Using Integral E-Portfolio to learn Linear Algebra

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Abstract—**The use of e-portfolio is becoming common in the learning and assessment of students. This is due to the need of teachers to enhance student autonomy making them to reflect on the process of learning. Lately, we have worked with different software, facilitating its generation and use. In this paper, the recent experience in the use of e-portfolio for undergraduate students of the Universitat Politècnica de Catalunya are set.**

Index Terms—**E-portfolio, integral e-portfolio, linear algebra.**

1. INTRODUCTION

Throughout history the use of portfolios was more common in other areas of knowledge than mathematics in general and linear algebra in particular, as, for example, in architecture and arts fields. The emergence of Information and Communication Technology (ICT) has caused a change in the world of education and one tool in within the ICT context is the use of e-portfolio.

In recent years is becoming habitual use of the electronic portfolio for learning and assessment of students. This is due to the need for teachers empower students through reflection on their own learning processes ([17]). The electronic portfolio not only is an electronic learning portfolio, its great potential could be used in other professional fields. In the field of education has extended its use as a technique for gathering evidence and competencies rather than integrating evaluation in the teaching-learning process by collecting samples of learning activities at key moments and reflecting on achievements and difficulties encountered in the scope of both generic and specific competencies that had been proposed, showing their ability and progress.

In the last years several authors work in introducing the e-portfolio at the higher education, as we can see in [2], [4], [5], [8], [10],[11], [13], [17] and [16] for example.

2. LINEAR ALGEBRA FOR UNDERGRADUATES

It is well known that Linear algebra is fundamental in different areas of sciences. Because of multiple problems can be modelled by means linear systems where linear algebra became essential to obtain and discuss the solution.

Nevertheless, one of the main difficulties to overcome in the first year courses of university students enrolled in different programs other than the career math is that they do not see the importance that mathematics may have in their fields of interest. This can seriously affect their motivation in the course, and its ultimate success. This effect appears to be more pronounced in the first year of linear algebra due to its abstract factor, while the calculus find it easier to think that may be useful.

To address the question that every teacher of linear algebra often heard: why do we need to know that? we can make use of new technologies and in particular we can use the e-portfolio.

After to propose several projects about real life problems, students can place their progress in the e-portfolio. Through the e-portfolio, the students can discuss among peers and with the teacher.

In this paper we present a model of e-portfolio for the subject of linear algebra. This model will be implemented in engineering studies of the higher technical School of Engineering at the Universitat Politècnica de Catalunya.

To prepare this e-portfolio has been essential define the goals which we want that the students reach as well as the topics that we consider basic to overcome objectives.

The topics include linear system equations, vector spaces, matrices, linear maps, the matrix of a linear transformation, change of basis, eigenvalues and eigenvectors (see [12] and [15] for an undergraduate course of linear algebra).

3. E-PORTFOLIO

Portfolio is a word of French origin "portefeuille" meaning briefcase for carrying books, papers, etc. In the field in question, the university teaching, the word comes from "Portfolio Assessment" or "Portfolio process", so it has the sense of "assessment folder" or a broader form of "learning portfolio". In the case where this activity takes place on a digital platform called an e-portfolio. More specifically in our context, the portfolio is a method of teaching, learning and assessment is the contribution of different types of productions by students through which they can judge their abilities in the context of a discipline or field of study. These productions staff report process followed by the student, allowing him and others to see their efforts and achievements in relation to the learning objectives and evaluation criteria previously established.

A. Different ways of using the e-Portfolio

The e-portfolio allows students and teachers, create and manage a virtual space with both personal, academic and professional (see [3]); turn incorporating a review and justification of the importance of these activities have.

a) E-Portfolio Evaluation:
   It allows to assess the achievement of specific criteria to obtain a degree or work.
b) E-Learning Portfolio:
   Allows providing information on learning objectives incorporating both self-reflection and the student and the teacher
c) E-Portfolio "Demonstration of best practices":
   Allows submit information to specific audiences or achievements.
d) E-Portfolio Transition:
   Let us bring evidence and records useful in times of transition or passage of an academic level to another

Regardless of the mode of use of e-portfolio, the process of design, creation and development involves data collection, organization, reorganization and presentation.

Hellen C. Barrett in [6] proposes a balance between all the possibilities of use of e-Portfolio and is represented by means the graphic Figure 1. Specifically in the graph, the author proposes a
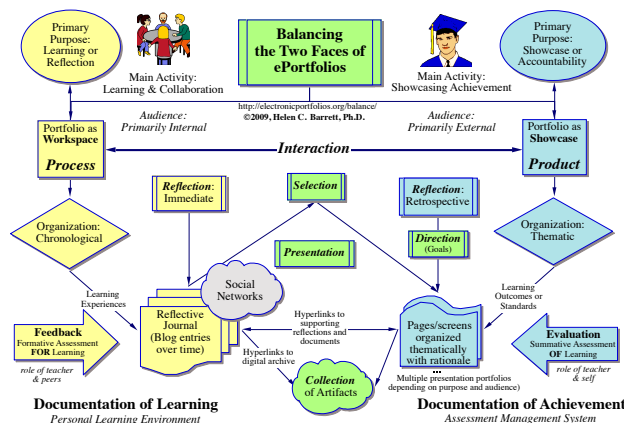

Figure 1.   Balancing the Two Faces of ePortfolios [6]

balance between different aspects of the e-Portfolio that interact along a continuum such as: Process-Product, Immediate reflection-Reflection retrospective, Reflective journal-Organized web pages, Formative evaluation-Summative evaluation, Learning documentation-Documentation of achievements, among others.

4. THE E-PORTFOLIO AND LINEAR ALGEBRA COURSE

After analyzing the different types of e-portfolio, firstly we thought that the most appropriate model of e-portfolio would be used in a course of linear algebra is the "e-Portfolio as a repository of learning experiences"

By means this kind of e-portfolio, teachers and students can work activities and teaching and learning using the Internet. More specifically

a) The student uses the e-portfolio for:
   1) Collect, systematically, the learning achievements,
   2) Self-assess how to acquire and develop the skills required in the subjects they are studying.

3) Self-assess their learning outcome.

b) The teacher uses the e-portfolio for:

1) Collect and place the work done by students in their courses.
2) Evaluate how to acquire and develop skills by students through the implementation of some activities (with the tutor, with the peer group, independently, etc..).
3) Evaluate the outcome of learning.

But finally and after observing that the different uses of e-portfolio are not exclusive and all of them can be used simultaneously, we believe that the most appropriate is to use the "integral e-portfolio", that is to say an e-portfolio that integrates all the different uses.

With this type of e-portfolio, cooperative learning is stimulated, this type of learning is very important for engineering studies (see [1]).

5. INTEGRAL E-PORTFOLIO EDITION

To implement the integral e-portfolio we use the integrated Moodle and Mahara (Mahoodle) platform, as well as the simultaneous use of platforms Exabis inside Moodle and Google Sites.

Different authors as for example Diana Bri, Miguel García, Hugo Colls, Jaime Lloret in [7]), analyze educational platforms in order to facilite the decision about platform on which to choose.

"Mahoodle is the usual name given to the joining of the systems Mahara and Moodle. Mahara is an open source e-Portfolio and social networking web application and Moodle it is an open source e-learning platform, also known as a Learning Management System, or Virtual Learning Environment. Both systems have built-in support for each other in the form of single sign-on and transfer of content or export different types of objects from Moodle to Mahara (API Portfolio) and to import objects from Mahara to Moodle (API repository). You can only link one to one Moodle Mahara either place the level of an individual institution or individual institution. You can not link Moodle in various institutions in Mahara. Exabis is also an open source of e-Portfolio able to be connected to Moodle by means of a plug. We are using the e-portfolio 4.1 version for Moodle, "My Portfolio" in Exabis, let us users upload files,
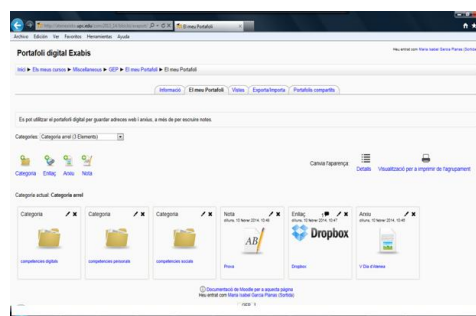

Figure 2.   E-portfolio Mahoodle model,

Figure 3.   E-portfolio Exabis inside Moodle

In figures 2 and 3, images of two models of e-portfolios that have been made using Mahoodle and Exabis + Moodle respectively have been presented.

With respect Figure 2 we have included different sections to help to the students to configure their e-portfolio. The selected model is in such a way that fits the needs of the course, although students can add more paragraphs to make visible their portfolio and can display more information of the minimum required for the course. In the left side appear the icons to introduce the profile and curriculum, a place to put files and a place to keep a journal. In the center the icons that allow you to organize personalized portfolio and the right side is the place to share (links to discussion groups) set the privacy level of each part of the portfolio.

In Figure 3 different pictures called categories where each of them gives access to different competencies are observed. It is possible to access to multiple frames and assign different categories. In this particular case, we have chosen three categories for storing information, one of one is for the student profile, there is also access to a table that is used for notes and drafts and also there is network access.

The Exabis platform is simpler than Mahara however is easier to import and export materials

from Moodle.

6. EXPERIENCES IN USING E-PORTFOLIO

In our experience with students from the Universitat Politècnica de Catalunya has been taken into account that the learning activities for the development of an electronic portfolio are setting learning objectives, data collection, peer review, feedback from peers, reflection, and sharing of materials. These activities include gathering knowledge, organization, reorganization, presentation, sharing, application, knowledge accumulation and management.

During the year 2012-13 started a pilot implementation of the e-portfolio in the student test using Mahoodle management system within the Athena Labs platform This project is developing and testing with a selected few number of student participation. In the year 2013-14 the pilot has expanded to the use of Exabis + Moodle. With this assay we can compare advantages and disadvantages according with Mahara or Exabis was used.

The academic results obtained by the students who have participated in this pilot have been better than those of other students. However, the small number of students who have participated not allow to extrapolate results. The next academic year 2014-15 will launch this pilot but in this case the assay will involve all students enrolled in the first year of undergraduate degrees in Industrial Technology, Chemical Engineering and Materials Engineering.

The study has been performed on the portfolio to be used in the subject of algebra can be applied to other materials, but the structure of the portfolio must be adapted to the subject. In fact, during the academic year 2011-12, we conducted a pilot study for the subject of drawing, but in this case the online application used to be Google Sites. Participants were chosen from among students of the School of Architecture of Barcelona of Universitat Politècnica de Catalunya, studying the subject of drawing I corresponding to the first year of studies. The pilot test was conducted in two groups called M13 and T21 with a share of 82.19% and 92.14% of students, respectively. The procedure followed was to integrate an e-portfolio in their academic activities distinguishing traditional teaching of distance teaching. Students also introduce its curriculum and
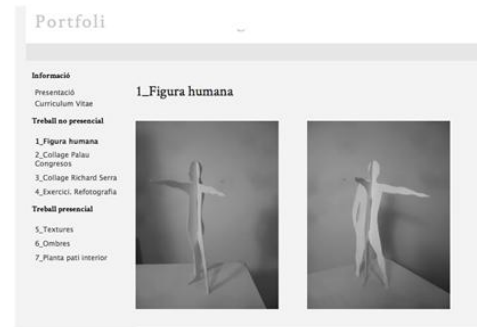

Figure 4.   Source: ETSAB, Drawing Course I, year 2011-12

the work, should develop a short summary including both text and images summarizing the results of the activities. The instrument used as we discussed was the Google Sites platform.

7. CONCLUSION

As a conclusion we show some advantages of using portfolio

a) Promotes global formative assessment
b) Integrate generic and specific skills
c) It allows the student to demonstrate the depth of their learning,
d) Provides opportunities to reflect on their learning and how far they have come
e) Learning to learn and take more responsibility in their learning process
f) Provides opportunities and evidence to evaluate teaching
g) Facilitates horizontal and vertical coordination of content (feedback from colleagues, department, etc.).

Through our experiences we can conclude that the e-portfolio through Mahoodle is a good tool to link teachers with students and vice versa, and to optimize this tool is necessary to improve the interconnection between Mahara and Moodle platforms, and also Exabis and Moodle.

In order to enable students to actively use the e-portfolio is necessary for teachers to prepare guidelines and provide a reference template.

Moreover teachers must prepare and plan the course comprehensively in order to coordinate the different tasks carried out in the classroom with the work of the e-portfolio.

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