Experience in developing personal learning environments for the subject systems of data acquisition.

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***Abstract*—The teaching methodology at the engineering university degrees is basically practical. It is set in a context in which students are involved in their teaching process building up their own learning. This article shows evidence of the work made in the subject "Data Acquisition Systems" (DAS) in which the teacher fosters a personal learning environment (PLE) within this area in order to enrich the students' training process.**

Keywords*—Data Acquisition Systems (SAD); sensors; personal learning environment (PLE); social networks.*

I. INTRODUCTION

Innovation at teaching favors the evolution, change and also the improvement of the Higher Education and even more; it guarantees a qualified university teaching. It is very common to find innovation projects aiming to the promotion of these changes among universities.

These innovation projects foster the creation of teachers' groups within which innovative activities have been carried out facing the current Education Paradigm which we suffer. The different proposals are based on technical and methodological aspects of the teaching practice. Within that innovation frame, emerge the use of didactic methodologies, the development and evaluation of competences and finally, the design of activities which improve the learning results. That is the reason why these projects should ideally assess some criteria such as: the learners and teachers' satisfaction, the implement of participatory methodologies, and also the improvement of the performance rate [1], [2].

Despite, the little recognition towards teachers who get involved in innovation practices could become a very negative aspect and make teachers feel demotivated. For instance, if we compare the recognition by working on innovation and by working on research, it is clearly seen that the second one is given much more accreditation. Nevertheless, many teachers care about quality and feel encouraged to improve step by step their job. It enhances them to propose innovation projects to cover all the students' learning needs and to provide them with the required tools and sources so that they can acquire the key competencies such as "learning to learn".

Through ages, the human being has been surrounded by an environment that makes him build up his own knowledge in an innate way; that is to say, without realizing that [3]. However, the first time when this idea of " Personal Learning Environment" appeared, was at the annual conference JISC-CETIF in 2004 [4]. Since its beginning, the PLE's were took as an interesting part within e-learning, a learning far for master classes or lectures and focused, at the same time, on the variety of tools that internet offers to us [5]. Step by step, it was being spread and today is one of the most controversial topics in the educational technology environment [6]. Furthermore, those new concepts have been classified as an emerging educational tool [7].

In the educational technology field, a PLE is understood as "an ensemble of tools, sources of information, connections and activities which each individual uses in a regularly to learn [3], [6]. Initially, different thoughts in relation to the concept were born [8]. One theory stays that a PLE is that technological tool which main aim is to develop the best e-learning [9]. A second theory defines the PLES's as a pedagogical idea about how to learn using the technology [6]. Nevertheless, both thoughts have a common point which is the techno-pedagogical idea within the concept of PLE [3]. Therefore, implementing PLE could offer us a wide variety of work tools, services, and contents which are accessible to students in the classroom and out of the classroom too. PLE could also be very useful for a knowledge based society since it entails a constant learning throughout one's life [10]. By contrast, it is not quite common to hear the term PLE within the engineering teaching area. Despite, some authors include the design of a PLE in their subjects' guide in order to foster an active learning among students [3].

Nowadays, all the tools or sources that we find on the 2.0 web allow us to better organized all the contents, to distribute them and to adapt the learning process itself to each user's needs. In this way, a learning focused on the students is being favored. In this article, the personal learning environments are those in which each individual discriminate what resources uses in order to learn, create or share.

For the construction of a PLE each one will may decide a via to access to the services by which a personalised learning

process is guaranteed. At the same time, the contents could be organised through different types of content management. This way, they can complete their knowledge with other resources such as web links, pictures, videos, audios, documents and PowerPoint presentations. Each of the resources should be lodged in specific places for them.

This project would go further with the authors' experience within that area [11] and shows the experience carried out in the subject so-called "Data Acquisition Systems" in which the construction of a PLE at this field by students is highly taken into account for their evaluation in order to enrich students' training process.

II. TOOLS FOR THE DESIGN OF A ENGINEERING STUDENT'S PLE

In the engineering field there are some experiences in the classroom with PLE as in the case of activities which are developed through the "Electronic Communications" subject in which the learners value successfully the work done and they also described the methods which were applied as useful for their learning process [12]. Another experience with good results is the case of "Microprocessors" subject. In that occasion, it is used the DIY (Do It Yourself) technique in order to create those PLE's. In that particular case, the number of passing students increased a 20% if we compare it to previous cased in which the same technique had been put into place [10].

As previously mentioned on the personal learning environments definition, the technological tools are used to support the overall learning strategies. That's why knowing the use technology students give to the development of a PLE could be interesting, as they vary between countries [13]. The 2.0 web tools offer a huge potential for college students faced towards the development of PLE´s [14]. At the 2.0 web, the users take an active role, in which not only they read, but also deliberate, clarify, evaluate and share [15]. Thanks to these paradigm changes amongst others, information grows rapidly inside internet. Forecastings predict a double increase every 72 hours of this information, which would be quickly left obsolete, collapsing many web contents [16]. In this context a new concept emerges: content cure. The content curator role is defined by Guallar & Leiva [17] as:

"System carried out by a content curator either for an organisation or individually, consisting of a search, selection, characterization and continued diffusion of the most relevant content from many web information sources about a specific theme (or themes) and area (or areas), focused on a determined audience, either in the web (mayor trend) whereas in other different contexts, such as organisations, offering an added value enrolling audience and users together."

Guallar & Leiva also propose the 4S's content curation method, going through the search, selection, sense making (characterization) and share (diffusion of selected and characterised information) [18].

Fig. 1. Scheme of the 4S method and the tools used.

Fig. 1, in order to accomplish the curation process which best adapts to the users needs correctly. This methodology can help engineering students to acquire cross-sectional capacities, as defined in the memorial of their degree title [19], specially the following:

- CT2 - "Information management capacity, use and application of technical specifications and necessary legislation for the engineer praxis"
- CT6 - "Oral and written transmission capacity of information adapted to the audience"

There is an extensive bibliography available referring to the tools used in the development of PLEs [20], [21]. Among those, concretely in the subject of "Data Acquisition Systems", the chosen ones are shown in figure 1.

III. AIMS AND METHODOLOGY

While the academic years 2016-2017 and 2017-2018, an innovation project is being carried out. That project aims to develop a Personal Learning Environment in several subjects of the Electronic Engineering Degree. The experience shown within this essay has been carried throughout the already mentioned Data Acquisition Systems subject, which belongs to the elective classes of the 4th year of the degree. Chart II includes the syllabus of the degree and it shows that the Data Acquisition Subject is a cross-curricular subject to the possible specialties of the degree.

One of the first points to cover within this subject from the very beginning is a deep review of the different data acquisition system set ups. Chart II includes an outline with the elements which form a data acquisition system. That kind of systems enable the monitoring of any sign (from our environment or part of an industrial process) in a suitable way and also the automation of the mentioned measure process.

TABLE I INDUSTRIAL ELECTRONIC ENGINEERING DEGREEE SYLLABUS.

Electronic Engineering Degree *240 Credits*			
First & second years *60 Credits/basic training and compulsory training*			
3 year	*60 Credits of compulsory training courses*	Introduction to photovoltaic systems Industrial informatics Basis of environmental technology Analog electronic	Digital Electronic Analog systems **Electronic instrumentation** Control Engineering Power electronic Advance Automatic
4 year	*30 Credits of compulsory training courses*	PC control Final Degree Project Projects Advanced Electrical Engineering	
	30 Credits of effective training	**Electronic system Specialty** **Automatic systems Specialty** **Photovoltaic systems Specialty**	
		Oferta común no asociada a mención	**Data Acquisition Systems** Chapter 1 Introduction to Data Acquisitions Systems Chapter 2 Systems & Signs *2.1. Kind of signs* *2.2. Operations Signs* *2.3. Types of systems* Chapter 3 Measure and conditioning of the entrance signs. **3.1. Classifying of sensors** **3.2. Characterization and selection sensors criteria.** *3.3. Design of measure systems* Chapter 4: Interconnection of the measurement system. Interfaces. Chapter 5: Measure systems Noise

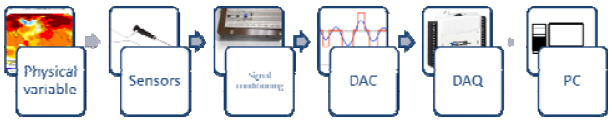

Fig. 2. Architecture of a data acquisition system.

The project is set in the gauges field since in every industrial process it is essential to know the evolution of the most important variables within that process.

TABLE II FICHA PROPUESTA EN LA ASIGNATURA SAD DE UN SENSOR DE TEMPERATURA TIPO TERMISTOR.

Thermistor	
Manufacturer	HANNA instruments
Description	It is a probe for general uses (liquids), NTC thermistor for applications such as liquids, air and contact. 1
Technical characteristics	Model HI 762BL Range -50 a 150 ºC Precision +/- 0,2 ºC Probe error: +/- 0,2 ºC Reply time 15 s Handle probe ABS Material Stainless steel. Error possibility +/- 0,2 ºC
Adress	http://www.hannachile.com/catalogo/pdto~hi_762bl/Sonda-Termistor-de-Usos-Generales-Liquidos.htm
Comments	Precalibrated are provided

The solution to this problem is not quite obvious and the students should learn about a vast number of aspects in order to reach that learning outcome. In the Data Acquisition Systems subject, the 3rd chapter is devoted to the gauges but from a practical perspective (applications, ranges and parameters and selection criteria) and it will be in that section where students will be asked to develop a PLE in relation to the gauges topic.

The students already have previous knowledge about it for it is covered in the subject of Electronic Instrumentation in which they have seen the gauges topic from a physical perspective: mathematical bases for measuring the gauges and the most important parameters of functioning to have a linear measure of the process.

a) Scoopit. Load cells

b) Sensor manufacturers.

Fig. 3 Aspect of some of the developed applications that are part of the SAD PLE. a) content cure performed on scoopit about force sensors. b) webmix of mechanical variable sensors, with the compilation of different sensor manufacturers.

In previous years, students accessed to the manufacturer's characteristics of the product and they created a data sheet similar to the one in the chart above. However, this year, the methodology has also been included to make a PLE about sensors:

- To study the functionality of the sensors and the static and dynamic parameters which define its performance.
- To analyze the sensors selection criteria according to the aimed variable to monitor: temperature, mechanic variables (position, speed, weight…), electric variables (voltage, intensity or power)
- To create a webmix with Symbaloo to consult the manufacturers' characteristics of the sensors, information related to the sensors application notes, sensors more frequent applications, websites in which they are sold and blogs related to the sensors study.
- To join the Google+ community and post and share all the aspects related to the project, doubts…
- To create an account on Feedly in students group to organize and classify the interesting posts related to gauges for that subject, enterprises which cover the monitoring of variables and the progress in the sensors field.
- To create an account on Scoopit as a tool which enables the selection of the most interesting contents. The students have to create a mind map on board with some of the learned sensors.

IV. Description of the Experience

As mentioned before, that project consists on the implementation of a PLE about sensors and the selection criteria for them. Students have been given the advice of searching all the information on websites or blogs, manufacturers of gauges, characteristics sheets, application notes, most frequent uses of gauges as well as the selection criteria according to the aimed variable to measure. Then, students select the contents, tailor and share them with the rest of the group throughout Symbaloo, Google+, Feedly and Scoopit. To avoid the minimum loss of time within tool engagement, students have been formed about their correct use and configuration at a basic level.

In Fig.3 it is displayed the aspect of one of the developed applications, being part of the SAD`s PLE.

- Part a) of the diagram shows the information that students have previously worked through following the characteristics sheet made by a force sensor manufacturer, applying for the previously mentioned content cure definition.
- Part b) of the diagram displays a mechanical gauges variables webmix elaborated by students, compiling different force, weight and acceleration gauges manufacturers amongst others.

During the PLE development process, students created a Google+ group in order to comment and share thoughts between themselves and other external groups part of the PLE construction community, leading to a major collaboration between members of all groups.

V. Evaluation of the Experience.

A survey about SAD sensors has been made, in order to interpret the PLE students experience [22]–[25]. The purpose of this survey aims to know the strategies and tools that engineering degree students normally use during their learning process, in and out of the classroom, especially the ones occurring in a digital context.

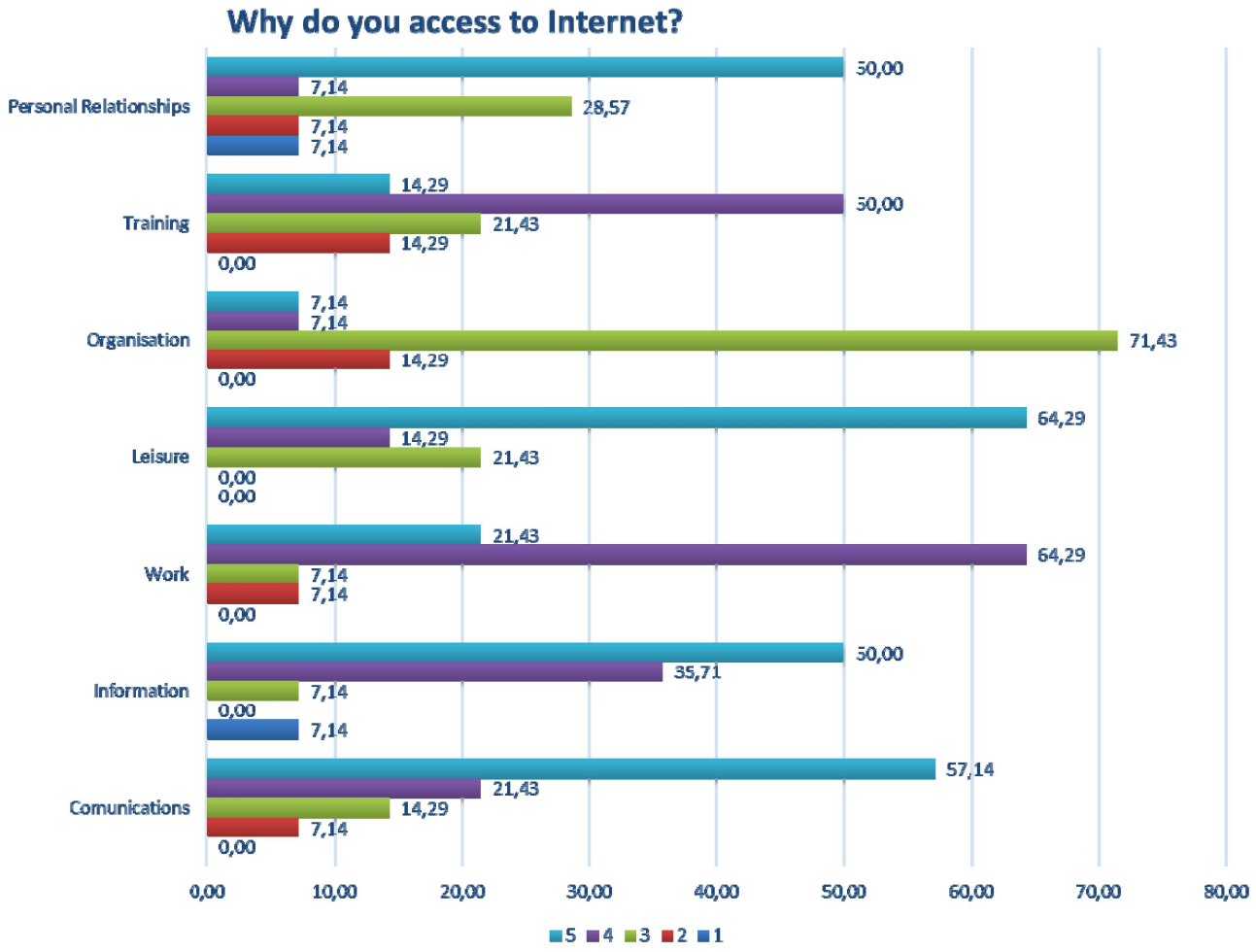

Fig. 4. Students evaluation about web browsing in different areas.

As previously mentioned, the survey intends to compile students opinions about their personal learning environment, without making such concept explicit. The survey consists of a Likert based answer sheet with six options: (1) Totally disagree; (2) Disagree; (3) Agree nor disagree); (4) Agree; (5) Totally agree; (6) DK/NA. Fig.4 shows the obtained results when students were asked to evaluate which is the main purpose of them browsing the web.

The majority totally agree with the main use given to the internet, this being leisure (around 65% of them choose this option). With this same five points mark, communication, information and personal relationships scopes present a 57%, 50% and 50% respectively. Nowadays they totally agree or just agree given that a 85% use Internet for work while a 65% uses it for educational purposes. On the other hand, the maximum is for the option “Agree nor disagree” with more than a 71% of the votes.

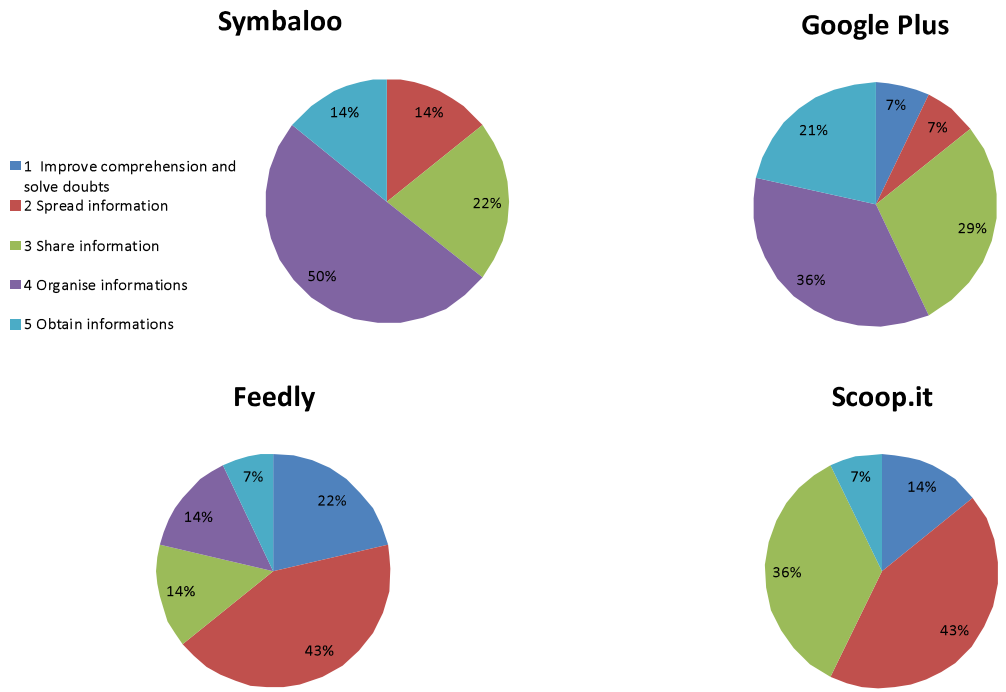

Fig. 4. Students' access to Internet evaluation st different areas.

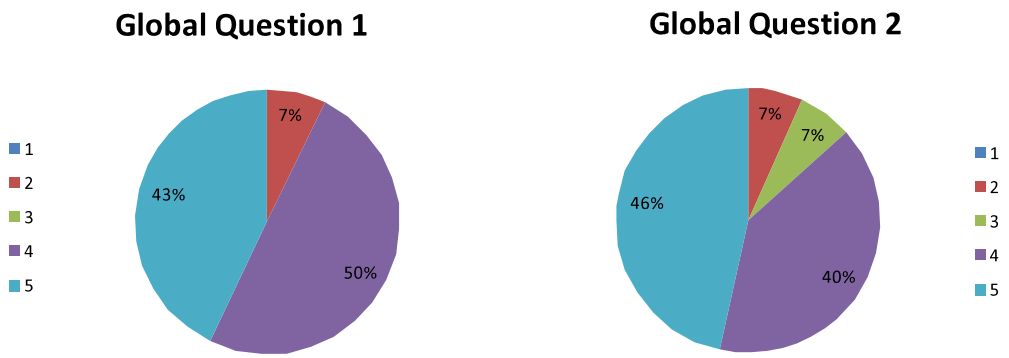

Fig. 5. Global question 1: Does the evaluation of the activity adapt to both work and effort made. Global question 2: Does the consecution of this activity help me develop abilities and competencies considered important towards my professional future?

In a second group of questions, they have identified the functionality of the new tools used and with which they will create a PLE about the gaugues learned in the Data Acquisition Systems Subject: Symbaloo, Google+, Feedly and Scoopit.

As it is shown in Diagram 5, a 50% and a 36% of the students identify the principal function of the contents organization for Symbaloo and Google+ respectively. In the case of Feedly and Scoopit, students would use them to widen and share information, which are its most highlighted functions.

Finally, two global questions were relocated. Firstly, students were asked to interpret if the evaluation of the activity was correctly adapted towards the work and effort. A 43% of students totally agreed, and 50% of them agreed on the effort evaluation. In second place, students were asked if the consecution of the activity helped them to develop competencies and abilities considered to be crucial towards facing their respective professional future.

In this case, the response percentajes went from 46% who answered a 5, and 40% who answered a 4. The 86% of the participants agreed or totally agreed about the usefulness of the experience looking forward to a professional future. On the other hand, there was only a 7% who weren't sure if the tools presented to create a personal learning environment were of any use. These results encourage teachers to enhance this experience to many different areas and subjects regarding the teaching innovation project.

VI. Conclusions

According to the compiled information previously exposed, it's interesting to see how students from this degree tend to associate web browsing with leisure activities, communication and infotainment, rather than areas like work, organization skills or curricular development.

Students collaborated together in order to develop a PLE about one of the most complex and varied themes of the SAD subject. This self-made environment can be completed at the same pace in which the students develop their own skills on each of the subjects areas. The students also had access to the tools they were offered, encountering no difficulty whatsoever in order to use them correctly.

As it follows, students were consulted about the overall experience; by answering a survey, their experience gets monitorized and feedback is sent to the subject investigators. Firstly, students were asked to assess if the evaluation of the activity correlates with both the effort and work accomplished. According to the results, the 93% of the students assessed the experience as "very positive".

Finally, once all the information is gathered and put together, it is important to highlight how the work done (including all of the associated activities for the PLE development) has been positively assessed by students not only referring to the SAD area, but also remarking the learning process carried out within other engineering scopes. This can be reaffirmed with the fact that 86% of the interviewed "totally agree" or "agree" about the experience being useful towards a more professional orientated future. Teachers receive positive feedback from this valuations, which can make them expand the experience to other related subjects involved in the teaching innovation project, defined as: "Environment integration and personal learning schemes as a way to enhance teaching in a college engineering degree (PLE - PLN)", in which the proposal is framed.

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