ENHANCING USER EXPERIENCE IN VIRTUAL LEARNING ENVIRONMENTS WITH DIGITAL PENS

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Abstract

The exponential evolution that Information and Communication Technologies (ICT) have suffered the last years has been one of the reasons why all type of sectors as industrial or educational have improved their productivity. One of the disadvantages of this fast evolution is that not all users have been used to this new technologies, basically because the way of doing a task has drastically changed. This problem is known as "increase of the technological or digital gap". In order to reduce this technological gap we have designed, implemented and evaluated a new Virtual Learning Environment (VLE) based on digital pens. This solution consists of the integration of typical devices with a Learning Management System (LMS), concretely, Google Apps. A digital pen looks and feels like a normal ballpoint pen but thanks to it the handwriting can be captured, stored and sent by a safe way. In this case these data are sent to the LMS where students can manage and share notes by this platform and complete an existing document in the LMS with the digitalized information. The platform also offers a way to evaluate the students. Students can do several tests created by teachers previously. To carry out this activity, students will use a digital pen. Thus, the digitized information with the answers of the students will send to the platform where the tests are corrected immediately.

Keywords: Learning Management Systems, digital pen, technological gap.

1 INTRODUCTION

During several years educational plans have suffered different changes. In spite of these changes has never been a consensus between different countries in order to have a common plan. At superior level (University) this problem has been resolved thanks to the Bologna plan.

Bologna plan [1] was born in 1999 in Bologna (Italy). This plan was created by all the Education Ministers of the European Union. The main goal of this plan is the European Space of Superior Education improvement. Taking into account the agreement to which different countries reached, this plan must be implanted in all Universities before 2010.

One of the most important changes that this plan carries is the modification of the teaching method. Before this plan was implanted, teachers evaluated their students basically by examining them, they based the student qualification on the concepts he knew. With the Bologna plan, now, the teaching method is based on concepts and competences.

Thanks to these changes in the teaching method, now what the student learns is more related with the professional profile he wants to have. The aims of the Bologna plan are the improvement on the learning of the student and to guide him to the employability more than helping the student to get good marks.

The competences that with the teaching method want to be transmitted to the students are divided in two subclasses [2]. On one hand, there are the specific competences. These types of competences are the ones that are closely linked to each profession. On the other hand, there are the generic or transversal competences. Thanks to this class of competences the student will know how to face up to different situations that will appear in his professional life.

Inside the generic ones we can find instrumental (tools for learning and education), interpersonal (capacities that allow students to have a good social relationship) and systematic (related with the global conduct management) competences.

One of the interpersonal competences that the new teaching method wants to drive is the teamwork. This is one of the principal reason why we have designed and implemented a system centred in giving facilities to students in order to do teamwork.

The article is structured in the following way. Firstly, in section 2 what a digital pen is and its functionality is explained. Section 3 presents the most used Learning Management Systems (LMS). In section 4 we explain the mixed platform we have designed and implemented. Section 5 presents a preliminary evaluation we have done. Finally, our research conclusions are shown in the Section 6.

2 DIGITAL PEN

The use of digital pens [3] has increased during the last years and nowadays you can find them in different sectors as administration, health and education.

These kinds of pens are aesthetically similar to the traditional ballpoint pens as is shown in the Fig.1. The person who uses a digital pen rarely realises that he is using this kind of pen instead of a traditional one while he is writing. Although the user does not realise, the digital pen has a digital micro camera inside of it. This camera records what the user is writing (50 captures per second) and saves it in an internal memory. When the user has finished, what he has written is sent to a server that digitalizes it.
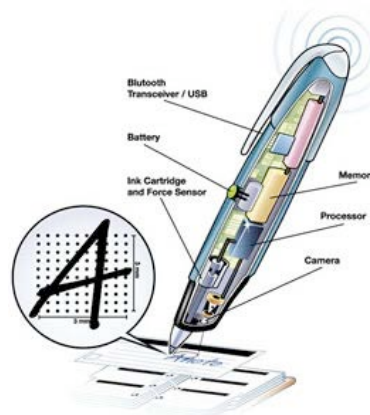

Figure 1. Digital Pen

The problem that has the use of the digital pen with a typical sheet of paper is that when the information that the user has written is digitalized it is impossible to know exactly in what part of the sheet of the paper has been written.

The Anoto Technology [4] was created in order to solve this inconvenient. This technology uses a digital pen and an own pattern to digitalize what the user writes. The digital pen is used with a surface that has the Anoto dot pattern printed on it. Thanks to this pattern, the digitalization server can detect in which exact point of the paper the user has written. The pen reads and records pen strokes in relation to the barely visible pattern. Thanks to this pattern, apart from detecting in which position the user has written, also recognizes in which sheet of paper has been written.

3 LEARNING MANAGEMENT SYSTEMS

A Learning Management System (LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events. These kinds of platforms have been implanted in several education centres during the recent years.

Moodle [5] is an open source LMS platform and it was one of the first LMS to appear into the market. Thanks to these two characteristics Moodle is the LMS which has the highest market share. Moodle offers the lecturer the possibility of administrating different courses, groups and documents inside them. The students can access the information the lecturer has uploaded and communicate with other classmates and lecturers.

But undoubtedly, the strongest point of Moodle is the community of developers behind it. The developers create different modules that add new functionalities to this platform, which makes Moodle be updated all the time.

Other LMS that is commonly used is the Blackboard Learning platform [6]. This product belongs to Blackboard Company which also offers other kind of platforms such as *Collaborate*, *Analytics* and

Mobile. Although the functionality of Blackboard Learning is mostly the same, due to its commercial use the market share of this platform isn´t as high as Moodle´s.

As Moodle, Blackboard Learning offers to the developers the opportunity of adding extra functionality to the platform. In this case, the problem is that the developer community isn´t has high as Moodle's.

Sakai CLE [7] is another open source LMS. Despite being a relatively new platform it has entered deeply into the market. Although the features this platform offers are basically the same as the two platforms aforementioned, Sakai adds one more in its basic distribution. The feature consists in tests management. Thanks to it the lecturers can evaluate in an easy way the knowledge of the students.

These three LMS platforms are the most commonly used ones, but there are also other fairly used platforms.

Although a high rate of education centres use this kind of platforms specifically created for education sector, there are also centres where generic platforms are used. The most used platform in this case is the Google Apps platform [8], and concretely GoogleDocs. The main advantage this platform offers is the possibility of sharing and managing documents in a collaborative way and the integration with other Google applications. But the problem that exists is that as it is not a specific education platform, it has not the functionality of course management and all the consequences it entails. Usually the education centres that use this platform, do that as a consequence of having an agreement with Google Company. Table 1 shows the differences between the LMSs.

Table 1. LMS Comparision

	Moodle	Blackboard	Sakai	GoogleDocs
Course Management	Yes	Yes	Yes	No
Test Management	Yes	Yes	Yes	No
Collaborative online edition	No	No	No	Yes

Once we have analyzed the most used LMSs, we have realized that although through this kind of tools the access to the courses content has been centralized and automated, they do not enhance the collaboration between students. This fact has to be taken into account, among other things because the collaboration is one of the competences on which the Bologna plan emphasizes more.

Usually the lecturers are the only ones that share contents using the LMS in order to make them available to the student. We have observed that one of the reasons why the students do not share their notes with other classmates is because it represents an extra work for them. Students are not willing to take notes using a computer or spending time passing their handwritten notes to digital notes once the lesson has finished.

4 MIXED PLATFORM

Our intention with the system we have designed is the integration of the use of paper with different LMSs in order to allow the creation and sharing of documents as well as promote collaborative activities both in classroom and on a remote way. To carry this out we have defined a mixed learning environment where the traditional paper and the new technologies are united. In this way the system promotes different competences such as teamwork and self learning.

4.1 Functionalities

The system we have designed has different functionalities. The most important ones are described below.

4.1.1 Digitalization

Once the student has written on a paper with the Anoto pattern printed on it, the digital pen sends the handwritten information to a computer or a mobile device via USB or Bluetooth. From these devices the information is sent to a server where what the student has written is digitalized and saved in the system. The format in which this information is saved is different if what the students has done is a test or he has takes notes about a lesson.

4.1.2 Content Management

The student can manage all the notes he has taken in class thanks to this functionality that the system offers. Using any device which has access to Internet (PC, Tablet, mobile, etc) the student can create new documents with the digitized content, add information to a document that already exists or classify all the digitalized contents.

4.1.3 Tests Management

The system we have designed allows the user to know the mark he has obtained in the test he has done five minutes ago. When the student connects to the system can access the information of all the tests he has done. This information includes the mark he has obtained in the test and the questions he has answered correctly or badly and why.

4.1.4 Share of content

In order to enhance a continuous collaboration between students and lecturers, the system offers the possibility to the user to share his documents with his classmates and lecturers. This functionality offers the user the possibility of obtaining extra knowledge thanks to the notes of other people. But also the person who shares his documents takes advantage of it because the people who read the content he shares can check it, add commentaries and evaluate it.

Besides this we have to take into account that apart from the functionalities that we have implemented, we have to add all the functionalities of the LMS which have been selected to integrate with.

4.2 Scalability

As we have explained before, our solution integrates with different LMSs in order to offer the students as many functions as possible apart from the ones the platform we have designed does.

After an analysis, we have decided to integrate our solution with GoogleDocs and Moodle platforms. We have selected these two platforms because they have a high market share and the minimum functionalities that a LMS should have. Although we have only integrated our system with two platforms, the system is designed and implemented in such a way that the integration with other platforms can easily be done.

We have decided to design the system in such way because we think than our system is very productive and there will be education centres that use different LMSs and will be interested in integrating them with the platform we offer.

4.3 Measurement of competencies

As we have commented in the Introduction of this paper, nowadays the teaching method in the Universities is based on competencies. With our platform we enhance basically two competences: Self motivation and Teamwork.

By carrying out tests, students can assess themselves whenever they want and test their knowledge about the subject they are reviewing. In this manner the students are self motivated at all times and they can check their progress in the study by carrying out the tests.

On the other hand the teamwork of students is enhanced thanks to the possibility of content sharing that the platform offers. The possibility of measuring this competence adds value to the solution we have proposed.

5 EVALUATION

In order to validate the system we have measured several parameters related to the quality in use. According to ISO/IEC 9126 [9] standard the quality in use is defined as the quality of the software system that the user can perceive when it is used in an explicit context of use. Focusing on this work, we have defined the quality in use as the quality of the implemented platform that the students and lecturers can perceive when it is used in the context located at the University of Deusto.

To measure the quality in use using the platform described by this work, quality in use has to be divided into four main capabilities. According to the mentioned standard, those capabilities are four: effectiveness, productivity, safety and satisfaction.

- Effectiveness: The capability to enable users to achieve specified goals with accuracy and completeness.
- Productivity: The capability to enable users to expend appropriate amounts of resources in relation to the effectiveness achieved.
- Safety: The capability to achieve acceptable levels of risk of harm to people, business, software, property or the surrounding environment.
- Satisfaction: The capability to satisfy users.

Focusing on the teacher experience using the platform, we have measured only the effectiveness, productivity and satisfaction capabilities.

The metrics used to calculate the shown capabilities are based on the adaptation of the exposed capabilities. In order to do so, we have redefined the effectiveness as the capability to enable teachers to achieve the evaluation of the student knowledge with accuracy and completeness. Productivity is redefined as the capability to enable teachers to expend appropriate amount of time in relation to the effectiveness achieved. Finally, satisfaction is defined as the satisfaction level of the teachers using the platform exposed.

Due to the difficulty to obtain resources, the evaluated group is only formed by two teachers and several students of the Network Design and Evaluation subject that is taught in the fifth year of the degree of Computer Engineering at the Faculty of Engineering at Deusto. We lent five pens to the students who could share notes by the exposed platform. After that, students had to make tests to evaluate their acquired knowledge. The students assisted three classes in which they had to generate notes. After the notes taking, the students studied and they were evaluated by the platform. These tests have been studied by the teachers and several metrics (see Figure 2) have been captured by one form for the subsequent calculation of the exposed capabilities.
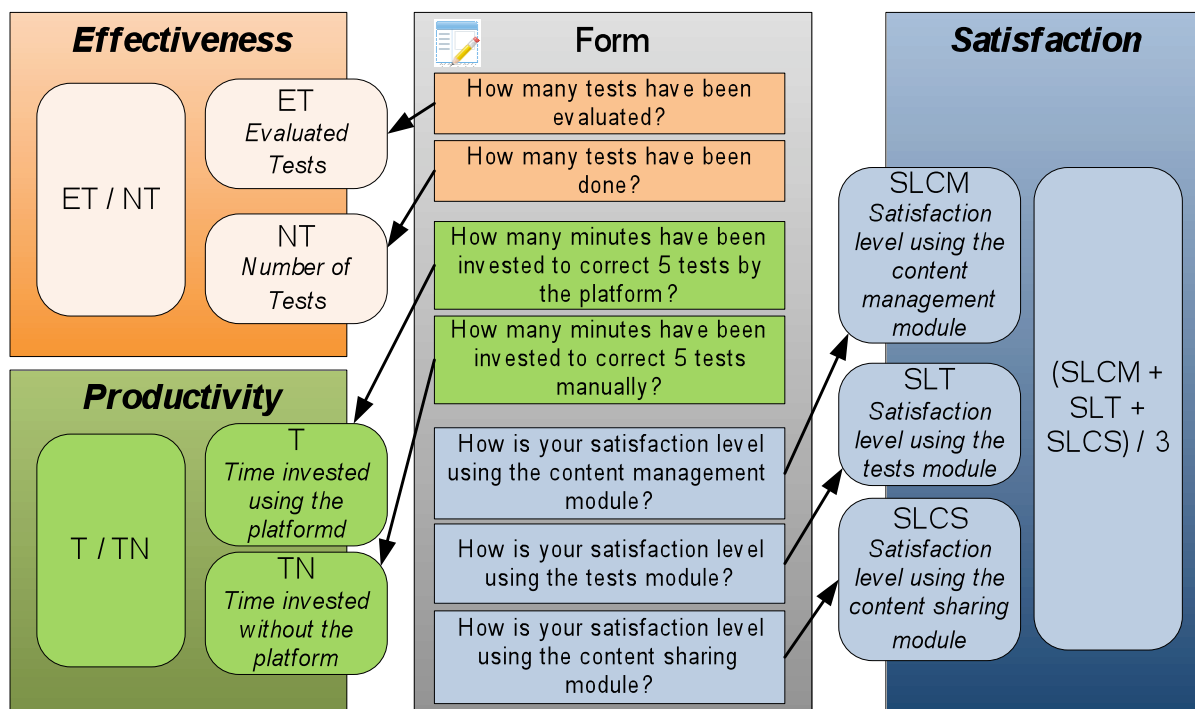

Figure 2. Capabilities and metrics to measure the quality of use of the exposed work.

In order to calculate the effectiveness, the teachers have to measure the number of tests evaluated and the number of all tests. To calculate the productivity the correction time has to be retrieved. Finally, satisfaction level is measured by the average of the different satisfaction questions about the developed platform.

As we have exposed previously, this evaluation is focused on the teachers experience using the platform. We have obtained the capabilities metrics by using Google Docs. One form created by Google Docs has been sent and answered by mail. The retrieved results can be seen on the following table. The implemented platform is 100% effective; it means that teachers can evaluate every test done by the platform. This system has a good satisfaction level (82.5%) but the best result is the system productivity. Teachers will evaluate by the system 3.5 times faster than manually.

Table 2. Retrieved results

Capability	Teacher 1	Teacher 2	Average
Effectiveness	100%	100%	100%
Productivity	340%	366.66%	353.33%
Satisfaction	80%	85%	82.5%

6   CONCLUSIONS

To conclude, we have designed, implemented and evaluated a system that enables notes sharing by a digital platform with digital pens, notes evaluation and automatic test correction. By this way, we can improve not only the specific competencies, but also the transversal competencies. We can also provide a better method to digitize the notes without new strange devices enhancing the user experience focused on students but also on teachers.

In order to validate the developed platform we have validated focusing on the quality in use and the teacher experience. In order to do so, we have evaluated the capability the system has to enable teachers to achieve the evaluation of the student knowledge with accuracy and completeness, expending a reduced amount of time with a good satisfaction level of the teachers. Because of that we can conclude this system can enhance the user experience without requiring additional knowledge.

REFERENCES

[1]   Poblete Ruiz, M. Evaluación de competencias en la educación superior. Preguntas clave que sobre evaluación de competencias se hacen los profesores.
http://paginaspersonales.deusto.es/mpoblete2/PONENCIA01.htm

[2]   Poblete Ruiz, M. Evaluación de competencias en la educación superior
http://paginaspersonales.deusto.es/mpoblete2/EVALUACIONCOMPETENCIASPUCON.htm

[3]   Digital Pen. http://www.anoto.com/?id=19146 (retrieved on September 22, 2011)

[4]   Anoto Pattern. http://www.anoto.com/?id=19147 (retrieved on September 22, 2011)

[5]   Moodle Platform. http://moodle.org/about/ (retrieved on September 23, 2011)

[6]   BlackBoard Platform. http://www.blackboard.com/ (retrieved on September 23, 2011)

[7]   Sakai CLE. http://sakaiproject.org/node/2260 (retrieved on September 23, 2011)

[8]   Google Docs basics https://docs.google.com/support/bin/answer.py?hl=en&answer=49008 (retrieved on September 23, 2011)

[9]   ISO/IEC 9126:2001.(2001). Information Technology - Software Product Evaluation Quality Characteristics and Guidelines for their use.