ARTICLE

OpenFING: A Project based on a Digital Library of Recorded Courses

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The OpenFING Project is an initiative by students for students, based on the creation and use of a digital video library of higher education courses, where students record video from standard lectures. The project attempts to address issues such as overcrowded lecture halls and students who work full time and thus cannot attend normal lectures.

Today OpenFING seeks its consolidation along with an undergraduate introductory course on audio-visual and multimedia production. The project must be considered as a basis on which professors and students can develop teaching and learning innovations respectively, including different computer tools to support teaching and learning. In this article we describe the current status of OpenFING, six years after its creation; we describe the first study of how students and teachers perceive the initiative; and we conclude suggesting further developments.

Introduction

Many universities broadcast their courses openly on the internet as part of a policy that embraces the publication of imparted knowledge (some examples are the Massachusetts Institute of Technology's OpenCourseWare (Massachusetts Institute of Technology, 2018) and The Open University's initiative OpenLearn (The Open University, 2018)). At the same time, private organisations also publish courses (Khan (Khan Academy, 2018), Udemy (Udemy, 2018), etc.). The open policies may change from one site to another, and the resources can be video-based, as well as slides- or text-based, but most of the resources use video. This variety of available resources promotes the implementation of new teaching and learning methodologies, such as blended learning (Ifenthaler, 2012; Seel, 2012; Jones et al., 2011) and flipped learning (Bergmann and Sams, 2014, 2012).

This paper is written by students, teachers and learning technologists who collaborate in the development of the OpenFING Project at *Facultad de Ingeniería* (FING), which is the Engineering school of the *Universidad de la República* (UdelaR), the major university in Uruguay. UdelaR has some philosophical pillars imposed by its organic law, the constitution of the country and cultural background:

· Public education, from pre-school to higher, must be free of any fee to any person living in the country.
· UdelaR must be open to anyone who has completed secondary education.
· UdelaR must engage in teaching, research and also social impact projects.
· UdelaR is co-governed: it is led by a rector and two committees: one dedicated to main strategic and academic issues like curriculum, and one dedicated to more operational tasks such as teacher appointments, budgets and political issues. Teachers, students and alumni, as full members, form these committees. This structure is replicated in each school.

FING has that same structure and principles. The culture and context of our country have some consequences in the school:

· The main budget of UdelaR is government-based. Therefore, the budget is limited and FING's budget is no exception.
· FING is a large faculty. Uruguay has a population of 3,000,000. In 2016, FING had more than 9400 enrolled students and more than 900 teachers to cover 20 programmes in Engineering, including Computer Science.
· The involvement of students at any stage is expected and welcomed.
· A lot of students also work full time.
· The lecture halls for the initial years of most programmes are overcrowded.
· Most FING courses have two mid-term exams with a

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pass mark of 60%. A lower score prevents the student from taking the final exam.

· In line with UdelaR's principles, a teacher must be a professor and a researcher, and also be involved in governing the institution, having to deal with administrative tasks. As stated above, some courses are oversubscribed, which increases the number of tests to mark. In this situation, teachers tend to display burnout symptoms: they usually use expressions such as, 'I have no time to do anything new.'

OpenFING is essentially a digital video library of standard lectures or masterclasses. The project emerged from a student's initiative: recording courses and publishing the videos openly on the internet. Originally, the use of videos was regarded as a support for the personal study of the student, not as a substitute for the classes. However, the digital resource also addresses issues such as overcrowded lecture halls and the attendance of students who also work full time. Also, the project is a means of introducing innovation in educational strategies, such as the flipped learning model, used in various parts of the world with good results from a learning point of view (Bergmann and Sams, 2014, 2012).

In order to sustainably support the OpenFING project and the continuous participation of students, in mid-2016 the course Introduction to Audiovisual and Multimedia Production (IPAM) was created, awarding credits for FING's degree programmes. This allows students who participate in OpenFING to learn digital skills related to the use of cameras and non-linear video editing, as well as the development of other digital educational resources.

The main objective of this paper is to share OpenFING's experience and tasks planned for the project's evolution. The aim is to improve academic level and enhance the learning experience, taking advantage of the participants' efforts. A short preliminary version of this work was presented at LACLO-WREA, La Plata, Argentina, 2017.

The paper contains the following sections: Section 2 presents how OpenFING operates; Section 3 describes the IPAM course; Section 4 describes educational experiences that are being developed by considering the integration of OpenFING in teaching and learning processes; Section 5 introduces students' perceptions of OpenFING and the opinion of teachers; Section 6 considers related work; Section 7 presents the conclusions, further research and development.

OpenFING

OpenFING was created in 2012 as part of an undergraduate thesis in Computer Science (Parodi, 2013), with the intention of providing support in teaching and learning activities using a Semantic Web Technologies platform based on videos. The initiative attempted to solve the problem that a large percentage of students have: most cannot attend classes regularly or must do so in overcrowded lecture halls. Having the complete classes recorded on video and available on the web allows students to follow the course online at their own convenience. The initiative also sought to provide an additional tool for students to prepare for their tests, particularly during exam periods.

Nowadays, the OpenFING platform (OpenFING, 2018a) has more than 60 filmed courses (mainly at undergraduate level), making a total of more than 1300 individual lectures. What differentiates this initiative from others is the number of volunteers that have participated: over 80 people including IPAM students.

Between 2013 and 2015, a camera and video editing workshop was held each semester. These workshops were attended by some students enrolled in the Computer Science degree, which prompted the degree directors to assign academic credits to those students who had recorded or edited a course. This was a way to encourage student participation in the OpenFING project. Approximately 40% of the regular courses of Computer Science degree were recorded and published by OpenFING in that period. Also, the option of recording new optional courses was added every semester. It must be understood that nearly 50% of all FING students are enrolled in a Computer Science programme; accordingly, recording those courses turned out to be a high-impact action. From 2016 until now, academic credits are obtained through the IPAM course (see below), and the contents cover further academic programmes from FING.

Accomplishing the organisation of such a complex schedule has certain logistical challenges; thus every semester important decisions have to be taken by the coordinating group:

· Which courses to be recorded needs to be agreed, involving authorisation from the corresponding teachers and planning for the use of equipment (cameras, microphones, memory cards, tripods). If the teachers refuse their permission to have lectures recorded, then the course goes back to a queue of courses that may be recorded the following period.

· Agreement must be reached on how the course should be published. It is either published on the public OpenFING site or in the Virtual Learning Environment (VLE) where only teachers and students can access it.

· The coordinating group needs to recruit FING students who are interested in participating in OpenFING, and establish who records and edits each course. The recruitment campaign is run using OpenFING's Facebook page and the official FING website.

· During the semester, coordinators need to keep in touch with those students who are filming and editing the lectures, making sure they are performing their tasks in a right and committed way. The editing process is carried out by groups of four students. The task list is defined and distributed among the group members.

· All equipment needs to be checked to ensure good performance. Before each lecture scheduled to be recorded, students check every camera, microphone, battery pack and memory card and their availability.

The members of this team are mostly committed students who remain working on the project for some years, and pass on their knowledge to new members. Recently, FING

started to pay a small stipend to two of them, and also had a staff member from *Unidad de Enseñanza* (UEFI) – a centre for teaching and learning development at FING – join the team. The recording and editing tasks are carried out by students of the IPAM course. Also, volunteer students participate of their own accord, receiving no academic recognition or payment.

The strength of OpenFING's working model is the students' involvement in the recording and editing of lectures. For example, during the recording they must decide if the teacher or the blackboard must be on frame at a particular time. It is mandatory for the student to have certain knowledge of the lecture topic to do this. The cameraman's knowledge of the topic is essential. For this reason, it is necessary that students in a recording team have previously taken the course. This form of organisation is considered an added value when compared to a lecture recorded by a standalone, fixed, big long shot. This fixed model is for example used by *Facultad de Psicología* (Psychology School of UdelaR), or when the recording is done by people who have no knowledge of the course to be filmed.

The OpenFING streaming model is based on an Open Education workflow and on the collaboration between professors and students. The courses are available in digital format, under a Creative Commons open license (BY-NC-ND 4.0). This increases the opportunities for studying and learning, and also the visibility of the University's production. Since 2013, following international trends, UdelaR's governing body is internally promoting the adoption of policies intended to implement more use of open virtual resources. The use of Free and Open Source Software (FOSS) and the creation of an Open Access repository, plus a series of policies aimed at opening up education, allow the material to be used by anyone, democratising access to knowledge. With more than 110,000 undergraduate students (*Universidad de la República*, 2013) and close to 11,000 teachers (*Universidad de la República*, 2016), the University accounts for the vast majority of the country's total student enrolment, and is considered the main site for the promotion of Open Access and the development of Open Educational Resources (OER). Compared to other South American countries, Uruguay seems to present an enabling environment for Open Education (Hodgkinson-Williams and Arinto, 2017).

OpenFING has been adopted by students as an additional study tool. The following statistics were collected using Piwik (Matomo, 2018) between October 2014 and July 2017, and show the growth in unique visitors to the site (**Figure 1**).

The current and future platforms

The OpenFING platform was intended to be a collaborative tool based on a variety of materials, but focused on the videos of lectures. The project has a platform with a server which is integrated into the server pool of FING. In this pool, three services are executed: a video server, a production web server and a development web server. These servers are managed and maintained by the *Unidad de Recursos Informáticos* (Information and Communication Technologies Unit) of FING, in coordination with a Computer Science professor and a volunteer student. There is also another dedicated computer used for exchanging footage between cameramen and editors, as well as for other tasks (post-editing, viewing, graphics).

A new version of the platform is being developed, which includes mechanisms of comment's moderation, together with an easier way to publish videos and an independent chat room. Also, some additional tools might be added, like a Cornell Notes editor and some data analysis process in order to monitor learning and teaching activities. We expect to have an updated platform soon with a collaborative mechanism and facility to relate topics in different videos. Moreover, functionality to add notes to a video will be developed in order to manage teaching in a better way.
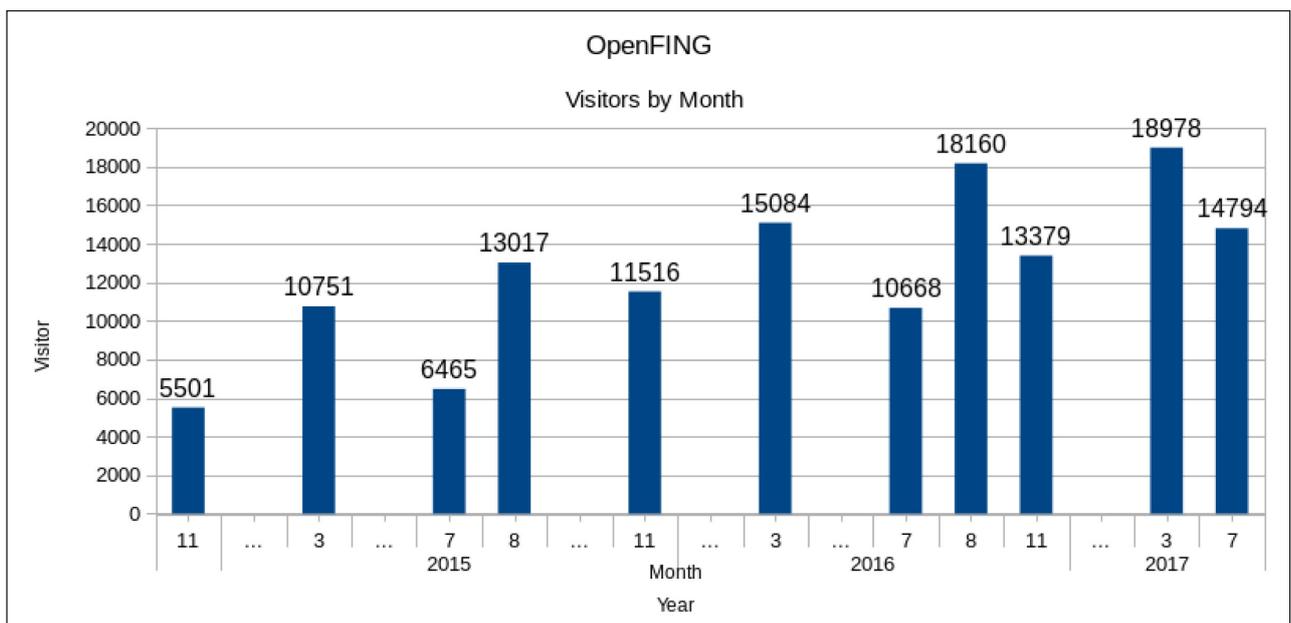

Figure 1: Visitors by month.

It is expected that these strategies will have an impact on student learning, by providing a space for reflection and exchange of different points of view on the content of the courses. The objective is to transform the project into an effective collaborative and interactive learning platform.

IPAM: Introduction to Audiovisual and Multimedia Production course

In 2016 the deanery of FING, learning technologists from the UEFI, the responsible professor for the project at the *Instituto de Computación* (InCo) – the Computer Science department at FING – and staff from the *Facultad de Información y Comunicación* (FIC) – the School of Information and Communication of the UdelaR – started to work together around OpenFING to generate an optional undergraduate course in response to three observed problems:

· the sustainability of OpenFING over time
· the lack of basic audiovisual knowledge and production skills among engineering students
· the differences in quality of OpenFING outputs.

The aim of the course is to develop the ability to create learning resources in various formats, developing skills of content hierarchy, design, production of original materials and therefore communication and digital literacy skills (Littlejohn et al., 2012). The theoretical–practical course is offered to students in different FING programmes, as well as those from other schools. Students enrolled in IPAM work in teams. In summary:

· they engage in the recording and editing of a regular undergraduate or graduate course of FING, to be published in the OpenFING digital library
· they produce an audiovisual or multimedia resource related to the courses, programmes or research, or develop topics of interest for FING, intended to be used both by students and staff.

Multimedia resources, based on hypertext and non-linear products with an interactive structure (Littlejohn et al., 2012; Tomàs i Puig, 1999), set a strong frame for the development of personal learning strategies. These types of resources are aligned with the future plans for the OpenFING platform. IPAM encourages the development of OpenFING, as well as the production of other open educational resources like multimedia content. General knowledge on communications and audiovisual production is imparted by FIC teachers. Detailed information about the course, including its programme, is available online at the VLE site of the course: IPAM-EVA.

Implementing new methodologies to support teaching and learning

Higher education continues to be generally centred on the transmission of information by the professor to the students, although in recent decades emphasis has been placed on changing this situation and thinking of strategies that situate the learner at the centre of the educational process (Goodhew, 2010; Fink, 2003). In particular, FING teachers usually have three types of interaction with students:

· A *theoretical class*. The classic lecture with a teacher explaining mainly theoretical concepts.
· A *practical class*. A teacher or a teaching assistant explains the solution of exercises on the blackboard.
· A *query class*. One or more teaching assistants check with a small group of students (may vary from 15 to 50) the exercise resolutions that students present. This strategy is not developed on all courses.

Staff spend most of the contact time with content explanations; thus the interactions between teachers and students are limited. Also, in this context the role of students tends to be very passive. The conditions of massive attendance in which the courses are developed, in particular from first semester to sixth, seem to be an obstacle to implementing innovations in teaching. At an international level, the need to transform the relationship between teaching and learning of engineering is shared, emphasising the active role of the student (Goodhew, 2010; Biggs and Tang, 2011).

In order to integrate technology and resources to achieve more active teaching and learning practice, professors need to redesign their course methodologies. The following paragraphs describe experiences that represent successful cases in FING.

In 2015, the Discrete Mathematics course was offered in a blended learning format, using the classes that were recorded previously in 2014. The new version of the course presents changes that modify two aspects of the traditional course: the way in which the teacher leads the class and the way a participant studies. Each week, the learners had online sessions to prepare for class, with topics, notes, books and recorded lectures on the VLE platform. In addition, practical exercises and periodical consultation classes were offered. The experience was positively evaluated (Otegui and Pereira, 2017). In particular, although the approval scores did not vary, similar results were obtained with fewer teaching hours, allowing the course to run in both terms.

In 2017, an alternative modality was developed for the Logical Mathematics course (required for Computer Science students in the third semester). In parallel with the traditional course, the alternative was offered to a subgroup of students. The new modality focused on promoting students' active work using a flipped learning approach. Tasks that students usually performed at home were performed in class and vice versa. The teacher's theoretical lecture was replaced by the availability of other resources, such as lecture videos, class notes and books. Class time was then dedicated entirely to interaction activities, such as discussing the issues students found difficult and working on practical exercises. This strategy transforms the class into an exchange, contact and engagement space. In this experience, the following resources were integrated: VLE, recorded lectures of the theoretical content available on OpenFING, and the use of specific software. These resources facilitated the student–teacher

exchange of information prior to the face-to-face classes. The software used was a prototype developed by the students of a programming course and complemented by functionality added by the teaching team. The software consists of a tool based on the Cornell Notes model; it provides students with a space to record relevant ideas, summaries and questions about the videos, the bibliographic material and the exercises to solve in each class (Bergmann and Sam, 2012). The teacher received the digital Cornell Notes generated by each student weekly, and prepared the classes accordingly, based on the issues or difficulties they had raised and their summaries.

The academic results of the new modality of the Logical Mathematics course show an increase in the percentage of students who obtain the needed credits without the final exam. From the student opinions gathered in surveys, the vast majority positively valued the modality. They highlight aspects of its design: first, the theoretical content was sufficient from the available materials; second, difficulties could be reviewed in class; third, compulsory attendance and scheduled deliverables favoured continuous work as well as group dynamics. From the teaching point of view, the experience was ranked as very positive. The increase in contact time with students allows the design of lectures to be adapted to the specific needs of the group and generates a positive learning environment for the presentation and analysis. The modality was taken by 50 students, so the challenge is to scale to 350 students, which is the estimated average number of students enrolled in the course each year for the last five years.

Another experience that we point out refers to the Computer Programming II course, which takes place in a blended format. As of 2016, the theoretical classes recorded by OpenFING were included in the VLE of the institution. In the last two years the rate of approval without final exam increased from 11% in 2016 to 17% in 2017. Student surveys show the importance of the videos in their learning process, mainly due to the impossibility of attending the face-to-face course. As mentioned earlier, approximately half of the students are in work and participate in the course in a virtual modality. These students also describe the usefulness of the recordings for the preparation of the course assessments and, predominantly, the final exam.

The professors who implemented these new teaching experiences believe that OpenFING has great potential as a tool to improve the development of courses, allowing them to focus their time on the direct exchange with students, promoting the understanding of issues and strengthening the student–teacher relationship. In institutional terms, it is considered important to consolidate these strategies, which include changes in teaching methodologies. These strategies are aimed at promoting new teaching and learning models to replace the traditional ones that still have a strong anchoring in FING (*Facultad de Ingeniería*, 2016). The flipped learning model constitutes a change in teaching tasks, as teachers prepare the lectures based on the learning experience of the students and their progress. There is also a concomitant change in the role of students, mostly for the ones who are used to

being passive participants in the traditional educational model. The changes and new educational processes are monitored at the pedagogical level by UEFI, which provides a space for support, exchange and development of educational practices.

Opinions of OpenFING
During late 2017, the first study on user experience and perception of OpenFING was performed. Data was collected from both students and teachers. While positive, most of the evidence gathered previously had been anecdotal. It was therefore both appropriate and timely to formally evaluate the use of OpenFING in supporting teaching and learning at university. In this section the methodology used is presented and a preliminary analysis of relevant issues is depicted.

User satisfaction survey
In October 2017, an online survey was published on the project's website (OpenFING, 2018b). The survey was built mostly using closed questions, multiple choice or Likert scale from 1 to 5. This strategy was used in order to handle in a better way the workload and information analysis. The research was designed based on previously collected input about the project taken both from direct contact with students and the constant email feedback.

The questions were oriented to ask about the regular use of OpenFING, the study practice carried out by the students using the videos and, also, the general suggestions for improvements to the platform. The questions were addressed to FING students, but the analysis revealed that OpenFING is not exclusively used by students from the institution.

By December 2017 the survey was completed by 852 anonymous students. Eighty-six per cent were FING students and 14% were students of other universities and teachers of other educational institutions.

Further analysis reveals that not only are the videos being used for revision for an exam but also for study during the course. Sixty-four per cent claim they find it useful while the classes are ongoing. Fifty-nine per cent consider the videos give them the right preparation for the activities proposed by teachers. Actually, more than 80% of users think that OpenFING enables them to follow a course appropriately (83%) and, in fact, even more users think their learning is improved by the project, represented by 88% of the users.

The survey also collected data about the different learning strategies applied by the users. Eighty-three per cent of users take notes while watching the videos, while 77% watch the complete videos. Sixty-six per cent pause the video for a better understanding and to take notes. This enabled us to better understand the number of hours dedicated to watching the videos: 38% spent two to four hours a week and 27% spent four to six hours a week.

The survey shows 58% of the users prefer OpenFING because they were unable to attend lectures. Forty-nine per cent use it as a substitute for all lectures in the course. The reasons for not attending differ: 44% say they prefer to watch the class online and 26% say the class hours

clash with their work schedule. However, 84% agree on a high level of satisfaction with the learning experience using OpenFING.

OpenFING is considered a flexible resource by 86% of all users because it allows studying at any time. The following are some opinions taken from open answers (translation by article authors):

· *"Me ha sido de mucha utilidad asistir a clase, luego poder ver la clase …"* (2017) 'It has been really useful to attend the lecture, and then be able to watch the video later …'
· *"OpenFING es fundamental para seguir algunos cursos. Podés pausar y procesar la información."* (2017) 'OpenFING is essential for following certain courses. It allows you to pause and process the information.'
· *'Lo uso frecuentemente, incluso antes de ir a alguna clase para ya llegar preparado.'* (2017) 'I use it frequently, I even use it before going to class in order to be prepared.'
· *'Es una herramienta muy buena también para ir viendo la clase "a tu propia velocidad", pausando y volviendo para atrás.'* (2017) 'It is a very good tool for watching the classes at your own pace, pausing and rewinding freely.'
· *'Me sirven los videos para mejorar los apuntes que tomé en clases.'* (2017) 'The videos are useful to me to improve the notes taken in class.'
· *'He hecho cursos enteros por OpenFING, (…) brinda la posibilidad de estudiar en horarios muy flexibles'* (2017) 'I have taken whole courses on OpenFING, (…) it gives me the ability to study at flexible hours.'

In general, the users seem to be satisfied with the platform user experience and the quality of the videos. However, multiple choice questions suggest some improvements: 21% say that frame composition must be improved, 28% point out the need for improving the audio when students ask questions during the class and 18.6% would appreciate graphics with information about the topic of the video. Also, 26% suggest the possibility of adding comments to the video, 23% demand a quicker upload of the videos to the platform and 19% ask for an online chat. Finally, 17% express interest in other kinds of educational resource in addition to the recorded lectures.

Teacher satisfaction survey

Another survey aimed at teachers was run simultaneously. It was the first time that information was obtained from their perspective; hence the design of an open questionnaire to collect personal and subjective feedback from the teachers (OpenFING, 2018c). It was important for us to know how they use the videos in their teaching, the impact of the use of videos in their courses, and pros and cons.

In October 2017, the survey was sent by email to 61 teachers who had been participating from 2012. Only 27 answers were received by late 2017. The answers were classified in categories and analysed.

Most of the teachers have a positive opinion about OpenFING. Sixty-three per cent express that idea directly in their answers and 70% also highlight the project as a useful tool for study habits and course follow-up. Additionally, 26% of teachers highlight the possibility for students to recover missed lectures due to absences, and point out that students use them in preparation for practical classes.

Twenty-six per cent of responding teachers say they have implemented changes in their teaching practice because of the existence of recorded courses. Another 26% claim they are willing to and 48% have not made any changes yet.

The following are opinions from teachers collected in open questions (translation by article authors):

· *'Creo que muchos estudiantes ven el curso en OpenFing. Esto me genera sentimientos ambivalentes. Por un lado, me parece excelente el material como apoyo. Por otro lado, tengo la impresión de que algunos estudiantes prefieren seguir la clase por OpenFing que asistiendo y esto me parece un error y no sé mucho cómo evitarlo'* (2017) 'I believe that many of my students use OpenFING. This generates contradictory feelings. On one hand, it seems excellent as a support resource. On the other hand, it feels wrong that many students choose to follow the course using OpenFING instead of attending in person, but I don't know how to avoid it.'
· *'La dependencia que se puede generar sobre esta forma de aprendizaje (sustitución de la clase por la visualización de videos) si no se la integra adecuadamente en cada curso. En este sentido entiendo que somos los docentes quienes debemos analizar cómo aportar a la formación de los estudiantes. Las clases magistrales pueden filmarse; entonces los docentes debemos dedicar nuestro tiempo al aprendizaje activo, potenciando muchas veces lo que hasta ahora se hacía.' (2017)* 'The possible dependency on this learning style worries me (watching online videos instead of attending the course) if watching the videos is not integrated in the learning practice in a sound way. In that sense, my opinion is that it is us teachers who must analyse how the videos can enhance students' instruction. If lectures can be recorded, then teachers can spend time on active teaching, improving what we have done up to today.'

Teachers' evaluation of developing audiovisual content for teaching is positive. In relation to improvements for the project, 27% propose the creation of short audiovisual content about specific topics in a more detailed way, and also video creation for online courses like MOOCs.

With respect to the impact of the use of OpenFING on their classes, 77% of teachers indicate a lower attendance rate to their lectures. More than a few teachers are worried: 35% consider that the situation can be risky, since a substitution of class attendance with video increases the lack of interaction among students and between students and teachers.

A change in teaching strategies, and the development of new pedagogical resources mentioned above such as audiovisuals about specific topics, could modify the statistics of preference for online classes (44%).

Related work

The use of lecture hall videos as an educational resource is not new. Chtouki et al. (2012) highlight the commitment of the students in an experience that studied the impact of the integration of YouTube technology in the teaching of English as a foreign language, making use of educational videos. Following a controlled academic experiment, they conclude that the experience was successful. In Gorissen et al. (2012) the use of video recordings of live lectures is regularly perceived by students as supporting their learning when preparing for assessments. Furthermore, Giannakos et al. (2015) argue that regular use of video-based resources may enhance learning if the student has appropriate learning skills and strategies. In this vein, Cornock (2016) developed a guidance framework in order to develop students' effective and efficient use of lecture captures. He found that students use recorded lectures in their own ways depending on private study practice as well as the intended learning from the specific course.

New learning models have been created, such as the flipped learning model, which focus on the development of active teaching and learning methodologies through the use, although not exclusively, of videos for educational purposes (Bergmann and Sams, 2012). In Pedrotti and Nistor (2014) the authors describe an experience using a system for online lecture videos and, although a good level of acceptance by students is highlighted, they mention aspects that can operate negatively if the use of these resources is not related to the educational methodologies and practices followed by the teachers. As highlighted in the experience of the three FING courses, the integration of digital technology (the recorded lectures and the VLE in this case) can function as a window of opportunity to change the traditional pedagogical paradigm towards new ways of teaching and learning. In each case, the use of the video resources needs to be pedagogically aligned (Biggs, 1996), and the reasons for its inclusion and how its integration will benefit teaching and learning need to be defined (Lugo, 2011).

Conclusions and future work

OpenFING started as a project of students wishing to record, edit and publish lectures in order to make them available to other students as learning and study resources. The good experience of the teachers who participated initially facilitated the growth of the project within FING. From 2016 onwards, the OpenFING project began to be articulated by different actors from the institution: the group of students who coordinate the project, learning technologists from UEFI, professors from FING and FIC as lecturers of the IPAM course, with the explicit support of the deanery of FING. This initiative has the potential to be a multidisciplinary educational development, involving staff from different faculties and university students in a common educational project. The current version of the OpenFING platform allows students to watch videos from more than 1300 filmed lectures.

Many platforms that offer virtual courses and educational resources are well known: Coursera (Coursera 2018), Khan Academy (Khan Academy 2018), FutureLearn (FutureLearn, 2018), Merlot (Merlot, 2018), among others. The OpenFING project stands out as an educational project made by students for students. Students manage and coordinate their peers for the recording and editing of videos, and perform tasks ranging from the identification of courses to record and contacting the appropriate teachers to the final publication of the videos on the web. This not only makes it possible to keep the project alive each semester, with the support of teachers and the institution, but also generates a remuneration for students who actively participate. This collaborative participation in the production of resources that contribute to the students' learning occurs either through the IPAM course (which supports OpenFING) or voluntarily. Those following the IPAM course will benefit from acquiring knowledge of digital and communication skills, and audiovisual and multimedia resource production, as well as obtaining credits.

A prototype platform was created which enables comments, questions, the addition of related links and course topics that might be associated with video fragments by the users and teachers. The prototype allows suggestions to be presented to the users. However, the development carried out must still be adapted for mass use. At a technical level, it will be necessary to investigate the application of other techniques to select and/or filter interesting materials associated with the videos, using, for example, natural language processing, data mining and machine learning mechanisms, as well as exploring possibilities of processing audio and video to retrieve information.

An updated platform with a collaborative and thematic relationship mechanism is expected soon (Carpani et al., 2014). Annotation strategies of video fragments will be designed, focused on the development of software for the management of teaching. This software will add each student annotation about a video fragment into a graph database. The database may enable the analysis of each student graph and detect "wrong links" exposing any wrong understanding about some topic in order to personalize the teaching task. It is expected that these strategies will have an impact on student learning, by providing a mechanism for reflection and exchange of different views on the contents of the courses. The main objective is to transform the project into a collaborative and interactive platform for learning. This line of development is also highlighted by other researchers (Novak et al., 2012; Picci et al., 2012; Rich and Trip, 2011).

From the evidence collected by this paper, we can conclude that OpenFING is perceived by students and some teachers as an appropriate resource complementary to learning, both for preparing for assessments and outside of revision periods. Taking into account the objectives of the OpenFING project – to allow flexible access to study content, and to offer the possibility of developing learning strategies for students as well as teaching innovations – the results from both surveys guide future research. On one hand, further research is needed on how to develop students' competencies when using OpenFING, for example, in order to champion a better practice for note taking, so as to improve the support for student learning and make the most of the study experience. Obtaining

evidence from the students' experiences could shed light on the specific uses, preferences, strategies and needs of the engineering students. On the other hand, from the evidence of the teachers' survey, further research would uncover why those teachers willing to implement changes in their teaching practices have not done so yet. To maximise the understanding of their needs and how best to support them in the development of active teaching strategies with the use of OpenFING and other resources, FING has the UEFI, specifically conceived to support staff regarding technology-enhanced learning practices.

To conclude, the development of active teaching strategies needs to take into account the context of each course, depending on its size, budget and viability. The challenge lies in disclosing and further developing the processes involved in the relationship between the teacher's learning design of the course, the lectures as teaching interventions, OpenFING recorded lectures as learning resources, and the students as independent learners.

Competing Interests
The authors have no competing interests to declare.

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