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Use of Audio Files Improves Students' Performance in Higher Education

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1. Introduction

The use of podcasting and audio files for educational purposes has increased lately in higher education (Campbell, 2005; Bongey et al., 2006; Lakhal et al., 2007). It is only five years since podcasts were developed, but their widespread use can be attributed to their 'easy of use', once downloaded automatically using software such as RSS (Really Simple Syndication) (Bullis, 2005). From the very beginning, Campbell (2005) highlighted the possibilities that podcasting could offer in higher education. In fact, as the literature reveals (e.g., Cebeci & Tekdal, 2006; Hürst and Waizenegger, 2006; Lim, 2005; Malan, 2007), a significant number of faculty members are adopting these new techniques into their online or blended courses while at the same time underlining the advantages for their teaching practice. Indeed, an increase in learner satisfaction (Lakhal et al., 2007) and a lower feeling of isolation (Lee & Chan, 2007) have been observed for students on distance courses, while other strengths have been highlighted through studies of individuals who attend courses in the classroom. The result, as revealed by certain authors (e.g., Lane, 2006; Brock, 2007), appears to be that students often make use of podcasts to review basic concepts or to catch up when they have been unable to attend class for a while. Students report that this technology is also an interesting aid with regard to studying difficult material and in preparing for exams, which in turn should improve their classroom performance (Lakhal et al., 2007). This finding is fully in line with Fillion's (2005) study, in which higher performance levels were observed for students using other information technologies in on-site courses when compared with students taking on-line courses. Therefore, a combined usage of audio technologies with more traditional methods of lecturing in the classroom may represent a promising teaching strategy in the delivery of higher education on-site courses. This is especially true in an era in which a large number of students use mobile devices (i.e., iPods, MP3s, MP4s, mobile phones, smart phones, PDAs or laptops) on a daily basis for both educational and entertainment purposes.

However, several managers, administrators, IT service-providers and lecturers are still reluctant to implement podcasting and other audio technologies in higher education. Amongst other reasons for rejecting these methods, the following have been commonly cited (Bongey et al., 2006; Fitcher, 2006):

- They may lead to absenteeism: if students are able to access all the educational content of their courses in this format, why would they attend classes?;
- They imply a unidirectional mode of communication: if the bidirectional context is absent, students would miss the opportunity to interact with the instructor when solving doubts and questions they may have;
- Additional technological structures are required for hosting the files on the university server, which demands too many resources from the institution;
- The relatively low rates of student subscription or downloads made may not be worth the effort involved in producing the materials.

Nevertheless, the most important criticism focuses on the lack of direct evidence of effectiveness. To assess if podcasts are an effective learning tool, Vajoczki et al. (2008) described a number of success indicators, which can be grouped into four main categories: student satisfaction, educational outcomes, instructor satisfaction, and financial feasibility. Here, educational outcomes or students' grades play a key role. In fact, the other complains might be easily forgotten if the usage of audio technologies provided evidence of an improvement in student performance. It is precisely this area that has not been sufficiently supported with empirical data, which is the aim of our study.

A recent study looking at the possible effectiveness of podcasting used on online courses (Lakhal et al., 2007), observed higher learning effectiveness in a group of podcasting users as compared to non-users. However, it failed to demonstrate better performance in students who listened to audio materials. In a similar vein, and based on a study conducted with 83 college students, Janossy (2007) stated that student performance is improved by podcast. His survey only accounted for learners' subjective impression regarding whether they felt podcasting had helped them perform better. It was not, in fact, based on actual data about students' performance. For that reason, empirical evidence is needed to confirm the effectiveness of audio files and/or podcasting.

In the present study, we tested the specific hypothesis that audio files would improve students' performance on a non-distance based university course. As a previous step to designing a whole course with several audio files or a Podcast system, we considered the option of elaborating a solely recorded material course to test its effectiveness. Designing a series of audio files for a continuous download appeared to be too time-consuming an activity, without having preliminary proof of its actual value. Therefore, a steadier initial process was selected with the use of a single, first audio file.

The chosen material to be recorded and uploaded for students' use was a topic identified as problematic in previous semesters. Since other students had already suggested that having contents on phases of psychological interviews summarised would have been helpful, this seemed a suitable topic for introducing the audio file selected. Apart from the contents themselves, an important decision to be made regarded the length of the file. Other authors (e.g., Bottentuit Junior & Coutinho, 2008; Janossy, 2007) have already suggested that lengthy files should be avoided if we do not want students to become bored, a factor which can lead to an abrupt termination of the listening. Whereas in the classroom it is uncommon to abandon the room, a more private way of "attending" the lecture allows for free drop-up. After some deliberation, the optimal length for the audio file was thought to be around 5 minutes (as suggested by the students who participate in Janossy's, 2007, study). Other general considerations (Bottentuit Junior & Coutinho, 2008) were taken into account during the editing of the file: a) the material was written beforehand in a paper, which was

afterwards read in a clear and loud voice; b) speed of speech delivery was not excessive; c) especial attention was paid to intonation in order to keep it as natural as possible, using real conversations or speeches to an audience as models; d) recording was made in a place with no interfering noise; and e) an adequate distance from the microphone was kept during recording.

2. Method

2.1 Sample

Although a total of 140 students had enrolled on the 'Psychological Assessment' course (compulsory for the Bachelor degree in Psychology) at the beginning of the semester, only 103 of them decided to take the exam in which the contents of the audio file were included. Therefore, the results presented here refer exclusively to those students who were awarded a score in the second exam of the first semester of 2008. Students' age ranged between 19 and 28, 20 being the median age. Most of them ($n = 84$) were female. Eighty-two took the exam for first time, whereas 21 had taken the exam the previous year and failed it. The institution – University of the Basque Country – is a large state university located in the Basque region of Spain. Since the fees for the course are very low and grants are offered to local students who cannot afford the fees, it is not expected to be a biased high-SES sample. Instead, the sample is expected to be quite heterogeneous in this regard. All students were Spanish-Basque bilingual speakers and took the course in Basque.

2.2 Procedure

On-campus lectures were delivered according to a timetable fixed before the semester began (two one-hour sessions per week during 15 weeks). Students had PowerPoint presentations as supplementary materials to follow the lessons, but not a single reading reference was proposed as compulsory. Instead, a selected list of textbooks was provided at the beginning of the course with the most important contents being fully explained during the lessons, so that students could take notes as desired. Students were informed that topics not fully developed in the classroom would not be included in the exam. At the same time, the lecturer explained that some other on-line materials (including the object of this study: the audio file) would be added to help the students to understand the specific contents of the course.

The audio file used in this study would increase the chances of getting a better mark in theory-related examinations of the course. In addition to theoretical contents, some more practical activities were included in order to attempt to assure a successful completion of the course. Overall, a minimum of 50% of the total marks was required to pass the course, with an additional evaluation criterion included to ensure a balanced score vis a vis the theoretical and practical marks. Since both aspects were equally evaluated, it was expected that students would obtain a score of at least 25% in theoretical contents and another 25% in practical assignments. However, the maximum score that a student could get by means of the cloze-test exams would be 30% of the total (as a result of the fact that the other 20% of the marks were allocated for an assignment focused on the elaboration of theoretical contents). Taking everything into account, deciding to use the audio file as a supplementary study aid would never amount to more than 10% of the marks of the exam (the exam was divided in three parts, and in only one of them would the topic in question be included).

A single audio file was created, in which part of the contents of one lesson ("Phases of the psychological interview") were summarised and recorded by the lecturer herself. The length of that explanatory file was of 6.52 minutes, and it was delivered using a '.wav' file extension (12.5 Mb) compatible with several audio formats.

One day after the lesson was explained, the instructor announced the existence of an audio file that summarised the "Phases of the psychological interview", and indicated where it could be found and the password needed to download it. A password was necessary because it had to be stored in a common folder used by all members of the university. Nevertheless, a link was placed on the MOODLE (Modular Object-Oriented Dynamic Learning Environment) online course home page and used as a supplementary aid (see Figure 1). One of the advantages of this virtual platform with educational purposes is that it enables the instructor to analyse students' progress through activities designed to offer possibilities for continuous evaluation (Alonso Reyes et al., 2005). In this case it allowed us to be able to trace each student's use of the platform (see Figure 2). Since the act of tracking student use could be considered a violation of the right to anonymity, at the beginning of the course the instructor informed students of the situation and asked students who were not be comfortable with it, to say so, so that those their information was not analysed. None of the students expressed concern at the process explained to them and as a result everyone's use of the MOODLE platform was analysed in order to evaluate the effect of audio file downloading.

Students' access to the audio file before the exam was registered in a dichotomous way (Yes = downloaded the file; No = not logged in the link). Because some of them wanted to check the answer to the question referred in the contents of the audio file, we made sure that only logs that took place during a specific time period (date and time) prior to the exam were considered for the study. They had 10 days to listen to or download it from the time it was first stored online.

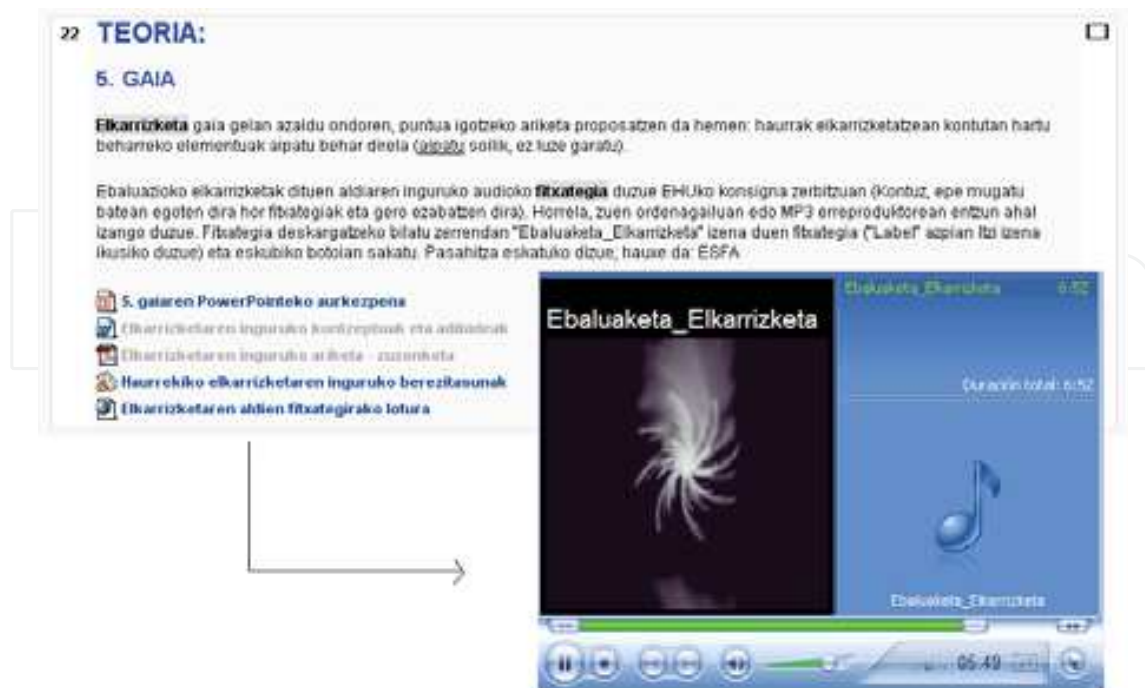


Fig. 1. Audio file in the MOODLE platform including instructions for downloading



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Fig. 2. One student’s log-in record, with an indication of the number of visits, and the date and time of the last log-in

2.3 Analyses

In order to test our hypothesis, namely that those students who had downloaded the audio file would answer better the question related to its contents; some contingency tables were performed (for options that considered a null answer in a different way) and the χ^2 statistic was calculated. Since there were 10 questions in the exam, we only considered the results of the question referring to the contents of the audio file. There were four possible answers, with only one of them being correct. In addition, a further analysis was conducted; as we were aware that there might be differences with regard to the rest of questions of the exam between the two groups (download status: Yes/No), we performed a *t*-test analysis, followed by a specific analysis of effect size employing Cohen’s *d* statistic.

3. Results

Before describing the results, it should be noted that students could decide to leave the question blank if they were unsure of the answer and that they would not be penalized for doing so (an incorrect answer would mean reducing the score by one third). For that reason, although it is sensible to think that the blank option was closer to failing to know the answer, we calculated the χ^2 statistic for three different possible combinations in the contingency tables: a) not considering the blank answers for analysis, b) considering them as a separate category, and c) considering them as a fail. We analysed the possible relationship between the category of using the audio file and answering correctly the question referred in the contents of the file by following the above mentioned order.

Out of the 103 students who took the exam, 56 gave the correct answer, 24 gave a wrong answer, and 23 left it blank. Regardless of how the blank answers were classified, in all cases the hypothesis was confirmed; those students who *presumably* listened to the audio file (the only information we have is that they downloaded it), answered correctly to the question in a higher percentage as compared to those who did not download the file. This information can be seen in more detail in Table 1, Table 2, and Table 3.

Downloaded		Answer		Total
		Incor rect	Correct	
No	Observed frequency	20	30	50
	Expected frequency	15	35	
Yes	Observed frequency	4	26	30
	Expected frequency	9	21	
Total	Observed frequency	24	56	80

Table 1. Contingency table, without taking into account the answers left blank

Downloaded		Answer			Total
		Blank	Incorrect	Correct	
No	Observed frequency	17	20	30	67
	Expected frequency	15.0	15.6	36.4	
Yes	Observed frequency	6	4	26	36
	Expected frequency	8	8.4	19.6	
Total	Observed frequency	23	24	56	103

Table 2. Contingency table, considering the answers left blank as a separate category

Downloaded		Answer		Total
		Incorrect	Correct	
No	Observed frequency	37	30	67
	Expected frequency	30.6	36.4	
Yes	Observed frequency	10	26	36
	Expected frequency	16.4	19.6	
Total	Observed frequency	47	56	103

Table 3. Contingency table, considering the answers left blank as a fail

Referring to the first option, in which we did not consider the blank answers for analysis, the test was statistically significant [$\chi^2 (1, N = 80) = 6.349, p < .05$], indicating that there was a relationship between the levels of the categorical variables. That is, those students who downloaded the file had more correct answers for non-random reasons. When considering blank answers as a separate category or as a fail, the tests were also statistically significant, producing the following values respectively [$\chi^2 (2, N = 103) = 7.569, p < .05$; and $\chi^2 (1, N = 103) = 7.110, p < .01$].

One question that may arise from the results reported above is whether the performance improvement occurred for every type of students or, whether some students may have benefitted more from this method, achieving better marks. Specifically, students with better

cognitive skills in general might have been considered to be more motivated to use several study methods with the aim of getting better grades. For that reason, we analysed to what extent the two groups were similar or different in terms of performance. This was done by looking at the grades obtained when the question about audio file's contents was deleted. As suspected, the t-test analyses revealed differences statistically significant between the two groups [$t(101) = -3.80$; $p < .001$], showing that the group of students who downloaded the audio file would have obtained better grades ($M = .62$, $SD = .27$) than the group who show no interest in the recorded summary ($M = .41$, $SD = .27$). Furthermore, the effect size can be labelled as large (Cohen's $d = .79$), which makes the distinction between the two groups even clearer.

4. Conclusion

In this pilot study we have assessed the level of performance improvement that could be derived from the use of audio files on a university course. Our preliminary analyses showed that there is an actual improvement in some students' performance due to having listened to the recorded summary of the lesson. We suggest, therefore, that not only distance-based universities are suitable environments for the implementation of such methodologies, but also institutions delivering higher educational services on campus may benefit from incorporating new technologies, such as e-learning and m-learning. However, the effect may not imply a direct cause, because those who made use of this aid were the students who would, regardless, achieve better grades. Can we therefore conclude that there is a previous level of motivation that makes some students more prone to use whatever tool that would help them succeed? Were there any students who were not especially motivated to study by reading the books and notes, but found this way of studying attractive enough to download and actually listen to the audio file? A more careful examination of students' records allowed us to learn that some of them did not get good marks overall, yet answered correctly the key question after having downloaded the file. In fact, it is apparent that this issue requires further examination. Even though the number of students not easily motivated by other methods but more prone to use new technologies was low, we consider future research along the lines of the current study valuable.

5. Discussion

The educational settings of the future (and actually of the present time) are better characterised as environments where the learning processes take place centred around the students themselves (Alonso-Arbiol, 2008; Nix, 2005). By taking into account these clients' new profiles, we can imagine contexts wherein mobile devices (iPod, MP3 and MP4 players, mobile phones) originally devised for entertainment and pleasure, become suitable for educational purposes too (Kukulska-Hulme, 2005). In this context, the new possibilities that Podcast systems offer may be of great help. However, the effectiveness of their use must first be demonstrated so that managers of institutions of higher education and instructors can see the benefits of embarking on this new endeavour. The study presented here is only the beginning, but other 'improvement' suggestions for the future may help pave the way and, therefore, increase its credibility.

Stemming from the experience of just one audio file, the next step could be the testing of a Podcast system by which students would get periodical 'feeds' of valuable information. After all, one example may exert a novelty effect that may not have continuity once students lose interest in the new activity. For that reason, a next project should include several audio files to evaluate its effectiveness over a longer period.

In line with maintaining the novelty effect, or at least to break with the monotony of having just one instructor delivering the lesson, it may be wise to include people other than just the lecturer when recording the audio files. Besides summaries of the lessons, some other more attractive formats could be incorporated in order to increase the likelihood of the files being downloaded. The aim here would be how to have a balanced mixture of interesting yet informative contents. If one thing has been established in the literature it is that endless audio (or video) files that are just repetition of boring lessons delivered in the classroom are bound to be a failure, and needless to say, a complete waste of energy for the enthusiastic instructor who elaborated them. As Janossy's (2007) study suggested, students like relevant, short and clarifying messages. So, 'good things, when short, are twice as good' also applies here.

Other elements not contemplated in the present study, and that could provide new clues for further understanding of the efficacy of audio files, may be explored through qualitative research designs in which students' opinions are gathered. For instance, during the course of the study described here, we knew whether the students downloaded the file or not, but no much more could be added except for that. Aspects such as the reasons for downloading (or not) the file, the difficulties encountered with the document (both of technical origin or understanding of the contents), the perceived usefulness, and contents and formats suggested for the future, should be included in the protocol of qualitative interviews to be given to users and non-users of this technology.

Finally, this pilot study has been performed by the author of this chapter, an enthusiastic defender of the inclusion of new technologies in educational settings. But are all instructors willing or ready to incorporate teaching strategies that are perhaps more demanding than those traditionally deployed? Those who declare themselves against the use of new technologies as teaching and learning aids, argue that the creation of distance-based institutions and of others providers of online educational contents services only serves the purpose of distinguishing the two types of clients in this market. They further argue that those universities with classrooms could not simply substitute the newer ones by adopting their methods. But is it a question of choosing between the physical environment and the completely virtual setting? Is not the blended option, to the extent permissible within the limitations of each institutions resources, a more flexible way to offer new solutions for diverse learning problems?

So far, and with the simple design of just one audio file, we have shown that students' performance can be improved. Now it is the turn of managers to keep projects such as this one rolling until they become part of our teaching activity. This obviously means more support from IT staff, new training courses for instructors, and some investment and faith in the teaching activity *per se*—especially in those environments in which the pressure for getting excellence in research is much higher than for developing a successful teaching career—. While this may sound time-consuming at the beginning, if steady improvements are achieved, we will all one day congratulate ourselves for having made it possible.

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The widespread deployment and use of Information Technologies (IT) has paved the way for change in many fields of our societies. The Internet, mobile computing, social networks and many other advances in human communications have become essential to promote and boost education, technology and industry. On the education side, the new challenges related with the integration of IT technologies into all aspects of learning require revising the traditional educational paradigms that have prevailed for the last centuries. Additionally, the globalization of education and student mobility requirements are favoring a fluid interchange of tools, methodologies and evaluation strategies, which promote innovation at an accelerated pace. Curricular revisions are also taking place to achieved a more specialized education that is able to responds to the society's requirements in terms of professional training. In this process, guaranteeing quality has also become a critical issue. On the industrial and technological side, the focus on ecological developments is essential to achieve a sustainable degree of prosperity, and all efforts to promote greener societies are welcome. In this book we gather knowledge and experiences of different authors on all these topics, hoping to offer the reader a wider view of the revolution taking place within and without our educational centers. In summary, we believe that this book makes an important contribution to the fields of education and technology in these times of great change, offering a mean for experts in the different areas to share valuable experiences and points of view that we hope are enriching to the reader. Enjoy the book!

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