LECTURE ROOM WEB FOR THE IMPROVEMENT OF MATHEMATIC KNOWLEDGE

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Abstract

In this work it is detailed a proposal that a group of lecturers belonging to the investigation group of the Universidad Politécnica de Madrid (UPM) "Mathematics applied to Civil Engineering: MAIC" is accomplishing through a project of educative innovation financed by the UPM. It is proposed a "Mathematic Thinking Lecture Room" to be incorporated in the web pages of the universities. It is offered in it a series of activities which permit the training of the students in several transversal competences, most of them related to the mathematical thinking, and others that, although can seem far from it, it is possible to develop them together. The list of activities proposed for this `lecture room-web´ that can be increased with others along the beginning of it is:

- Games, pastimes and mathematical puzzles.
- The mathematical language: prove and solve.
- Training for the mathematical Olympiads.
- Activities related to the mathematical thinking: readings with mathematical content, mathematical cinema...
- Convocation of competitions: mathematical short stories, mathematical photography, mathematical short films...
- Forums and open discussions.

1 INTRODUCTION: THE NEED FOR COMPLEMENTARY ACTIVITIES

The changes that are being implemented in universities within Europe show that the aim of centres is not to teach. The aim is rather for the student to learn, and to learn not only knowledge but professional skills too. It is worth highlighting that, as with other subjects, although perhaps in a more pronounced manner, mathematics subjects' credits have been reduced dramatically in the new study plans. Consequently, offering actions that make it possible to obtain skills related to it and other sciences is very useful. With this aim, we propose to offer students a "Mathematical thought class", the activities involved in which focus on motivating students towards subjects relating to mathematics. Its purpose is to support university students, above all in their initial stages, and promote a better environment of work and cooperation, as well as greater interest in Mathematics.

The activities incorporated in the class, for which extensive knowledge of mathematics is not required, aim, on the one hand, to show that this science is astonishing, interesting and useful, accessible to almost everyone and plays an important role in professional as well as daily life, that it has great importance in culture, development and progress and, on the other hand, to complement and show students certain elements of this science that will help them in their education. It focuses on play, experimentation and participation making it an important teaching resource.

1.1 Objectives

The work to be carried out focuses on the creation of a Mathematical Thought Class to be incorporated into the website, where interested students are provided with, amongst others, the following possibilities:

- To learn mathematical concepts they do not know about and that are necessary to cope with their university studies

- To handle mathematical language and its symbols
- To train their brains towards scientific problems
- To learn to appreciate maths and its usefulness in all fields
- To link the scientific world to leisure

2 DESCRIPTION OF THE LECTURE ROOM WEBSITE

The activities proposed will be implemented via a website in order to reach all university students or students from interested centres. They shall be simultaneously accessible and interrelate with one another. They shall be complemented with contests and competitions that shall be announced on various dates.

A forum will be available at all times that will enable interaction between the students and between students and professors.

The structure of the website is shown in figures 1 and 2:

Figure 1: Website introduction screen

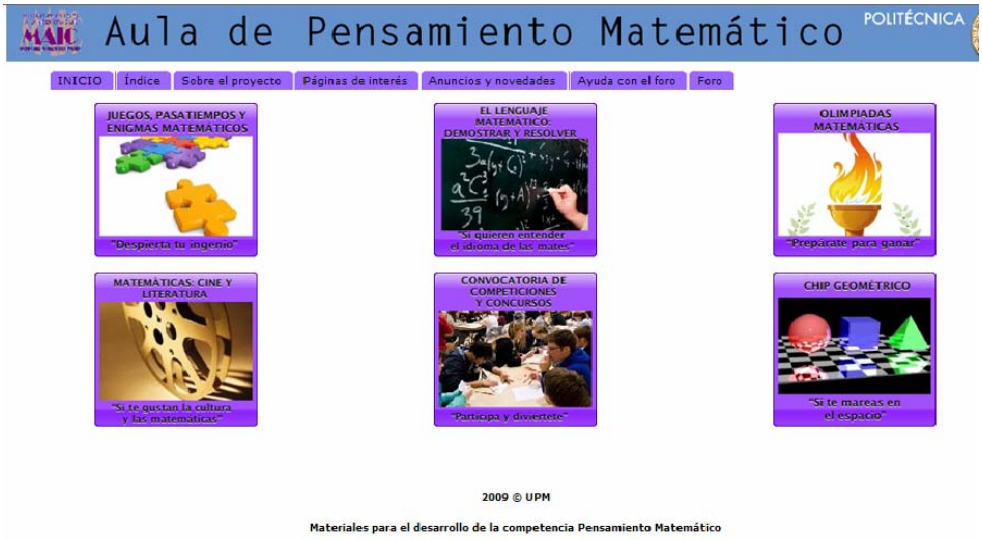

Figure 2: Website contents screen

Each of the activities are briefly detailed below:

2.1.1 Mathematical games, puzzles and problems

The mathematical challenges presented as games or puzzles can be recreational and entertaining for students and exercise their intelligence and equip them to resolve the problems that will undoubtedly arise throughout their studies and occupation more easily. It acts as complementary material that can be incorporated successfully into the basic subjects.

It aims to stimulate the capacity for reasoning, analysis and synthesis as well as that of mathematical thought in general.

The material to be included shall be selected in such a way that students encounter unusual and fun riddles that, although they will need a basic knowledge of mathematics, will provide them with a stimulating perspective at the highest levels of mathematical thought. They will be grouped in sections concerning the different areas of mathematics (see figure 3) and each of these sections will refer to other activities that contain complementary material (interesting lectures about the topics being dealt with, recommendation of a particular film with related content).

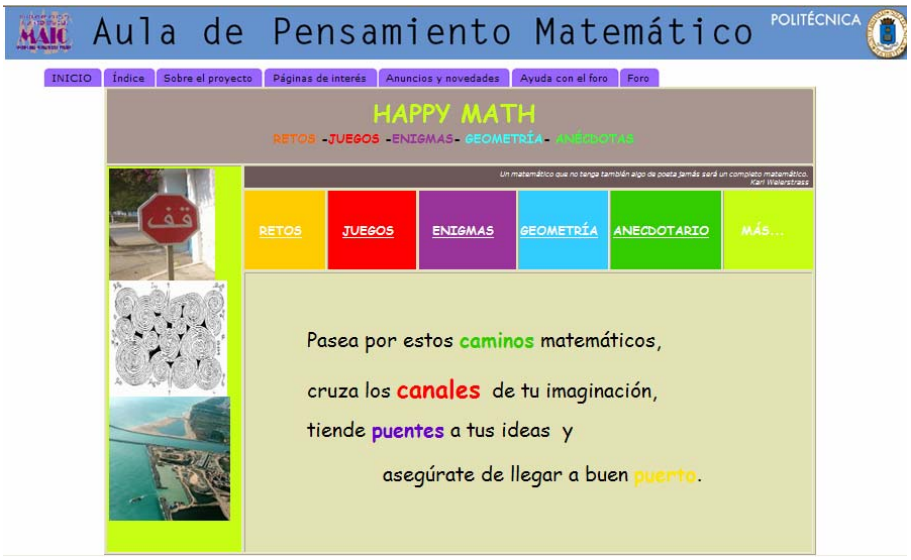

Figure 3. Structure of the mathematical problems, puzzles and games module

The existence of the open forum between students taking the module and between the participants and professors enables interaction and the discussion of queries, clues, proposals, etc.

It is very probable that playing with mathematical problems and puzzles will make students discover that mathematics is fun and interesting, therefore motivating their desire to study it in more depth.

2.1.2 Mathematical language, demonstrate and resolve

The manner of thinking, developing and expressing oneself in mathematics is, in many aspects, different to the manner of doing so in daily life. When a student attempts to delve into a more in-depth study of this science, there are various essential points they must take into account:

- Use the language of mathematics correctly, with its expressions and symbols that, on many occasions, are used with other meanings in daily life.

- Understand and be able to correctly prepare a demonstration. It is important to endeavour to be able to recognise which method is the most adequate to demonstrate a statement.

- Familiarise yourself with the idea of a mathematical problem and the various points of view for the resolution of such. Learn to apply the usual strategies for the resolution of problems.

This activity will help to clarify all of these matters in order to guide those who wish to delve into mathematics at university level. It aims to provide students with useful material to begin their technical

studies in cases where students find themselves involved in serious difficulties regarding the professors' proposals (Figure 4).

Topics such as the following will be covered:

- Differences between daily and mathematical languages: Towards scientific language.
- What is a demonstration?
- Strategies for the resolution of problems.

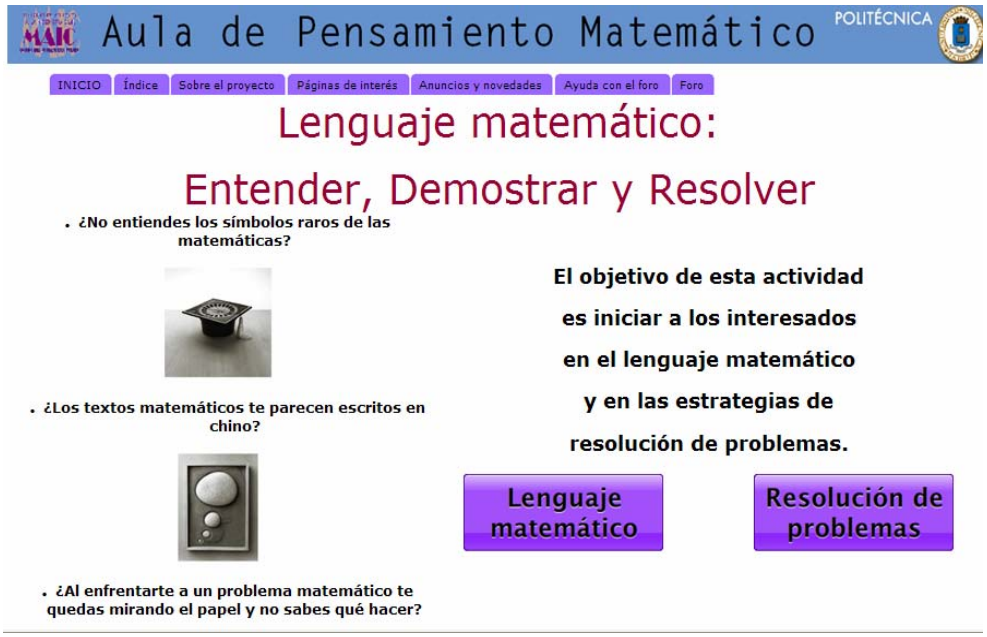

Figure 4: Screen relating to the Mathematical language activity

2.1.3 Preparation for the mathematical olympics

Preparation for the Mathematical Olympics and the participation in such represent a challenge for the highest achieving university students in the scientific disciplines. Consequently, this activity aims to include a university mathematics competition preparation manual, which will provide the student with the theoretical knowledge necessary for resolving the problems proposed in these types of tests, which tend to be more difficult than those that the student deals with in the degree subjects. The manual also includes a list of the main problems that, in recent years, formed part of exams for certain distinguished international mathematical contests and original solutions to these problems are provided. Attempts to resolve the problems proposed in the manual improves the students' deductive skills, it encourages their creativity and develops their mathematical thought, which can help them in the maths subjects of their studies. The mathematical theory dealt with in the manual is divided into topics (Figure 5).

This activity is closely related to the two previous ones as the mathematical puzzles and games are excellent preparation for dealing with more complicated problems, such as those proposed in the Mathematical Olympics, and the mathematical demonstration techniques are a useful tool for solving these types of problems.

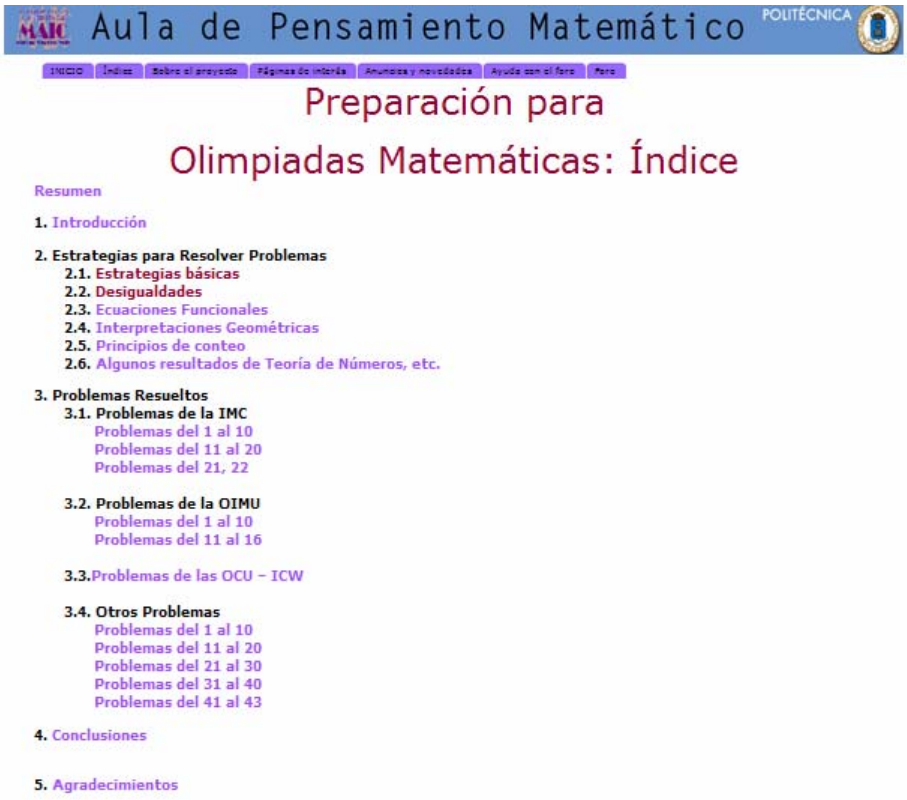

Figure 5: Structure of the mathematical Olympics preparation module

2.1.4 Activities related to mathematical thought: Lectures with mathematical content, mathematical films

The idea behind this module is to propose daily activities to students in which mathematics can easily be found which motivate them to study it and take an in-depth look at it. It aims to offer students information about films and books geared towards the general public but with certain scientific content, as well as comprehensive information about the mathematics dealt with therein. Through the forum, we hope to encourage debate and an exchange of opinions on these works, which is not only interesting from an artistic perspective but also in terms of scientific popularisation.

It is frequently found that adequate motivation and the proposal of activities that capture the students' interest can switch a light on in the class, and encourage the students to continue researching and forget about their predisposition to reject mathematical content. This is when it becomes possible to teach them how to formalise and describe scientific concepts with precision.

2.1.5 Geometric chip

The aim of this part of the class is to propose certain activities that cover various topics from a geometric point of view such as, amongst others: symmetry, proportions, fractal dimension, curves, surfaces, brain-teasers, puzzles, etc. (Figures 6 and 7).

Geometry has for many centuries been one of the pillars of academic education from the early ages. During the last century, it has gradually become less prevalent in curricula. Fortunately, current mathematical curricula at all levels are placing due importance on geometry.

The general objectives of this part of the class is to offer students activities, which in the majority are interactive, that will broaden their geometric capacity and motivate them towards this aspect of mathematics.

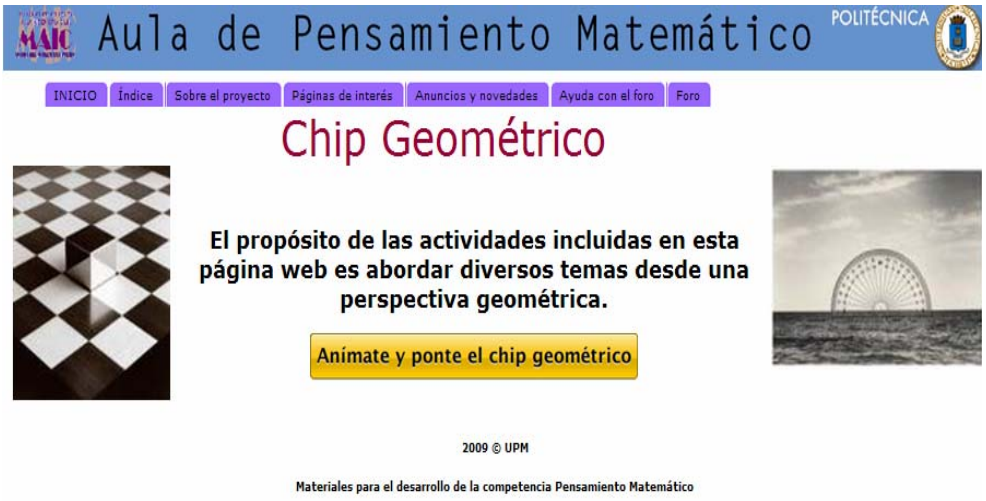

Figure 6: Geometric chip module front page

Figure 7: Geometric chip module contents

2.1.6 Competitions and contests

This part of the website will contain an up-to-date list of all of the contests and competitions related to mathematics that we have found out about (mathematical photography, mathematical short stories, problem solving, programming, etc.). This aims to encourage the students' participation in the competitions and contests.

3 CONCLUSIONS

The text presented aims to detail a project that a group of professors from UPM are carrying out in order to improve teaching and the performance of the students in subjects related to mathematics.

The aim is to present it as an appropriate and innovative tool in the educational system that is useful for other groups to adapt to their needs and to their students, therefore providing them with better results.

Moreover, the activities presented in the project are of an open nature which facilitates the connection amongst the university students and brings secondary school students closer to the university world.

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