and sent by email to the students 2 days prior to each of the six lectures during one semester. During the introductory lecture, students were informed about the availability of the podcasts and reminded about it consecutively throughout lectures. At the end of the last lecture, the paper-based evaluation questionnaire was distributed to all the present students and collected upon completion. Students were informed that the study was part of an external independent research and that all the information they provide serves only the purpose of this research.

Results
The majority of the questionnaire respondents (80%) reported having listened to at least three of the six podcasts. There was relatively high interest in the podcasts, the first being most listened to and only the last one listened to by just less than half of the respondents (see Table 1). This decrease is most likely due to the fact that students had to submit an essay at that moment that also caused lecture attendance for weeks 6 and 7 to drop. When students did not listen, they reported that it was because they forgot to listen and/or lacked or poorly allocated time. Technical issues occurred occasionally, such as the sound of the podcast being low or not available from the library’s computers.

More than half of the respondents (55%) reported listening to other podcasts, mainly entertainment (37%), news (33%) and educational podcasts (26%). Even though one student only reported to have listened to other lecture podcasts, it seems reasonable to expect that this is not a completely unfamiliar technology, especially if half of the respondents stated they listen regularly.

Activities while listening
Respondents predominantly reported just listening to the podcasts (65%), without engaging in other activities at the same time. When they did engage in other activities simultaneous to listening, these were: visiting the unit page on Moodle (29%), taking notes (18%) or carrying out other student related work (12%). Only a few did some non-study-focused activities, such as tidying the room, organising daily work, sorting books, cooking, surfing the Internet, getting ready to leave the house for the lecture and other personal activities.

Effects of the podcasts
Table 2 shows the results of multiple one-way comparative tests run to reject or accept a treatment effect hypothesis. The t-test shows that the treatment hypothesis is largely accepted with significant size effects. The only statement for which no treatment effect was found was related to

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th>Lecture 2</th>
<th>Lecture 3</th>
<th>Lecture 4</th>
<th>Lecture 5</th>
<th>Lecture 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>84</td>
<td>65</td>
<td>59</td>
<td>65</td>
<td>45</td>
</tr>
</tbody>
</table>
whether students thought listening to the course podcasts made them more interested in listening to other podcasts.

Effect of the podcast questions
The results of the t-tests show that students felt the podcast questions affected their reflection, activation of prior knowledge, understanding of the subject and general deepening of knowledge. They did not feel stimulated to seek additional information, nor to discuss with peers (Table 3).

Table 2: Effects of the podcasts (test value = 3)

<table>
<thead>
<tr>
<th>Listening to the podcast . . .</th>
<th>t</th>
<th>Mean</th>
<th>df</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>made me feel acquainted with the lecturer</td>
<td>8.152</td>
<td>3.86</td>
<td>48</td>
<td>1.16</td>
</tr>
<tr>
<td>helped me understand the topic better</td>
<td>7.924</td>
<td>3.78</td>
<td>48</td>
<td>1.13</td>
</tr>
<tr>
<td>helped me organise the concepts and ideas</td>
<td>7.325</td>
<td>3.84</td>
<td>48</td>
<td>1.05</td>
</tr>
<tr>
<td>made me think more deeply about the topics in the podcasts</td>
<td>3.504</td>
<td>3.47</td>
<td>48</td>
<td>0.50</td>
</tr>
<tr>
<td>helped me focus my attention in class</td>
<td>3.464</td>
<td>3.43</td>
<td>48</td>
<td>0.50</td>
</tr>
<tr>
<td>made me interested in looking for other podcasts</td>
<td>−1.566</td>
<td>2.80</td>
<td>48</td>
<td>*</td>
</tr>
</tbody>
</table>

*An effect size is not calculated when the value of t obtained is smaller than t critical.

Table 3: Effects of the podcast questions (test value = 3; p < 0.05)

<table>
<thead>
<tr>
<th>t</th>
<th>Mean</th>
<th>df</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was reflecting on the content of the podcast</td>
<td>7.245</td>
<td>3.69</td>
<td>47</td>
</tr>
<tr>
<td>I was thinking of what I already knew of the topic</td>
<td>6.856</td>
<td>3.75</td>
<td>47</td>
</tr>
<tr>
<td>I understood the subject better</td>
<td>4.014</td>
<td>3.52</td>
<td>47</td>
</tr>
<tr>
<td>I was asking myself similar questions</td>
<td>3.022</td>
<td>3.35</td>
<td>47</td>
</tr>
<tr>
<td>I deepened my knowledge on the subject</td>
<td>2.729</td>
<td>3.40</td>
<td>47</td>
</tr>
<tr>
<td>I was reflecting during the lecture</td>
<td>1.307</td>
<td>3.17</td>
<td>47</td>
</tr>
<tr>
<td>I was asking similar questions during lectures</td>
<td>−4.893</td>
<td>2.44</td>
<td>47</td>
</tr>
<tr>
<td>I was seeking answers by browsing the literature/internet</td>
<td>−4.687</td>
<td>2.40</td>
<td>47</td>
</tr>
<tr>
<td>I discussed the questions with peers</td>
<td>−3.214</td>
<td>2.56</td>
<td>47</td>
</tr>
</tbody>
</table>

*An effect size is not calculated when the value of t obtained is smaller than t critical.

Discussion
Although this study does not provide results on the actual impact of using epistemic organising podcasts on learning in terms of performance, it does give an insight on students’ motivation to use such additional resources to gain more from lectures. The evaluation provided by the students essentially confirmed the hypothesis that audio-only primer podcasts were experienced as stimulating for students to (1) engage more deeply with the lecture and understand the content better and (2) reflect on the topics and on what they know about them.

The responses indicate that the podcasts were taken seriously as part of the learning process, as students reported having focused predominantly on listening and on study-related activities, rather than listening to the podcasts as a background sound. As well, the majority of the respond-
ents stated having listened to the podcasts more than once, in order to understand them better and be able to answer the epistemic questions. Thus not surprisingly students largely reported they perceived advance organiser podcasts as affecting their learning in terms of better understanding the material, better organising concepts and ideas, better focusing their attention and generally facilitating deeper thinking about the content. Learning theory explains these findings. In terms of Ausubel’s subsumption theory (Ausubel, 1960), the podcasts can be seen as functioning as advance organisers and providing a basic structure around which new information is organised. Schema theory also predicts that familiarity with the content would enhance comprehension as it provides a framework in which the learner can position the new information (Anderson & Pearson, 1984). A general facilitation of learning and understanding of the subject are typically among the most often reported effects of podcasts (see Heilesen, 2010 and Hew, 2008 for reviews). For instance, Bolliger, Supanakorn and Boggs (2010) researched the effects of several types of podcasts (eg, introductory, lecture and supplementary podcasts) within online courses settings and reported that all types positively impacted motivation and attention and helped the students’ learning processes. Edirisingha et al (2007) used podcasts generated by students and/or tutors to help students improve study and presentation skills and explained the positive results by the flexibility to listen at convenient time, place and pace, to revisit key concepts and pace the learning activities from the teacher into the learner’s hands.

Students reported they felt stimulated by the epistemic questions to reflect on the content of the podcasts, to activate existing prior knowledge on the topic and to ask themselves similar questions and had a feeling of a general facilitation of learning and better understanding of the subject. Previous research has demonstrated that high-level advance questions, and particularly questions requiring explanation and elaboration, help activate prior knowledge and induce cognitive processes such as selection, knowledge integration and application (Osman & Hannafin, 1994; Pressley et al, 1992).

Furthermore, students thought that the questions stimulated them to ask themselves similar questions. The self-directed question-generation is found to “promote deeper understanding, initiate recall of background knowledge, require integration of prior knowledge” (Rosenshine, Meister & Chapman, 1996, p. 200) and is a strong index for metacognition (Spiers & Gallini, 1988). Unfortunately, we do not have any examples of students’ self-questions, therefore we cannot evaluate whether these were really at the same level of complexity.

Surprisingly, students stated that the podcast questions did not stimulate them to reflect during the lecture on what was asked in the question. It was expected that primer questions would direct students’ attention to specific bits of information presented during lecture, as it is typically the case for advance adjunct questions. Closer examination brought us to observe that the statement formulation was ambiguous or misleading, as the students were asked whether the podcast question encouraged them to reflect during the lecture but unfortunately did not stipulate whether this meant reflecting on the lecture in general or reflecting on the question posed in the podcast.

A generic positive experience with podcasts was found here, namely becoming acquainted with the lecturer. We acknowledge that different types of content lend themselves differently to sounding more or less “informal,” for instance discussions would be more spontaneous than scripted summaries or advance organisers. Nevertheless, students typically prefer a familiar voice and the informal, relaxed tone of their lecturer (Taylor & Clark, 2010), which gives an increased feeling of proximity through the podcast as compared with other materials (Fernandez et al, 2009). We found similar results, even though in our case the informal aspect came more as an afterthought to the lecturer than as a planned approach. We believe this is yet another aspect of using educational audio that adds to the motivation and engagement of the students in the learning process.

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Conclusion
The study demonstrates the importance of understanding how learners can best be stimulated to engage in and respond to learning before investing time and other resources in developing learning aids. Our observations did not find any significant changes or correlations between the number of students attending lectures and the availability of podcasts, but as in a majority of other studies, the students reported greater/deeper engagement. If podcasts are thoughtfully integrated into the existing and still prevailing use of lectures, they have the potential to enhance deeper levels of learning, especially if they involve students in carrying out epistemic tasks. This is, in any event, the opinion of the students as reported here, which is in line with the Cognitive Evaluation Theory (Ryan & Deci, 2000), which holds that the perception of certain aspects of the social and task environment are crucial to intrinsic motivation. It is encouraging that students were positive about the podcasts. Though actual learning improvement was not reported here, the post-lecture review activities that were part of the full-cycle epistemic task were collected and are subject of further analysis. Such an analysis is necessary to determine whether primer podcasts can be effectively used to enhance learning itself.

This study used audio-only podcasts, as lecture handouts were already available to the students. McKinney et al (2009) reported in a very similar condition (ie, PowerPoint® lecture handouts made available for note taking) that the students in the podcast and PowerPoint® condition outperformed the control group who attended the face-to-face lecture with the same slides, on an exam on the lecture content. Nevertheless, enhanced podcasts should be considered particularly when lecture handouts are not available. Research has demonstrated the effectiveness of enhanced podcasts on better recall and application tasks compared with audio-only podcasts (Kennedy, Hart & Kellemes, 2010). However, we would recommend Mayer’s (2001) cognitive theory of multimedia learning to be considered as a framework for creating the most appropriate types of podcasts for optimal learning results.

As well, although podcasts can be beneficial to students with learning disabilities such as dyslexia (Barton, Penny & Riordan, 2007), the needs of students with hearing disabilities should also be taken into account. In such cases, podcasts transcripts could easily be made available.

Furthermore, it would be useful to conduct research to explore how primer podcasts would affect learning in larger scale cohorts where variance of prior knowledge and students’ motivation could vary greatly.

This study adds evidence on certain aspects of the usage of educational audio podcasts. As a majority of other podcast studies shows, despite the ubiquitous presence of technology, there is only a small proportion of students who intuitively merge their technological gadgets with learning. Margaryan, Littlejohn and Vojt (2011), for example, reported that university students (ie, members of the Net generation) use a limited range of technologies for learning and socialisation as did Bullen, Morgan, Belfer and Qayyum (2008), Ebner, Schiefner and Nagler (2008), Kennedy et al (2007), and Kvavik (2005). As we all know, tool appropriation is almost impossible if the intended users do not themselves experience the tool as positive. The first step has now been taken.

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