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GOOGLE+ AS A TOOL FOR USE IN COOPERATIVE LABORATORY ACTIVITIES BETWEEN UNIVERSITIES

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Abstract

The following is a proposal for collaboration between universities with the aim to improve curricula that require laboratory activities. A methodology is suggested to implement an innovative educational project involving the exchange of laboratory activities. The exchange of laboratory activities can be carried out on different levels of interaction, requiring different levels of complexity in setting up the activities. A first experience was carried out in the area of machine design. Google+ was the chosen social network. A Google+ community was used to share academic material (notes, videos, activity guides, etc.) and the activity itself was carried out using Google Hangouts. The survey administered at the end showed the students' satisfaction with the experience.

Keywords – Google+, Machine testing, Interuniversity cooperation, New technologies, Social networks.

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1 INTRODUCTION

In order to prepare qualified professionals capable of performing their activity in the professional environment of the 21st century, educational institutions are faced with the need to incorporate the new tools made available by information technologies (Conole & Alevizou, 2010). Experimenting in virtual environments is necessary to establish methods of learning that are attractive to students and that promote creativity. However, we must not forget that these must still be effective learning tools.

Social networks, commonly used for personal relations among students, offer a number of possibilities for educational use (Oberer & Erkollar, 2012; Rejón-Guardia, Sánchez-Fernández & Muñoz-Leiva, 2013) that still have to be fully exploited. University institutions are currently using social networks to promote current contents and news and to revitalize the academic life of their members. But social networks also offer new channels to complement teaching practice (Del Moral & Vilalustre, 2012).

For both psychological and legal reasons, higher education is an appropriate educational level for the introduction of the use of social networks as educational tools. This poses a challenge for both students and faculty, and reveals a need to adapt teaching methods at the university level to the approaches of the European Higher Education Area (EHEA). In addition to the typical contents for each degree, the curricula for degree programs must also include interdisciplinary competences that will be of use to the students in their future professional careers (Marín-García, García-Sabater, Miralles & Rodríguez Villalobos, 2008).

The environment resulting from adaptation to the EHEA and the incorporation of new degrees requires a more flexible academic structure. These academic degrees can be created and modified more easily than the former Bachelor's degrees and diplomas. However, this flexibility is especially complicated in areas that require

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laboratory activities with complex and costly equipment. The field of industrial engineering is precisely one of these areas.

With the aim of incorporating new tools into educational practice and aware of the need for flexible, affordable access to different laboratory setups, a group of professors from two different universities proposed sharing the resources available at each of the two universities. The exchange also had the advantage of providing students a more global view of the course contents they were studying. The project, which was begun during the 2013-14 academic year, started with an analysis of the curricula at the two universities, in order to detect similar courses that were suitable for the activity exchange, and a study of the technical requirements needed for such an exchange to occur. As a result, the objectives of the project were:

- To foster cooperation between universities and the direct participation of students at the two universities.
- To make use of the advantages of the free online platforms to make shared teaching materials available to students at both institutions.
- To create new materials adapted to the changes in the EHEA, using freely accessible electronic resources.

During the 2013-14 academic year, a remote session of laboratory activities was carried out as a pilot test. Several conclusions were drawn from it, and it was enthusiastically embraced by the students.

This project was proposed and implemented in the field of engineering, which is the field in which the professors involved work, but it is believed that it could be easily adapted to other areas of higher education. In some areas, the financial justification for the proposal is not relevant, but the educational and social benefits of the proposal are sufficient to consider its implementation.

Finally, it should be indicated that the project calls for activity exchange sessions to be held throughout an academic quarter, but in no case is it proposing that a course is taught entirely online. This approach, while not completely out of the question, is beyond the scope of this article.

2 METHODOLOGY

The project is carried out with the participation of professors from the departments of mechanical engineering at the Universitat Politècnica de Catalunya (UPC) and Universitat Rovira i Virgili (URV). Specifically, they teach at the Barcelona School of Industrial Engineering (ETSEIB) and the Tarragona School of Chemical Engineering (ETSEQ).

First, the curricula for the currently established degrees and those in the process of being implemented at the two schools were analyzed. During the 2013-14 academic year, the last two years of the Industrial Engineering Bachelor's degree program and the Industrial Technologies degree were taught at ETSEIB, while the first year of the Industrial Engineering Master's degree program was offered at ETSEQ. It should be pointed out that ETSEIB already had a curriculum in place for the Industrial Engineering Master's degree, which was expected to begin (as was the case) the following academic year. Once all these curricula were analyzed, it was concluded that the Machine Design I and Machine Testing courses from the Industrial Engineering Bachelor's degree program at ETSEIB, also a part of the Master's degree curriculum, and the Machine Design and Testing course in the first year of the Industrial Engineering Master's degree program at ETSEQ were the most suitable courses for the activity exchange.

The machine design and testing courses are interdisciplinary courses within the mechanical engineering department, and they require the synthesis of knowledge acquired in previous courses. Furthermore, the activities for these courses permit very diverse experimental setups in which the students can apply theoretical knowledge and methodology in design and testing. As a result, it is a rewarding experience for the student to be able to work with the maximum number of laboratory setups possible. These are also the type of courses in which the problems presented do not have a single correct solution, and therefore different points of view from both the professors and the students can result in different, but equally valid solutions. These courses were chosen for these very reasons.

Within these courses, the experimental setups used at each university that had the potential to enrich the courses at the other university were identified. The project made it necessary to review the teaching materials used in the activities in order to meet the instructional needs of both institutions and to coordinate the theoretical concepts addressed.

The possibility of remote interaction between the activity setups was analyzed, for both those currently in existence and those that might be created in the future. In all cases, Internet video streaming was considered to maintain visual contact between the students and the activity setup when they were at different centers. Visual contact was deemed essential in order to successfully carry out an activity session. Different possibilities were also examined regarding the use of remote or virtual laboratories (Gomes & Bogosyan, 2009; Fábregas, Farias, Dormido-Canto, Dormido & Esquembre, 2011). Three possible levels of interaction were identified as applicable to the activities of the selected courses:

- Activities involving monitoring and sensors. The highest level of interaction would be to have a computer-controlled laboratory set up with centralized sensor information also stored on the computer by means of a data acquisition system. By remotely accessing the computer, it would be possible to remotely monitor and take measurements of the different parameters associated with the activity. An activity of this nature would require practically no intervention on the part of anyone at the university where the setup is located, although its design would be expensive. There is currently no activity underway with these characteristics.
- Activities involving sensors. The middle level of interaction would be to have an activity in which the adjustments were performed by an operator and the data acquisition was carried out remotely over the Internet. There are currently some activities that could be partially carried out with this level of interaction (only some of the measurements to be taken are not centralized in a computer-operated data acquisition system).
- Videotaped activities. The lowest level of interaction would be to videotape the activity and stream the information about the measurements obtained pointing the camera at the screens of the different devices used to acquire the data. This system requires the intensive intervention of an operator at the university where the laboratory setup is located. All the available activities can be carried out with this level of intervention.

This latter level of interaction, while seemingly the least ideal, has certain advantages over the other levels. In most of the activities for these courses, standard devices such as multimeters and oscilloscopes are used for data acquisition. Video broadcasting does not require the students to know how to use a computer-operated data acquisition system. This level of interaction also permits the data acquisition to be recorded beforehand and distributed to groups of students during the remote class session, in order to avoid the repetitive measurement of data that is common with machine testing.

Finally, we sought to identify the most suitable virtual platform on which to distribute the teaching material and remotely broadcast the video. The use of the virtual campus at either university was ruled out, as these environments were judged to be too rigid and we wished to identify less academic channels. The goal was to find an easy-to-use environment in which we could control access to teaching materials and an effective method for streaming the video, which permitted the computer desktop to be displayed. The social network Google+ was selected, since it is free and includes all of the required tools to permit distance learning that goes beyond just a master class delivered by videoconference (Lavandera & Real, 2011). Specifically, the decision was made to use Google+ Hangouts and communities. Google+ communities can be set to private, so that only invited members can join the community. The Google+ communities tool was thus selected to distribute the teaching materials and to carry out the preparatory work prior to the activity session. This tool can also be useful as an area for socializing between the communities at the two institutions, in the case of a long-term exchange of laboratory activities. The Hangouts tool was chosen as the basic framework on which to stream the video of the activity session. In theory, the activity session is intended to be carried out solely between two universities and with all students in attendance in the classroom. The Hangouts tool makes it possible to consider the option of holding activity sessions in which more than two institutions participate, and even the students take part in the session from home. The applications associated with Hangouts have also been analyzed, and the following have been selected for possible use in the activity sessions:

- Remote desktop. Enables the computer desktop to be controlled remotely. It can be used to interact with the data acquisition system and the system used to control the activity setup.
- Google Drive. Permits documents (pdf, text documents, spreadsheets, etc.) stored on Google Drive to be accessed and edited from Hangouts during the activity session.

- Symphonical. A virtual wall on which sticky notes can be placed. This can be useful for exchanging ideas and organizing different tasks necessary to carry out the activity.
- Slideshare. Makes it possible to share transparencies. This can be useful for providing the necessary theoretical explanations.

3 DESCRIPTION OF THE PILOT EXPERIENCE

For the first experience, a test carried out at ETSEIB was selected. The activity guide was reviewed and materials were added to prepare the students for the activity. The objective of this was to provide the necessary tools to boost the comprehension of the test to be performed.

The aim of the activity chosen as a pilot test for this project was for the students at ETSEQ to obtain the typical torque/rotational speed curve for a DC gear motor used to operate a set of windscreen wipers. Both the setup and the professor who guided the activity were physically located at ETSEIB. Use of the Internet was required to carry out the preliminary work, view the setup and collect the data. Interaction with the activity setup only occurred on video, due to problems related to the availability of a suitable Internet connection in the machine laboratory.

All students registered for the Machine Design and Testing course at ETSEQ participated in the experience, as it was not a very large group. The Industrial Engineering Master's degree is a new program implemented at URV (begun during the 2013-2014 academic year). The students participating in this learning experience came from different technical degree programs: degrees in engineering (industrial technologies, electrical, industrial electronic and automation, mechanical, chemical, textile, etc.) and Bachelor's degrees in one of the specialties of industrial technical engineering (having already studied the appropriate supplementary subjects). Both the previous level of education and the age profile of the students are diverse. More than half combine work and study and believe that this Master's degree provides the opportunity for professional advancement in the industrial sector.

During the weeks prior to the session, a private community was created on Google+ called Assaig de Màquines UPC-URV (Machine Testing UPC-URV), which all URV students registered in the course were invited to join. All the material needed to participate in the session (notes, videos explaining the devices used, the activity guide, forms to complete the preliminary work, surveys, etc.) was then posted online. Figure 1 shows a screenshot of the community that was created.

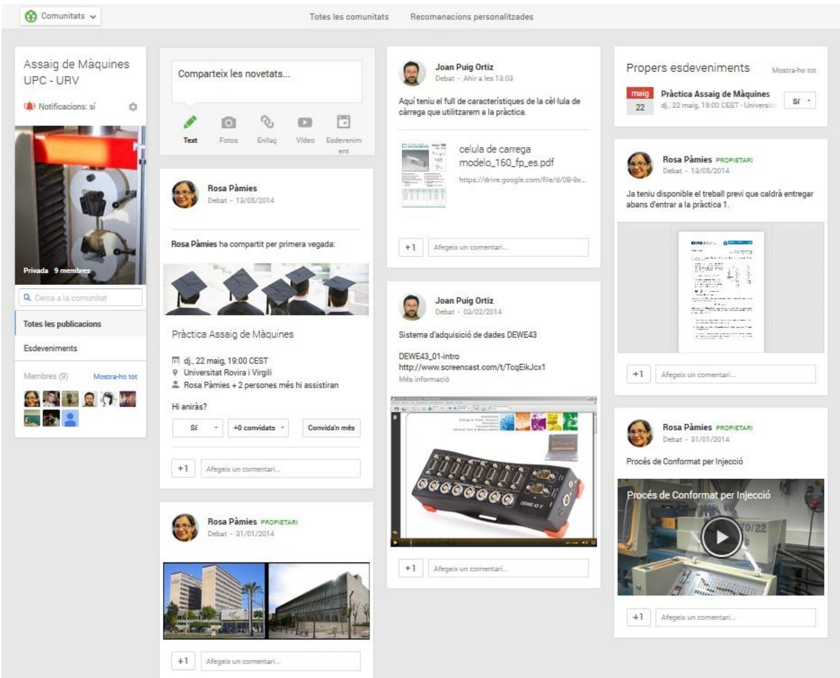


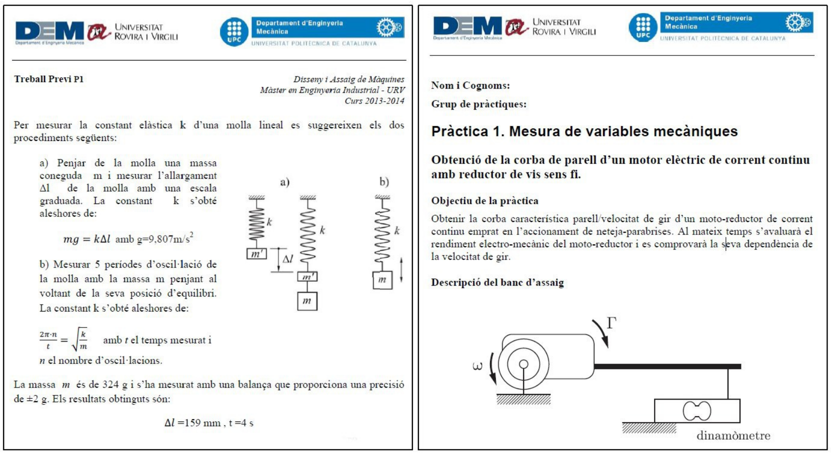
Figure 1. Image of the Google+ community that was created

In order to ensure that the activity session went as planned, special attention was given to preparing the materials in order to make them easy to understand by students with different academic backgrounds. Great care was also taken to ensure that the materials represented a clear guide, linking theoretical knowledge previously acquired in the lectures to the content of the activity session. Finally, it was ensured that the instructional material developed offered an integrated, global understanding of the entire experimental process. Taking into account all these factors, the materials were designed to:

- Support the master lectures. Materials containing the basic points to be worked on during the activity session and that transmit the idea of interrelationships with other course activities. These materials are made available to the students before the remote session.
- Promote active participation by the students. To arouse the students' interest, a form was designed with a set of increasingly difficult questions. The questions on the form were discussed in the Google+ community in order to make them available for future reference.
- Acquire knowledge. The activity instructions were updated to ensure an adequate understanding of the test by the new students and to boost their capacity to interpret the results.

The activity was implemented in three stages:

- Preparatory work. The students were required to answer questions on a form before the remote activity session. The form was made available in the Google+ community and the results were compiled on a Google drive spreadsheet that could be accessed by the professor.
- Completion of the activity. Using the Hangouts tool, ETSEQ students participated in the activity session that physically took place in the Mechanics Department of ETSEIB. Measurements were taken in groups by the students and were submitted on a form for addition to a spreadsheet. This spreadsheet was shared with all the students, once all the data were compiled from the groups. This ensured that all students had the maximum possible number of data available and gave them an incentive to detect errors, both their own and those of other groups.
- Post-activity report. Based on the results obtained, the students were required to complete a report that was also submitted online to the Google+ community.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Treball Previ P1

Disseny i Assaig de Màquines
Màster en Enginyeria Industrial - URV
Curs 2013-2014

Per mesurar la constant elàstica k d'una molla lineal es suggereixen els dos procediments següents:

a) Penjar de la molla una massa coneguda m i mesurar l'allargament Δl de la molla amb una escala graduada. La constant k s'obté aleshores de:

$mg = k\Delta l$ amb g=9,807m/s^2

b) Mesurar 5 períodes d'oscil·lació de la molla amb la massa m penjant al voltant de la seva posició d'equilibri. La constant k s'obté aleshores de:

$\frac{2\pi \cdot n}{t} = \sqrt{\frac{k}{m}}$ amb t el temps mesurat i n el nombre d'oscil·lacions.

La massa m és de 324 g i s'ha mesurat amb una balança que proporciona una precisió de ±2 g. Els resultats obtinguts són:

Δl =159 mm , t =4 s

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Nom i Cognoms:

Grup de pràctiques:

Pràctica 1. Mesura de variables mecàniques

Obtenció de la corba de parell d'un motor elèctric de corrent continu amb reductor de vis sens fi.

Objectiu de la pràctica

Obtenir la corba característica parell/velocitat de gir d'un moto-reductor de corrent continu emprat en l'accionament de neteja-parabrises. Al mateix temps s'avaluarà el rendiment electro-mecànic del moto-reductor i es comprovarà la seva dependència de la velocitat de gir.

Descripció del banc d'assaig

Figure 2. Documents used during the activity conducted as a pilot experience, available within the Google+ community

Figure 2 shows part of the preparatory work and the guide for the activity. The documents for the preparatory work and the supplementary documents were made available to the students a few weeks before the remote session was held. The activity guide was given to the students at the start of the activity session. Figure 3 shows the mechanical part of the experimental setup used in the activity session.

Aware of the importance of activities in higher technical education, the grade received on the preparatory work, the work during the remote session and the report after the session was given a weight of 10% of the student's final grade. The theoretical content of the activity was also subject to assessment on the course final exam. The option on Google+ to record the Hangouts sessions held made it possible to provide the students with a video recording of the session through the Google+ community. By carrying out the activity using the

Google+ tools, the students could view the activity as many times as they needed to and were provided with new material to be used to prepare for the final exam.

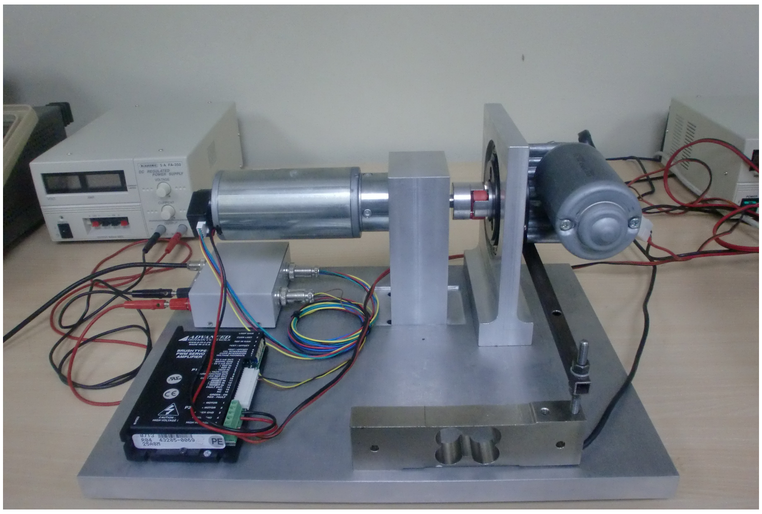

Figure 3. Experimental setup used in the activity

4 RESULTS

After completing the activity, the students were asked to complete a survey on a form created with Google Drive. Eight of the questions were rated on a scale from 1 (strongly disagree) to 10 (strongly agree), question number nine allowed the students to add comments and question ten was a yes-or-no question. The questions were as follows:

- Q1. The activity enabled me to apply the theoretical concepts studied in class on the statistical treatment of errors.
- Q2. The explanations given by the professor during the videoconference helped me understand the activity.
- Q3. I positively assess the possibility of doing this activity, in spite of not being able to physically operate the experimental setup.
- Q4. I positively assess the use of Google+ (and the online activity conducted) in order to share instructional materials between two universities.
- Q5. I positively assess the material that has been created using free online resources (Google+ community, forms, Google Drive, surveys, etc.).
- Q6. I believe university instruction should include the use of more information and communication technologies, as well as social networks.
- Q7. The resources available in the classroom were sufficient to properly carry out the online activity.
- Q8. My overall assessment of this activity is (1 very bad - 10 very good).
- Q9. Please comment on aspects that could be improved for next time.
- Q10. Have you ever participated in a remote activity in any other course at the university?

Table 1 summarizes the student evaluations and the standard deviation for each question.

	Q1	***Q2***	***Q3***	***Q4***	***Q5***	***Q6***	***Q7***	***Q8***
Mean	*8.87*	*8.47*	*8.93*	*9.27*	*9.27*	*9.33*	*8.27*	*8.47*
Standard deviation	*1.25*	*1.13*	*1.33*	*0.88*	*0.80*	*1.11*	*1.44*	*1.06*

Table 1. Results of the post-activity survey

Some of the comments received in response to question number nine were:

- “In my opinion, the activity went smoothly, thanks to both parties having prepared the material beforehand and considering that there was not a lot of time available. I think this last aspect could be optimized if the students were to receive the instructions for the activity earlier in advance."
- “In general, very good, but next time it would be a good idea to receive the instructions for the activity beforehand. This way we could read it at our leisure at home."
- “I assess doing an activity like this very positively, even though we did not have enough time.”
- “The videoconference should be conducted on all the computers.”
- “Unfortunately, the only negative aspect is that the professor could not be provided better facilities to carry out this activity with the use of audiovisual equipment. What might need to be improved does not fall within the scope of the activity, rather it concerns the media (quality of the projector, and primarily the sound), but the philosophy behind it is very positive.

In response to question number 10, all of the students responded the same: none of them had ever done a remote activity in any other course at the university.

5 CONCLUSIONS

This first pilot experience has been beneficial for both students and faculty.

The proposed project makes it possible to implement a cooperative educational project between two universities, involving an exchange of laboratory activities. The use of educational activities developed in online environments such as Google+ was positively assessed. The instructors stressed the possibility of promoting new learning methods through the use of new platforms for interaction. The students positively assessed access to the experimental setups at other universities.

Finally, and taking into consideration the comments made by the students, we propose to improve the procedure by providing the students the activity guide earlier and explaining the experimental setup that will be used the day before the activity, which would also facilitate understanding of the activity guide. We also believe that it would be appropriate to use a classroom with better media resources that would facilitate the connection between the two universities.

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