The Use of Learning Modules as Support Online Material for Teaching in Engineering

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Abstract

New teaching methodologies are based on a new student's role changing from a passive (only receiving and storing knowledge) to an active role in which the student takes part in knowledge generation. Polytechnic University of Valencia is pioneering the development and use of new teaching tools that can help student in the knowledge generation. One of these tools is the use of learning modules. Learning modules allow the student to play an active role in the teaching process. A learning module consists on an ensemble of different elements in a multimedia platform focused on a particular topic in a subject. These elements include a table of contents, text and graphical information, auto evaluation tests, proposal of problems, learning objects and hyperlinks among others. The main aim of these learning modules is to provide an interaction tool for the student to go in depth in a particular topic.

1. Introduction

In the last years the traditional student's role in University is being questioned and redefined. The typical passive role is not appropriate and does not contribute to provide competences or abilities. The Study Plans of the new Degrees have been defined in terms of the competences the student acquires through different subjects and this needs a clear active role. The student must participate in an active way in their own knowledge generation by following the guidelines of the teacher. In this new teaching-learning scene, the use of new learning tools could represent an important chance to help students in the learning process by providing interactive environments.

Polytechnic University of Valencia (UPV) is pioneering the use of new multimedia online platforms that can play a key role in the new teaching-learning scene. One of these tools are "learning modules". Learning modules (LM) can be defined as an online tool that covers a particular topic in the field of a subject. It combines the use of text, graphics, images, videos, external links, auto evaluation tests, problems, etc. in a multimedia environment. The learning module is available for the student and he can use it to go in depth into a particular topic or issue. The multimedia environment with graphics, sounds, videos, evaluations, etc. allows the student to get the knowledge by himself.

Learning modules are developed using a special platform at Polytechnic University of Valencia that allows creating teaching contents. The teacher selects the topics and all the supporting material (graphics, images, texts, questions, videos, external links, etc.) and prepares all this material in a logical sequence for learning. So that, learning modules are the result of a conscious content selection with the appropriate structure to be used as online teaching material.

The student can use learning modules to go in depth into a particular topic by following his own learning rate. These tools are especially interesting in the engineering area as there are many topics or concepts that need the use of additional supporting material such as images, videos, pictures, schemes, etc., to help the student in the learning process. For this reason, learning modules represent an attracting tool in engineering and are widely used by students.

2. Construction and usefulness of learning modules

Polytechnic University of Valencia provides a multimedia platform to build learning modules. This platform is called "PoliformaT" and contains different applications related to the teaching-learning process. Some of the main features of PoliformaT platform can be observed in the square shape in Fig. 1.

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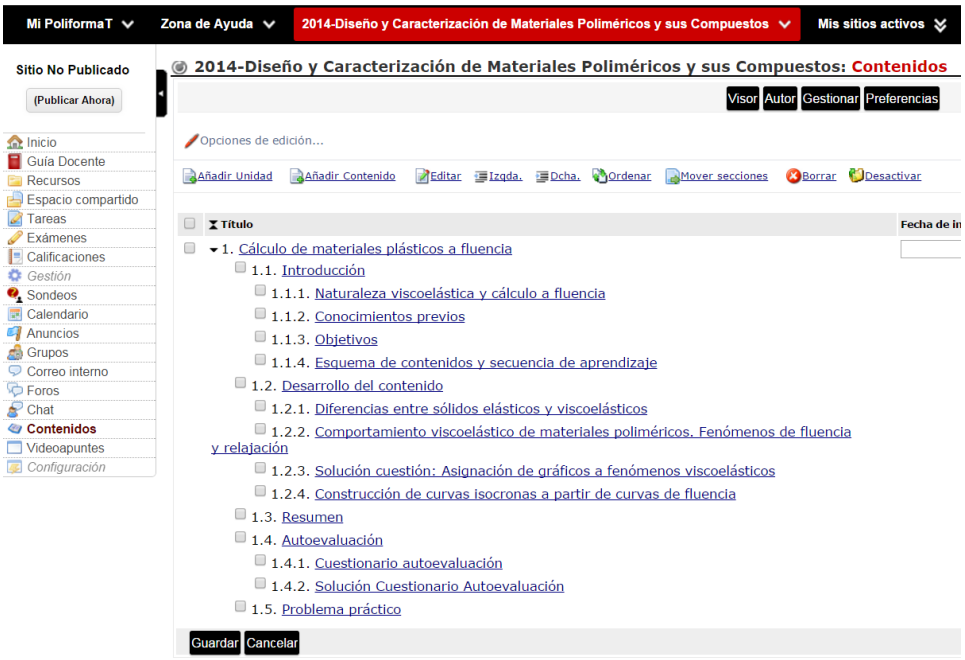


Fig. 1. General appearance of PoliformaT teaching-learning platform for "*Design and Characterization of Polymer Materials and Composites*" course.

Resources
This application is used to upload all the information of a subject. Theory classes, practical sessions, problems, etc. can be uploaded to this section in different file formats and students can download all this information.

Shared space
This application allows sharing information between teachers and students in a particular subject. For example, students can upload their homework (solved problems, presentations, etc.) and the teacher can correct the homework and upload corrections.

Tasks
In this application, tasks (solving a problem, auto evaluation test, etc.) can be defined and students must use this tool to solve the task.

Exams
This tool is useful to carry out online exams (tests, problems, questions, etc.) and correct them in an easy way. The tool possesses different templates for several types of exams.

Calendar
This tool indicates all the important dates in a special subject: beginning of the course, exams, etc.

Advertisements
Teachers and collaborators can upload messages about theory classes, practical sessions, changes in the planning, etc.

Contents
This tool allows creating multimedia contents. Learning modules are generated by using this tool.
Learning modules are generated by using different components as observed in Fig. 2. The blue square shows all the features. The element "Add unit" allows generating a blank topic and as other topics are added, they can be structured in sub-topics by using the "left" and "Right" buttons. All the sections created can be moved to give a coherent table of contents using the "Order" and "Move sections" buttons. All these buttons are useful to generate the structure of the learning module. Once the structure has been generated with the main topics and sub-topics (at different levels), we can use the "Add content" to include texts, images, graphics and all other supporting material. Finally, the "Edit" button can be used to make changes to previously written sections.

General components of this application (see the green square in Fig. 2) include the “Author” button, which allows working in the structure of the learning module and upload supporting material and the “View” button that allows the teacher to see how the learning module will appear online to the students. This is useful to make corrections. The “Manage” button allows to manage information, import and export information and finally, the “Preferences” button include selection of the preferred word editor, copyright of the supporting material, expanded view of topics and sub-topics, allow printing, etc.

Fig. 2. Elements in the “Contents” tool to generate learning modules.

Learning modules are characterized by the combined use of several supporting material:

- Table of contents.
- Text.
- Images, pictures, schemes.
- Auto evaluation tests and questions.
- Learning objects.
- External task.

The table of contents (ToC) allows identifying the structure of the learning module in terms of the main topics and sub-topics. The use of hyperlinks allows accessing and displaying the topic the student is interested in. Combination of text and graphic material such as images, pictures and/or schemes is similar to a typical word processor. The tool includes the typical navigation buttons “**Next**” and “**Back**” as well as “**Go to ToC**” as can be seen in Fig. 3 in the red square.

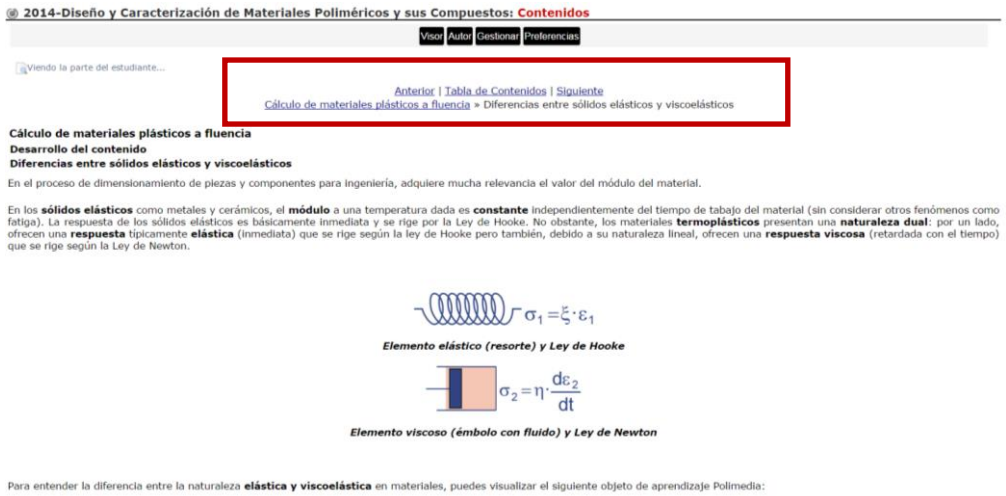


Fig. 3. Navigation tools in a learning module.

The text style is different from that used in a conventional book or article. The text is written in a direct style with expressions such as “*Now that you know these concept, then try to solve this problem*”, “*Come on, follow this link to check your advances*”, “*Please, watch this video and answer the following questions*”, and similar to increase interaction and motivate students.

One important element in a learning module is presence of several learning objects (LO). A learning object is a video explanation with a synchronized power point presentation and the teacher himself speaking about a part or section of a learning module. The video format allows some interactivity and contributes to knowledge formation. Fig. 4 shows a capture image of a video frame corresponding to a

Polimedia learning object. This video objects always have the same structure: presentation, objectives, table of contents, explanations and conclusions. These learning objects are characterized by relatively low duration around 10 min as they do not cover wide topics. In fact, different learning objects (LO) can be arranged in combination with graphics, images and supplementary text to give full learning modules (LM). This way, wide topics can be covered with adequate combination of interactive tools that are very interesting in the engineering field due to the typical complexity of different topics.

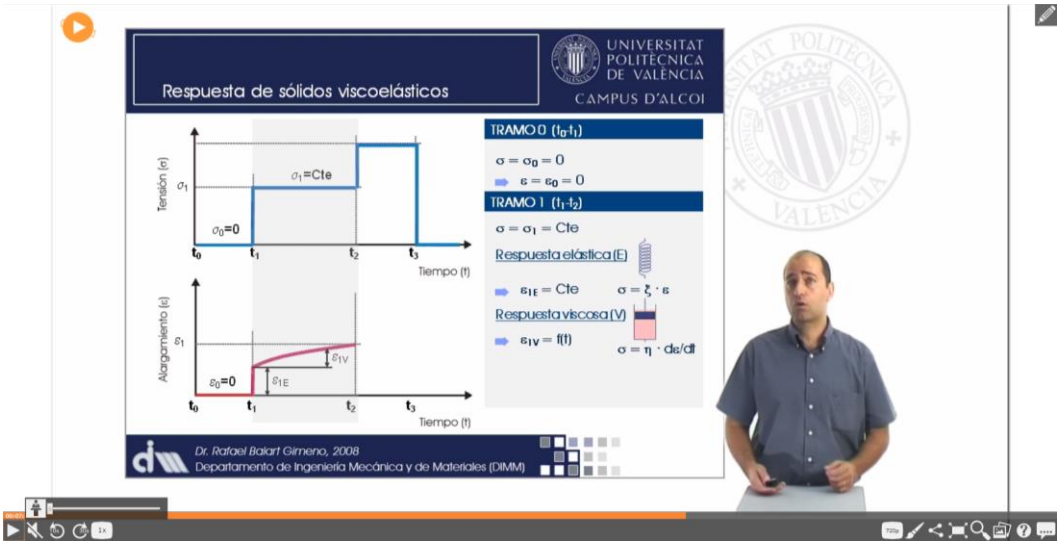
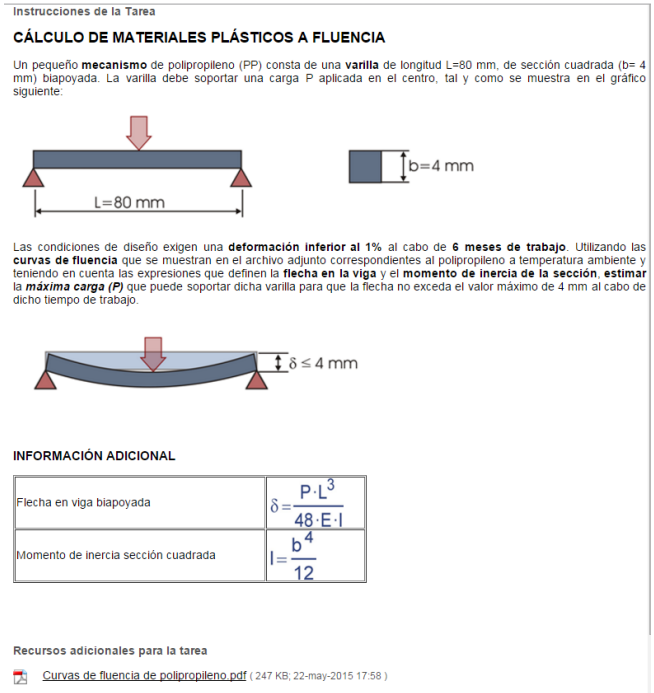


Fig. 4 Video frame of a Polimedia learning object (LO) embedded in a learning module (LM).

Another important element in a learning module is a final problem or task that the student must solve using all the concepts studied in the module; this problem or task can be used to evaluate the student's progression, detect difficulties in learning and reinforce the teaching process with appropriate explanations. The system allows uploading all complementary material the student needs to appropriately solve the problem.


Instrucciones de la Tarea

CÁLCULO DE MATERIALES PLÁSTICOS A FLUENCIA

Un pequeño **mecanismo** de polipropileno (PP) consta de una **varilla** de longitud L=80 mm, de sección cuadrada (b= 4 mm) biapoyada. La varilla debe soportar una carga P aplicada en el centro, tal y como se muestra en el gráfico siguiente:

Las condiciones de diseño exigen una **deformación inferior al 1%** al cabo de **6 meses de trabajo**. Utilizando las **curvas de fluencia** que se muestran en el archivo adjunto correspondientes al polipropileno a temperatura ambiente y teniendo en cuenta las expresiones que definen la **flecha en la viga** y el **momento de inercia de la sección**, **estimar** la ***máxima carga (P)*** que puede soportar dicha varilla para que la flecha no exceda el valor máximo de 4 mm al cabo de dicho tiempo de trabajo.

INFORMACIÓN ADICIONAL

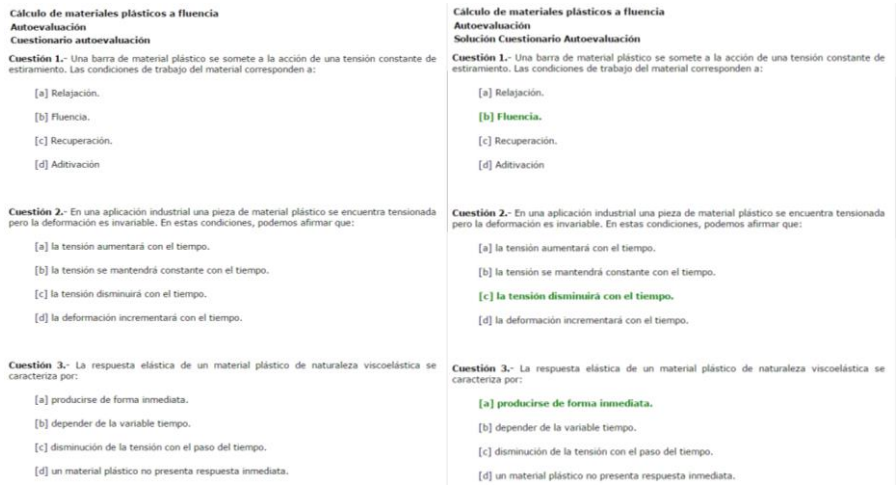
Flecha en viga biapoyada	$\delta = \frac{P \cdot L^3}{48 \cdot E \cdot I}$
Momento de inercia sección cuadrada	$I = \frac{b^4}{12}$

Recursos adicionales para la tarea

Curvas de fluencia de polipropileno.pdf (247 KB; 22-may-2015 17:58)

Fig. 5. Final task that the student must solve after finishing the learning module (LM).

In addition to this problem, the learning module can contain different auto evaluation tools to help the student check his progression. Fig. 6 shows a test questionnaire and the corresponding solution. The student can try to solve the test and once he has finished, he can see the correct answers and evaluate his learning degree.



Cálculo de materiales plásticos a fluencia
Autoevaluación
Cuestionario autoevaluación

Cuestión 1.- Una barra de material plástico se somete a la acción de una tensión constante de estiramiento. Las condiciones de trabajo del material corresponden a:

[a] Relajación.
[b] Fluencia.
[c] Recuperación.
[d] Aditivación

Cuestión 2.- En una aplicación industrial una pieza de material plástico se encuentra tensionada pero la deformación es invariable. En estas condiciones, podemos afirmar que:

[a] la tensión aumentará con el tiempo.
[b] la tensión se mantendrá constante con el tiempo.
[c] la tensión disminuirá con el tiempo.
[d] la deformación incrementará con el tiempo.

Cuestión 3.- La respuesta elástica de un material plástico de naturaleza viscoelástica se caracteriza por:

[a] producirse de forma inmediata.
[b] depender de la variable tiempo.
[c] disminución de la tensión con el paso del tiempo.
[d] un material plástico no presenta respuesta inmediata.

Cálculo de materiales plásticos a fluencia
Autoevaluación
Solución Cuestionario Autoevaluación

Cuestión 1.- Una barra de material plástico se somete a la acción de una tensión constante de estiramiento. Las condiciones de trabajo del material corresponden a:

[a] Relajación.
[b] Fluencia.
[c] Recuperación.
[d] Aditivación

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[d] un material plástico no presenta respuesta inmediata.

Fig. 6. Auto evaluation questionnaire and it solutions. This is a part of a learning module (LM).

All the above-mentioned features are the most characteristic of a learning module (LM). By a conscious selection of the supporting material (texts, hyperlinks, sounds, videos, questionnaires, etc.) it is possible to obtain a high effectiveness tool for online teaching and students can use this tool to play an active role in the teaching-learning process which, in turn, will provide them with appropriate competences or abilities in conjunction with the teacher guidance.

3. Summary

Learning modules represent an attracting tool in engineering as they provide an interactive platform between the teacher and the student that can help the student to generate his own knowledge with an appropriate guidance by the teacher. The use of a multimedia platform with different multimedia elements such as graphics, texts, hyperlinks, videos, tests, solved problems, etc. makes it easier to learn complex topics in engineering. Thus, learning modules can be very useful in the teaching-learning process; the success of this tool is directly related to an active role by the student and appropriate guidance by the teacher leading to synergistic results.