

# Mathematics for Engineering from a platform based in the project Sakai

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**Abstract** – Polytechnic University of Valencia (UPV) is a Spanish university since 1971 whose main focuses are the science and the technology. This university was founded in 1968 as the Higher Polytechnic School but some of its schools like the Design Engineering School (ETSID) are more than 100 years old. One of the ETSID delivered degrees is Aeronautic Engineering where from its outset in 2005 the use of innovative teaching methods based on technology has been promoted. Since 2005 UPV is using a teaching platform known as PoliformaT that it is based in the project Sakai ([www.sakaiproject.org](http://www.sakaiproject.org)). This platform includes several tools such as ‘Resources’ for the distribution of documents, ‘Forums’ and ‘Chats’ for consultations or discussions, and online ‘Assignments’ and ‘Tests’ to make evaluations after each session or certain blocks. During 2009/2010 we have used MATHEMATICA 6 as mathematical software and are fully implementing the use of Sakai from the very beginning both in laboratory classes as well as in the corresponding exams. Results and opinions of the students have been obtained with another Sakai-tool, the so called ‘Surveys’, which are discussed in this paper.

**Index terms** – computed aided mathematics, educational platform

## INTRODUCTION

Teaching in Spanish universities is evolving with the arrival of ICT in recent years. This process started in the mid-90s with our first computer aided mathematics classes specially meant for engineers. Since then, our lab classes have constantly been updated in content, merging into theoretical and practical classes and use of different software: DERIVE and MATHEMATICA [1, 2, 3, 4].

On the other hand UPV has recently implemented a learning platform known as PoliformaT, which is based in the Sakai project [5], with the aim of facilitating the introduction of ICT into diary tasks.

With this platform, the UPV intended to provide the university community with:

- A place where teachers find the tools necessary to structure and handle their courses using new technologies.
- A support for student queries in the subjects that they are studying and plan their work.
- A meeting point for teachers and students, allowing communication and joint work of both groups.
- A space where students can be evaluated in real-time related to the subject, and where teachers are able to develop and keep the topics presented to the students and the results that they have obtained.

In this paper we show how we have performed the migration of laboratory practices without the platform within the subject of Mathematical Fundamentals of Engineering in Aeronautical Engineering at the Design Engineering School ETSID (UPV) to using PoliformaT taking advantage of the change of semester.

## THE POLIFORMAT PLATFORM

PoliformaT was born from the union of several projects that the UPV has developed for the implementation of new technologies at various stages of teaching. At the same time, the UPV conducted an investigation of the most advanced educational platforms that exist today. From these studies and tests resulted in the election of the SAKAI project as suitable to be implanted in the UPV. Other prestigious universities are also involved in the SAKAI project, which is based on the philosophy of Open Source development [5].

The platform is available to members of the UPV since September 2006, thereby initiating the process of integrating the applications needed to manage the courses. It presents an interface of similar appearance in all subjects, thus facilitating its use by the students. This may have slight variations, because teachers can customize their subjects by activating or modifying the initial configuration. In this way they may:

- Create materials based on a text to which it can attach graphics, photos, videos and links quickly and easily by using a simple tool.

- Develop multimedia recordings (polimedias), which are synchronized with the image of a teacher or a digital representation on boards.
- Manage in a simple and efficient way classroom materials, having a place where to store information in any format.
- Propose and compile tasks and jobs that are needed.
- Handle group information.
- Submit and evaluate exams with different types of questions.

## MATHEMATICS FOR ENGINEERING WITH POLIFORMAT

Our Laboratory Practices are an integral part of our subjects and are given the prominence they deserve, both in content and in its assessment. The weight given to laboratory practice is 30% of the subject Mathematical Fundamentals of Engineering of the BEng in Aeronautical Engineering degree at ETSID.

Laboratory practice consists of three main parts: a first one that each student has to work out by itself, a common tuning at class with the instructor and a final part in which each student has to solve several questions and problems in the line of those developed previously.

Before each laboratory practice the students are told the subject we will cover next day at class. The students must revise the theoretical background of the practice which has been studied in the theoretical/practical classes and then they must learn the MATHEMATICA 6.0 commands related to the topic by reading and working a text prepared by the instructors [4]. Students should do the practical exercises proposed in this text with the aim of checking that they have understood the adequate use of these commands.

The first part of the class is taken up to revise all the command which are to be used and pointing out the main and more problematic issues of the theme. During this time have a chance to ask and clarify any problem they might have had either with the commands or solving the proposed exercises.

Once this has been done, each student on a personal basis must solve some exercises related to the subject by means of MATHEMATICA and conveniently introduced through PoliformaT. Each exercise is conveniently uploaded by each student in a file which remains available, with his/her answers along the right answers, for posterior check. This check may be carried out by the student during the whole year as well as by the instructor. After the solutions of the exercises are introduced by each student in each practice, the platform grades all exercises immediately after its completion.

All these exercises receive a weigh of 40% in the grading of the laboratory mark. The remaining 60% is obtained through two individual exams, one at the end of each semester, carried out with PoliformaT.

During each exercise the student will find all types of questions and answers: Multiple choice, True or false, and mostly Numerical response. An example of the last type may be seen as the one requested in Fig. 1 where the student has to follow several steps in order to apply properly the Stokes Theorem.

Time remaining: 0:49:10

Ocultar/Mostrar el tiempo restante

Parte 1 de 1 -

Preguntas 5 de 6 2.0 Puntos

Considera el campo de fuerzas dado por

$$F = (y \cdot \cos(xz) - xyz \cdot \sin(xz)) \mathbf{i} + x \cdot \cos(xz) \mathbf{j} - x^2 y \cdot \sin(xz) \mathbf{k}$$

y el arco de la curva alabeada C dada por

$$(\cos(t) / \sqrt{2}) \mathbf{i} + (\sin(t) / \sqrt{2}) \mathbf{j} + t \mathbf{k}, \quad \pi/4 \leq t \leq 6\pi.$$

a) Calcula la divergencia y el rotacional de F y evalúalos en el punto (1,-1,2)

Sol.:  $\text{div}(F) =$   y  $\text{rot}(F) = (*, \text{, *).$

b) Calcula la función potencial U(x,y,z) de F que se anula en (0,0,0). Evalúala en (1,-1,2)

Sol.:  $U(1,-1,2) =$  .

c) Calcula las coordenadas de los extremos del arco de curva.

Sol.:  $C(\pi/4) = (\text{, , )}$  y  $C(6\pi) = (\text{, , .$

d) Halla el trabajo realizado por la fuerza F a lo largo de la curva C desde el punto C(pi/4) hasta el punto C(6pi).

Sol.:  $W =$  .

Guardar y continuar Anterior

FIGURE 1

STUDENTS' SCREEN SOLVING AN EXERCISE WITH POLIFORMAT

As shown the student is able to see the remaining time on the left top corner of the screen.

The instructor is able to edit the score in one or more questions if necessary, but the result recorded by the student is always inaccessible. The instructor can even obtain get statistical data from the results of the whole session (see Figure 2).



FIGURE 2

STUDENTS' GENERAL STATISTICS PROVIDED BY POLIFORMAT

It is also possible to get the data related to one single question which may have several items as shown in Figure 3.

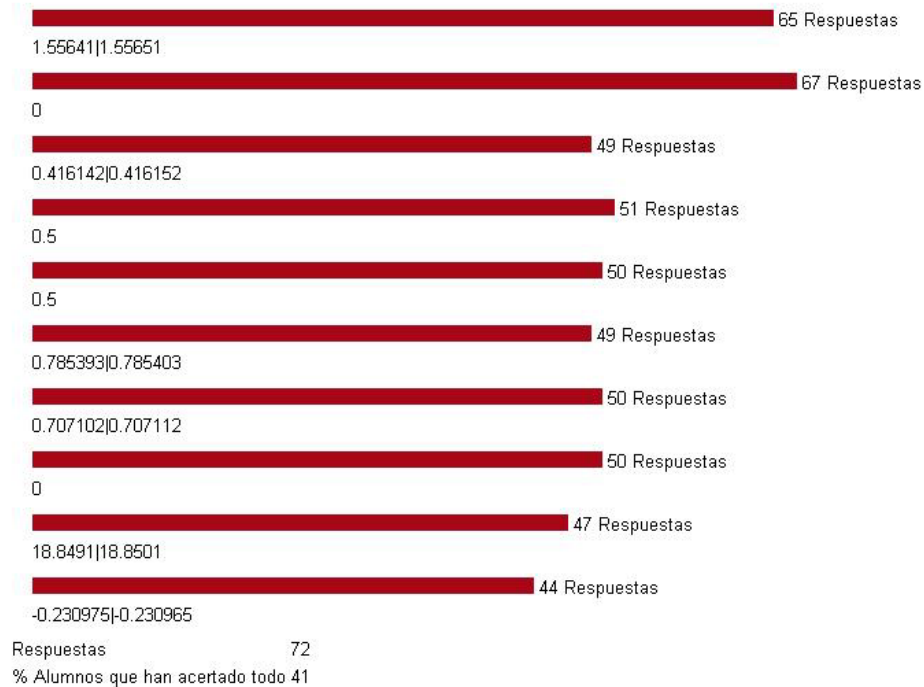


FIGURE 3

STATISTICS ON A SINGLE QUESTION WITH VARIOUS ITEMS PROVIDED BY POLIFORMAT

When the student has finished the practice, or time is over, the exam is sent to evaluation if the instructor has decided so, and the result obtained. It is up to the instructor whether the grades are to be transferred to the platform tool 'Marks', where each student can view all his/her notes.

## SURVEY ON THE LABORATORY PRACTICE

The platform PoliformaT allows to consult the students on issues in a completely anonymous way. The authors have used this tool during 2009/2010 course.

The questions proposed correspond to different issues. The first two questions were concerned with the organization of the practices itself. The questions, possible answers and results are shown in the Table 1.

<i>Do you think that the number of practices undertaken is adequate to learn the content of the subject?</i>	
Yes	92 %
There should be more	4 %
There should be less	4 %
<i>Do you think the assessment of laboratory practice in each session fits to the content developed previously to and during that session?</i>	
Much	34 %
Enough	51 %
Little	15 %

TABLE 1  
PERCEPTION OF STUDENTS ON LABORATORY PRACTICE IN GENERAL

It is clear that the vast majority of students thought that practices that have been done were very consistent within the course.

A second block of questions searched for the opinion of students about the benefits of using the platform in the laboratory practice sessions (Table 2).

According to the results we see that the students do not have a negative perspective towards the use the platform (4% think it may more difficult using it and just 8% do not like being evaluated at the end of each session).

<i>Using PoliformaT in the laboratory practices:</i>	
Makes easier to learn the contents of the subject	48 %
Makes more difficult to learn the contents of the subject	4 %
Makes no difference in learning the contents of the subject	48 %
<i>I think that being evaluated in laboratory practice through PoliformaT at the end of each practice session is good for your learning:</i>	
Yes, it's good	73%
No, it is not good	8 %
I don't know	19 %

TABLE 2  
ABOUT THE USE OF POLIFORMAT IN LABORATORY PRACTICES

The last two questions try to seek the perception of the students on the MATHEMATICA software used and a possible transfer of this form of evaluation to Theory-Problem (Table 3).

<i>I think that the MATHEMATICA software:</i>	
Enables to understand better the theoretical part of the subject and I will be able to take advantage from it in the future	79 %
Is a tool I will use just for calculations	17 %
Whose learning does not reward, there are other software easier to use	4 %

<i>Do you think it would be a good option that sessions of Theory-Problems carried out with a PoliformaT test during some day each week?</i>	
Yes, it would be good	57 %
No, it would not be a good idea	24 %
I don't know	18 %

TABLE 3  
PERCEPTION OF STUDENTS ON MATHEMATICA AND POLIFORMA T APPLICABILITY TO THEORY-PROBLEM SESSIONS

## CONCLUSIONS

Migration to PoliformaT meant a remarkable effort by the teachers involved, which this year has been minimally rewarded by the immediacy in grading the laboratory practices. As often happens, this is an investment that will take some years to harvest the benefit. It is worthwhile noting that even though the marks of practices have not changed significantly compared to those of previous years, most students perceive a positive change. A reason for this may be the use of Information and Communication Technologies in itself, which also gives them immediate evaluation after the practice.

In Table 1 the students express that the practices are appropriate to the course content and subject. In Table 2 we may see that most students think that makes easier (or there is no difference) to learn the contents of the subject by using PoliformaT, and think that being evaluated in laboratory practice through PoliformaT at the end of each practice session is good for their learning.

Finally, Table 3 shows that students are happy with the mathematical software used and consider a good idea to use the platform in order to improve its understanding of the theory-problem sessions.

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