Creative use of podcasting in higher education and its effect on competitive agency[1]

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Abstract

This paper describes an academic experience of podcasting, which involved a group of students of a course on multimedia communication and human-computer interaction. These students acted both as users of the university's podcasting service, and as creators of podcasted lessons. A comprehensive analysis based on the evaluation of the effects on student performance, on data from student satisfaction surveys, from interviews and from instructors' observations provided encouraging results: full-time students co-involved in lessons' podcasting outperformed colleagues of the previous years and achieved higher levels of what we define as competitive agency, that led them to better understand the theoretical issues of the course and to more effective practical skills.

Keywords: distance education and telelearning; improving classroom teaching; media in education; multimedia/hypermedia systems; pedagogical issues

1. Introduction

This paper presents an experience of educational podcasting set up at the University of Bergamo (Italy) for extending and improving its e-learning environment; the extension has been based on a free, open source software library developed at the University of Bergamo and currently used by about one thousand podcasting services around the world. This software environment, called Podcast Generator, is briefly introduced.

Then the paper illustrates an example of application of such environment to a course on multimedia communication, held in the second semester of the academic year 2005 – 2006, which involved the students both as users of the podcasting service and as creators of podcasted or podcastable lessons.

From the analysis of learners' experiences and critical evaluation of educational practice we derive some reflections upon the value of such approach to teaching and learning and we discuss how a creative and active approach can be implemented in improving learning.

These reflections are based on several sources of evidence: the results of the examinations and on their comparison with the results of the previous years; the elaboration of the results of standard customer satisfaction reports filled in by the students; the interpretation of interviews with students; the direct observations of both lecturer and instructors.

The results of our experience provide strong evidence to corroborate the hypothesis of the value of podcasting as a tool to be integrated in an engaging educational context for achieving great educative results.

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2. The Use of Podcasting for Educational Purposes

Podcasting is a method for distributing digital video and audio contents over the Internet. Each of these digital files is called a podcast or episode, and a podcasting service usually posts regularly-produced series of episodes. Each series is accompanied by a special file, the so-called feed, that describes the contents of the podcasting service, and allows users to subscribe to the series and automatically receive new episodes. The subscription is made possible by a specific client application, the aggregator or feed reader, capable of periodically accessing the podcasting server to check the feed and download new episodes, if any. In such a way, podcasting can be regarded as a push technology, since contents are delivered directly by the source to the clients, rather than requiring users to periodically check a web site and download materials. Nevertheless, often podcasters' web sites also offer direct download or streaming of their content, so that newcomers can download archived episodes.

Users can access episodes directly on their computers or on their portable audio / video devices, and most podcast aggregators can automatically synchronise with portable devices. In fact, a characteristic of podcasting is its nomadic style of fruition, which allows users to play podcasts even while travelling or doing something else.

Podcasts are currently available on many different subjects, from music to technology, news to foreign languages, politics to education. The use of podcasting for educational purposes is a rather new idea and opportunity for higher education and its potential is still to be exploited: several universities have set up podcasting, but the literature is still poor of examples, case studies and evaluations, most of them are merely surveys to investigate users' acceptance of podcasting and there is a lack of studies on the effect of podcasting on learning.

On the ground of these few studies, some scholars are sceptical about podcasting: Cann (2007) reports that both quantitative and qualitative analysis of the use of audio podcasts show that these are not popular with students; Deal (2007) summarises that podcasting does not significantly affect learning, at least not if used as a form of pure archive of classroom lectures; similar results had been shown in the recent past for the case of generic lecture webcasting.

On the other hand, other scholars consider their experiments with podcasting a success. For instance, Kurtz, Fenwick and Ellsworth (2007) highlight a significant increase in final project grades of their students; Evans (2008) claims that student are more receptive to learning material provided in the form of a podcast than a traditional lecture or textbook and that students believe that podcasts are more effective revision tools than textbooks, and more efficient than their own notes in helping them to learn; eventually, Barrett, Kuzma, Seto, Richards, Mason, Barrett and Gracely (2006) provide astonishing results achieved applying podcasting to teaching cardiac auscultation.

Somewhere in the middle, Abt & Barry (2007) claim that using podcasts provides little quantitative benefit for students over and above written text used to distribute the same contents; and Malan (2007) says that he received enthusiastic approval from subscribers to his podcasts, but he claims that, for enrolled students, podcasting provides a marginal improvement, and that its true value should be found on its potential to help those who otherwise could not enrol and attend the class, and would be excluded from the educational process.

Nonetheless, many educators consider podcasting as an exciting learning paradigm of impressive pedagogical potential and suitable to improve the teaching style of the lecturers and the quality of their lessons (Brittain, Glowacki, Van Ittersum & Johnson 2006; Cambell, 2005; Cebeci & Tekdal, 2006). Limited technical skills and efforts are enough to produce course lectures, interviews, workshops reports, which can be used to meet individual's learning or teaching needs; students can produce, edit and deliver podcasts by themselves: this can be considered a part of their assignments, a way to foster collaboration, team building and social networking activities (Abt & Barry, 2007).

Moreover, learning through listening is greatly appreciated by those students whose learning style is mainly auditory, while visual learners might benefit from seeing videos from which they can catch teacher's expressions and body language (Honey & Mumford 2006).

Given this conceptual context, the University of Bergamo is trying to exploit podcasting as a new facility to be integrated into its e-learning environment. Since 1999 the University of Bergamo has provided its students with several e-learning services: an e-learning platform for asynchronous activities, where students can find textual documents, audio files for learning foreign languages, exercises with real time automatic check and correction; tools for synchronous lessons; forums where students can discuss with each other and with instructors; web procedures for distributing materials and managing all the bureaucratic aspects of the university life.

Students' feedback shows that these efforts are appreciated for two main reasons:

1. the first reason is rather general and is related to the part time students. As quite common in Italy, we have a high number of part time students, who are very keen on any distance learning facility, which enables them not to commute to the university; furthermore, students declare to appreciate the availability of online tests and assignments, and the ability to interact with lecturers, tutors and other students via online discussion facilities.

2. the second reason, more specific, is related to the recent growth of our University. In fact, the number of students enrolled at the University of Bergamo doubled over the last five years, and this enormous increase caused some structural problems, which could be more easily resolved by means of e-learning services. For instance, the Language Laboratory has been virtually extended by developing on the e-learning platform a large set of lessons incorporating the digital version of the audio and video materials already available at the laboratory and by integrating those recordings with a huge number of exercises which can be performed on-line by the students (several hundreds of lessons for 24 different courses are available on the e-learning site of the Faculty of Foreign Languages and Literatures).

On the ground of this experience with multimedia files and the aforementioned positive feelings about podcasting, we decided to try the podcasting as an educational tool. Therefore, in 2005 we started designing and implementing Podcast Generator (PG), a free, open source library for building and managing podcasting services (http://podcastgen.sourceforge.net) and from there we built Pluriversiradio, a podcasting service for the students of the University of Bergamo, freely accessible in two different ways:

1. via web, as a webcasting portal, from which web surfers can access downloadable or streamed versions of multimedia files (URL: http://www.pluriversiradio.it);

2. through a feed aggregator, as a real podcasting service (RSS feed: http://www.pluriversiradio.it/feed.xml).

A detailed description of Podcast Generator goes beyond the aims of this paper and can be found in Betella & Lazzari, 2007.

Using the first beta release of PG, in March 2006 we created Pluriversiradio, a web site to collect podcasts and to provide web surfers with the proper feeds for getting files from their podcast aggregators. The contents of this site are strictly related to courses, seminars and conferences held at the University of Bergamo.

Despite born as a small size experimental project, Pluriversiradio was subsequently hosted by the Interdepartmental Centre for e-learning of our university, and our software library has been installed and used by about one thousand podcasting portals in Italy and abroad, such as the universities of Aarhus (Denmark), Caen Basse-Normandie (France), Central Queensland (Australia), Delaware (USA), and Pisa (Italy).

3. Podcasts for and from Students

Pluriversiradio has been used during the second semester of the academic year 2005-2006 for two undergraduate courses on multimedia communication and human computer interaction at the Faculty of Arts and Philosophy of the University of Bergamo.

Podcasting was used first of all for recording supplemental educational materials, to extend, deepen or integrate the theoretical lessons and the textbooks; these recordings, lasting from 5 to 15 minutes, did range

from syntheses of the lessons to discussions of a single, specific topic. This kind of use of podcasting was mainly oriented to that large part of students who rarely attend the lessons (distal users): those students may exploit the podcasts as a source of distance learning. Then again, even those students who sporadically attend the lessons (proximal users) may profit by the podcasts for integrating classmates' notes; lastly, those who regularly attend the lessons (central users) use the podcasting as a source of summaries or deepening. Both feedback from students and the analysis of log files tell us that our recordings are mainly accessed just before exams.

Moreover, students were also involved in creating podcasts for the second of the multimedia communication courses that used Pluriversiradio (Laboratory of multimedia communication); the course aimed at introducing students to the foundations of the human computer interfaces, to basic elements of graphics and to the management of audio files for extending the communication capabilities of web pages.

As soon as the students became rather skilled with audio files, we started an experiment with the full time students, who were involved in developing their own podcasts. These podcasts were intended as a means of assessment, and in this sense their target were the course instructors; but they had also to be regarded as an integration of the theoretical materials of the course, and therefore the students were responsible for producing podcasts to be used by their classmates.

The experiment was based on three assignments, the first two being prodromal to the third one, which was the most challenging:

1. for the first exercise, each student was given two files: one was the recording of an interview on multimedia themes (questions and answers) given by the lecturer of the course to a radio station, the second one provided a new set of answers to the same questions; each student had to cut the new answers from the second file and paste them into the first one to substitute the original answers and originate a new interview;

2. for the second exercise, the students had to provide their own answers to the original questions, record them using a digital recorder connected to a personal computer, and paste them into the file of the interview, overwriting the original answers; the students might choose to answer by expressing their own feeling about the topic, or by pretending to be either enthusiastic or sceptical of the technology;

3. for the third exercise, the students, working in groups of two or three, had to prepare a podcast about one of the themes of the theoretical course which had not yet been presented by the lecturer: subjects did range from the functions of web objects to the categorisation of web sites, from videogames to text transmission. Students were given some constraints (duration, sampling rate, bit rate), but were rather free to face the topic, to deepen the subject beyond the limits of the course references, and to choose their favourite format for the recording, provided that they had to choose the most appropriate design metaphor to create an effective lesson, profitable for their colleagues: some of them arranged a formal lesson, others simulated a moderated radio debate, others a desperate phone call between two friends the night before the exam.

The course instructors supported the students by providing task assistance, solving technical problems and promoting students' teamwork skills; students were also able to interact with each other through a forum provided by the university's e-learning platform, where they were free to post questions and answers and exchange experiences. The forum was constantly monitored by the instructors, but the students were encouraged to answer by themselves to the questions posted by their colleagues.

At the end of the semester those students who had produced all three podcasts were directly admitted to the oral examination; the others had to pass a preliminary test on their skills on multimedia programming.

4. Results

First of all, it must be noted that our analysis distinguishes between part time and full time students, but we have not been able to split the former into the two classes that we called "distal" and "proximal" in the previous paragraph. This is due to the fact that we were driven to analyse data about the experience of

podcasting when we noticed that student performance seemed rather better than in previous years: at that point we could only use data about exams or course satisfaction surveys, but we did not have, nor could be any more able to obtain, any information about course attendance, except for the evidence provided by the production of podcasting by full-time students.

The starting point of our analysis was given by exam results: they are one out of several criteria commonly used in evaluating student performance, and in reference to this experiment they serve as a readily available measure; student performance was evaluated by comparing exam grades over three academic years. As for the validity of their use, we have verified that the composition of the group of students under evaluation was very similar to those of the previous years with reference to the distribution of several variables, such as age, gender, proficiency level, schooling background. The same applies to the use of satisfaction surveys, which were performed according to standardised acquisition procedures.

We examined exam results with two goals in mind:

1. to determine if there were any significant differences in student performance with reference to the past two years;
2. to understand if there were any significant differences between the students involved in the experimentation (full time students) and the other ones.

Any difference found in the results should be ascribed to the introduction of podcasting, since the other variables, such as textbooks, lecturer and laboratory instructors, environment and students' profile did not significantly change from previous academic years.

Table 1 shows a comparison of the average grades of the students who passed the exam of "Laboratory of multimedia communication" over three consecutive academic years (Italian university grades range from 18 to 30): figures highlight that the results of the year 2005-2006 are undoubtedly better that the previous ones.

In order to interpret these data, we evaluated the effect size (Cohen's d) according to group mean differences: we designated the students exposed to podcasting as the experimental group, while those of a previous year served as the control group, and then we evaluated Cohen's d as the result of the ratio between the difference of the means of the two groups and the standard deviation of the control group.

Checking the scores of 2005-2006 against 2004-2005 we obtained a d value of 0.35: according to Cohen (1988), it corresponds to a small effect (on a scale 0.00-null, 0.20-small, 0.50-medium, 0.80-large); this effect could be considered educationally significant, since it is greater than 0.25 that, according to Slavin (1990), represents the threshold for educational significance.

Unfortunately, the study of the variance of our data by means of the ANOVA method (Bohrnstedt & Knoke 1994) did not provide enough evidence for supporting the idea that the variations are due to differences between the educational methods applied: by using the three groups of students shown in Table 1, we got a calculated F value of 1.47, while the critical value of F for $\alpha=.05$ to reject the null hypothesis (Ho : $\mu_{2004} = \mu_{2005} = \mu_{2006}$) would be about 3.05.

Therefore, although the impact on the treatment group looks promising, some caution is warranted in interpreting the effect size by itself, because the effect could have been the result of chance, even if it looks practically meaningful (Fan, 2001).

If we split the results in two, by separating the grades of full time students, who took part to the experiment, and part time students, at first sight the data highlight two main phenomena:

1. full time students usually perform better than part time students;
2. part time students provided in 2006 results similar to those of the past years, whereas full time students achieved a considerable increase.

This successful performance is even more significant since grades for this exam are usually rather high, because of the characteristics of the enrolment (students select the course deliberately and it is the final step of their curriculum on publishing, and therefore they are very motivated), and therefore there is limited room for improvement, which induces a sort of ceiling effect.

The analysis of data related to full time students provided an effect size of 0.6 (2006 vs. 2005) and 0.85 (2006 vs. 2004); with reference to Cohen's scale these results can be classified as medium or large effect respectively, and in both cases they are largely greater than Slavin's threshold for educational significance.

In this case the result is reinforced by the application of the variance analysis, since the ANOVA method generated an F value of 4.39 (2006 vs. 2004), the critical value being 3.1 for $\alpha=.05$: these findings support the hypothesis that there was a significant improvement of grades due to the new educational method applied during the academic year 2005-2006.

Although student performance is a significant gauge of the outcome and suitability of a course, student satisfaction surveys are important for casting light on students' feeling and derive some hypotheses for the continued success of an educational program.

Therefore we analysed data from the standard student satisfaction surveys that are part of the institutional audit process of the University of Bergamo. Students were asked several questions and their answers could range from 0 (strongly disagree) to 10 (strongly agree). For the purpose of this case study, only a subset of the questions is shown: those related to structural, logistic or bureaucratic topics were discarded, as well as students' personal data, but their comparison with data gathered in the past ensured the validity of our sample.

Table 2 shows the "satisfaction scores" for the course over the last three years, on a scale ranging from 0 to 10: the improvement is rather clear, and the main causal factor that significantly changed from 2005 to 2006 was related to the use of podcasting.

Similar considerations arise from the analysis of Table 3, that compares the scores of the three courses taught by the author in the academic year 2005-2006 and checks them against the mean and maximum value (for each topic of the quality assessment) over the whole set of courses of the Faculty of Arts and Philosophy.

The results, which move the "Laboratory of multimedia communication" to the top of the ranking, can be explained by the new structure of the course, which was not chosen for the other two courses.

In addition to these analyses, a questionnaire similar to that presented by Evans (2008) was administered to the full time students (see Appendix; questions to profile the student are not shown; we discuss here a subset of the questions). Using a five-point Likert-scale, with values ranging from 1 (strongly disagree) to 5 (strongly agree), students had to say whether they think that studying and revising using podcasts is quicker or more effective than using textbooks or class notes. They had also to say whether producing podcasts helped them for the theoretical and the practical part of the exam. Moreover, we asked them their opinion about using podcasts if they were responsible for a course on multimedia communication, or on their favourite subject.

For interpreting significant differences between different delivery systems (podcasts, textbooks, class notes), we used the same statistical framework proposed by Evans, that is a one-tailed Wilcoxon signed rank test for pair-wise comparison. The choice of the one-tailed test was due to the fact that the experimental hypotheses are directed, since we predicted higher rankings for answers related to podcasts compared to the other systems.

Our analysis highlights that textbooks are considered slightly more effective when studying a subject, whereas podcasts and notes are more significantly preferred for reviewing something already learned in preparation for an exam (Z=-2.725, Significance=.006, p<.05).

In contrast with Evans, we found that there is a significant preference for notes rather than podcasts as a quick tool for revising (Mode 5 average 4.1 vs. mode 3 average 3.3; Z=-2.640, Significance=.008, p<.05). The difference could be explained with a different interpretation of the term "revision", which was taken by our students as the process performed the night before the exam, when scanning a whole audio file may be perceived as a time consuming activity.

Students feel that producing podcasts was very useful for acquiring competences and skills in multimedia manipulation (averge 4.5 standard deviation 0.7) and for learning the theoretical issues of the course (average 4 standard deviation 1,1).

As far as using podcasts for "their" personal courses, students state that if they had to teach a course of multimedia communication they would be favourable to deliver their whole lessons (average 3.7), short supplemental materials (average 4.3), and podcasts made by students (average 4.4). Should they teach their favourite subject, rates are rather similar for podcasts made by the lecturer (3.6 and 4.2), but sensibly smaller

for podcasts made by students (3.7); in this case, subjects range from foreign languages (highest scores) to geography, history of cinema to theoretical philosophy (lowest scores).

Finally, some form of qualitative analysis, based on the grounded theory (Strauss & Corbin, 1998), was conducted on transcriptions of colloquia with students and on their open answers to the student satisfaction questionnaire.

After codifying these materials, some concepts clearly arose: among them the *ease of use* of podcasts as educational materials; their *efficacy*; the idea that lecturers and instructors might *take care* of their students through podcasts even when they *miss a lesson*; the *stimulus* provided by listening to *peers*; the *challenge* of explaining theories to *peers*; the *enthusiasm* generated by the feeling of being part of the multimedia *production process* necessary to develop a new *learning strategy*; the importance of choosing the *proper language* and a reasonable *time span* for recordings; the necessity to *profile perspective listeners*; a *deeper interest* for the subject of the course and an *increase of motivation* to learn.

Trying to summarise, in these interviews students affirm that the availability of lecture podcasts had a positive impact on their learning process and that it reduced their stress before the exam; withal, they declare to have been stimulated by the challenge of recording their own podcasts, that they felt compelled to better understand the issue they had to deal with their podcast and that they did listen to the podcasts published by their colleagues and got from them useful hints. Moreover, several students noticed that while developing their podcasts they spent time to reflect about their work and not only about the topic of their recordings.

These claims correspond to what observed on site by both lecturer and instructors: students did work with an open minded approach, taking care of their users when producing podcasts, listening carefully to lecturer's recordings (some tracking ideas not introduced during the lectures and recorded into the audio files were regularly and properly discussed by students when asked), actively cooperating with peers when using laboratory facilities for recording their own podcasts, showing a mature and proactive approach to learning.

5. Discussion

At first sight, two apparently clashing ideas seem to arise from the analysis of the quantitative results shown in Table 1:

1. the grades of the part time students provide evidence for claiming that the distribution of course materials through podcasting did not affect the results, and therefore that the use of podcasting for the purpose of supporting learning is pedagogically neutral;

2. the grades of the full time students suggest that their *involvement* in creating podcasted lessons enhanced their learning experience in a very effective manner (Smith, Sheppard, Johnson & Johnson, 2005).

In the following, we shall try to demonstrate that, even if the two assertions could logically coexist, the latter is supported by the data of the experiment, while the former could be confuted by using some knowledge about the context.

With reference to the first hypothesis, data from part time students could be interpreted as an evidence of the failure of the podcasting itself. On the other hand, they could simply suggest that, despite the large number of visitors to the lecturer's site (more than 140 000 unique visitors a year), part time students did not look at the list of files recorded by their colleagues and ignored those integrative documents.

This latter interpretation can be strengthened by noting that the syllabus of any course of the faculty had to be published prior the beginning of the academic year, in July, whereas the development of the podcasting service began some months later, the course started in February, and the decision of using podcasts was taken in March – at that point, in order not to violate the educational pact defined by the syllabus, the listing of the required textbooks and materials could not be modified any more and the podcasts were simply proposed as additional (not compulsory) bibliographic materials, accessible through links from the lecturer's site.

Therefore, instead of using data about part time students against the educational value of podcasting, we could more reasonably state that probably the podcasting portal was not known to the part time students, and

that the podcasts were not evident enough within the lecturer's site, as a subsequent usability test pointed out. On the contrary, some new data which we are currently gathering with reference to more recent distribution of podcasted materials seem to provide new evidence for the use of podcasting.

On the other hand, with reference to full time students, by data and observation we can say that podcasting design, recording, and editing spurred the development of reflective learning skills, stimulated students to go deep into the questions they had to face, and fostered positive collaborative behaviours, promoting the growth of students' collaborative learning skills.

Against this conclusion it could be argued that positive results depend on the number of students enrolled in the course, which dramatically decreased, for organisational reasons, from 2005 to 2006. In fact, according to Glass and Smith (1979), reduced class size would be expected to produce increased academic achievement and the major benefits from reduced class size are obtained as the size is reduced below 20 pupils. Besides noting that there is no general agreement on this subject (Slavin, 1989), we have to point out that when the number of students was higher, they were split into two groups and therefore the student / instructor ratio was approximately the same.

Finally, it could also be argued that the results were influenced by some kind of Hawthorne effect, that is an increase in student performances produced by the psychological stimulus of being singled out, made to feel important and part of something new (Gillespie, 1991); or by a form of Rosenthal effect, or teacher expectancy effect, that is an increase which is generated simply because students are expected to do better (Rosenthal & Jacobson, 1968).

In that respect, we have to stress that even the students of the previous academic years experienced something completely new for them and their curricula, that is the practical development of multimedia applications. As a matter of fact, this form of learning by doing is pretty new for our students of the Faculty of Arts and Philosophy, who are more accustomed to receiving information previously packaged and predigested by lecturers and textbooks; the experience itself of working on a laboratory, which is rather standard in engineering curricula (Feisel & Rosa, 2005), is something that constitutes a novelty for our students.

Furthermore, students were not aware of being tested, because the idea of reflecting on the course experience was suggested after its conclusion by the first astonishing results of the exams, which were beyond any expectation. Lastly, the introduction of podcasting had not been felt in advance by the lecturer and the other instructors as an improvement suitable to generate effects greater than those fostered by other technologies introduced in the previous years, and therefore students should not have been affected by any beneficial nor detrimental influence.

With regard to the results of the survey, it should be noted that the amazing evaluation of the "opportunities to meet faculty" can be explained by the combined positive effect of the availability of an online discussion forum, of the podcasted lessons and of the sense of community fostered by the cooperation with other students, faculty and instructors to build the set of podcasted lessons (McMillan & Chavis, 1986). This supposition would agree with Astin's correlational study of what matters in college (Astin, 1993), involving more than 20 000 students, which found that the environmental factors that are the most predictive of positive change in college students' academic development and satisfaction are interaction among students and interaction between faculty and students; according to Astin, these factors affect education outcomes more than any other environmental variables studied, including the curriculum content factors.

It may be useful to note that from the huge set of data related to the whole faculty we have spotted a correlation between the "overall satisfaction" and other issues (correlation above 0.9). This correlation might explain why the same classrooms and laboratories can be evaluated so differently from one year to the other, even if some part of the increased score could be attributable to the use of audio devices for podcasting. The same influence probably applies also to the feeling of "cultural enrichment", that usually is difficult to be affected by computer science courses in a faculty of humanities. Nevertheless, this feeling could be ascribed to a more intense learning experience, which increases the sense of auto-efficacy of the students (Bandura, 1982; Bandura & Schunk, 1981).

A key issue is that students declared that the course required limited effort: this shows that the improvement of the performance was not detrimental in terms of overwork and has not subtracted time from other activities and courses.

As for the data gathered from interviews and questionnaire, the results emphasize the impact of the creative use of podcasting on the perceived quality of the course, but also on the ability of the students to assess their own understanding of the topics of the course and to deepen their competence beyond the walls of the classroom, through a metacognitive practice that enhances their learning process (Flavell, 1976). Students' achievements in terms of domain knowledge acquisition are the result of a classic constructivistic educational process, where knowledge is produced through an active process by the learners themselves, is strictly linked to a real context and is achieved by means of forms of collaboration and social negotiation (Jonassen, 1994). According to several experiences shown in literature (Pascarella & Terenzini, 1991; Light, 2001), the high level of knowledge acquisition is related to the strong commitment of our students fostered by their high level of *engagement* within the podcasting project.

We do believe that, even if the inherent educational impact of podcasting is not necessarily significant, its use in an appropriate and challenging educational context can influence the quality of the learning experience and help students achieve good results.

Furthermore, those students, who are involved in designing, developing, recording and publishing lessons, experience the perspective of being listened to and evaluated first of all by peers (their colleagues) and then by web surfers and podcasting listeners: while the first scenario can be rather common for courses with a restricted number of attendees, which often may require students' active participation, the latter scenario is something new and challenging for our students. Recalling Bruner's ideas (1990), we think that the narrative dimension of the public performance compels students to an extra-effort which acts on what we define as their *competitive agency*, that leads them to a more intense and effective learning process, well beyond the simple assimilation of concepts or even their re-elaboration, up to the search for the meaning of what they are studying. This effort implies a sensible increase of their feeling of self-efficacy (Bandura 1982) and, if adequately driven by instructors, it may allow students maximise the exploitation of their zone of proximal development (Vygotsky, 1978).

6. Conclusions

An experience of creative use of podcasting to support courses on multimedia communication has been shown.

Quantitative analysis of exam results does not provide enough evidence for any significant impact on learning, if we take into account the whole population of students (full time + part time). On the other hand, both quantitative and qualitative analysis of exam results, satisfaction surveys and interviews not only highlight the full time students' involvement in podcast producing, but also that this involvement improves students' performance, promotes cognitive elaboration, and enhances their critical thinking.

These results suggest that involving students in producing their own short lessons can be an effective way to integrate traditional teaching, at least for courses related to multimedia communication and production. Students find this experience challenging, interesting and fruitful. Moreover, they seem to agree using podcasts as integrative and supplemental materials. According to students, even other disciplines would profit by the use of podcasting, mainly the teaching of foreign languages.

Further investigations should better address the real impact of podcasts on the learning process; for this purpose, we are working on the aspects related to the quality of the podcasts, that is quality of the production environment (recording and editing), quality of the product (content and communication style), quality of the distribution environment (paratext and management). With regard to this last issue, we are developing a meta-tagging methodology based on a formal podcasting ontology, so that future podcast aggregators might filter materials on the ground of users' preferences.

7. Acknowledgments

Appendix

The questionnaire administered to full time students

Where not otherwise indicated, use the following scale:

(1) strongly disagree (2) disagree (3) neutral (4) agree (5) strongly agree

a. How many times did you listen to my podcasts? (0) never (1) once (2) twice (3) three or more times
b. How many times did you listen to podcasts of your colleagues? [on average over the whole set] (0) never (1) once (2) twice (3) three or more times
c. Which device did you use normally for listening podcasts? (1) PC (2) iPod (3) other mp3 player
d. Did you use any alternative device? (0) No (1) PC (2) iPod (3) other mp3 player
e. I listen to podcasts while travelling
f. I listen to podcasts while doing something else
g. Reading from my class notes is an effective way to study
h. Reading from textbooks is an effective way to study
i. Listening to podcasts is an effective way to study
j. Reading from my class notes is an effective way to revise
k. Reading from textbooks is an effective way to revise
l. Listening to podcasts is an effective way to revise
m. Reading from my class notes is a quick way to revise
n. Listening to podcasts is a quick way to revise
o. Should I teach "Laboratory of multimedia communication", I would podcast my lessons
p. Should I teach "Laboratory of multimedia communication", I would podcast summaries or deepenings
q. Should I teach "Laboratory of multimedia communication", I would ask students record their own podcasts
r. Should I teach my favourite subject, I would podcast my lessons
s. Should I teach my favourite subject, I would podcast summaries or deepenings
t. Should I teach my favourite subject, I would ask students record their own podcasts
u. I think that producing our own podcasts helped me learning multimedia manipulation
v. I think that producing our own podcasts helped me learning multimedia theory
w. How long should be an effective educational podcast? (minutes)

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Table 1. Average grades (min 18 – max 30)

	2003-2004	2004-2005	2005-2006
Average Grades (μ)	28.1	28.1	28.7
# of students	66	98	30
Standard deviation	1.7	1.8	1.7
Cohen's d 2005-2006 vs. 2004-2005		0.35	
Critical F Ho: $\mu_{2004} = \mu_{2005} = \mu_{2006}$ α=.05	3.05		
Calculated F	1.47		
FULL TIME STUDENTS			
Average Grades (μ)	28.4	28.7	29.4
# of students	36	41	17
Standard deviation	1.2	1.1	1.2
Cohen's d 2005-2006 vs. 2004-2005		0.6	
Cohen's d 2005-2006 vs. 2003-2004	0.85		
Critical F Ho: $\mu_{2004} = \mu_{2005} = \mu_{2006}$ α=.05	3.1		
Calculated F	4.39		
PART TIME STUDENTS			
Average Grades (μ)	27.7	27.6	27.7

Table 2. Scores for the course of Laboratory of multimedia communication over the last three years (min 0 – max 10)

	2003-2004	2004-2005	2005-2006
opportunities to meet faculty	8.9	8.7	10.0
cultural stimuli from faculty	8.5	7.4	9.7
qual. of teaching: faculty	8.3	7.9	9.1
qual. of teaching: instructors	8.3	8.3	8.9
usefulness of laboratory work	8.6	8.2	9.2
qual. of classroom/lab facilities	9.1	7.6	9.9
interest for course contents	8.4	7.9	9.3
overall quality	8.6	7.6	9.4
cultural enrichment	8.5	7.5	9.1
overall satisfaction	8.4	7.8	9.4

Table 3. Scores for the courses on computer science compared with mean and maximum scores over the whole Faculty of Arts and Philosophy (min 0 – max 10)

LEGENDA:
101: Foundations of computer science;
MC1: Introduction to multimedia communication;
MC2: Laboratory of multimedia communication;
I s: first semester; II s: second semester

	101 (I s)	MC1 (II s)	MC2 (II s)	mean I s	max I s	mean II s	max II s
opportunities to meet faculty	9.1	9.0	10.0	8.3	9.6	8.2	10.0
cultural stimuli from faculty	8.1	8.1	9.7	7.5	9.3	7.5	9.7
qual. of teaching: faculty	8.5	8.1	9.1	7.7	9.3	7.8	9.2
qual. of teaching: instructors	n.a.	8.2	8.9	6.9	8.1	7.2	8.9
usefulness of laboratory work	n.a.	9.2	9.2	7.2	8.5	7.5	9.2
qual. of classroom/lab facilities	7.1	8.6	9.9	6.7	9.3	7.1	9.9
interest for course contents	7.4	7.7	9.3	7.8	9.4	7.8	9.3
overall quality	7.9	8.1	9.4	7.5	9.0	7.5	9.4
cultural enrichment	7.7	8.1	9.1	7.7	9.4	7.7	9.3
overall satisfaction	8.2	8.2	9.4	7.7	9.3	7.7	9.4