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PENSAS@MOZ

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Abstract: PENSAS@MOZ[†] is a R&D project developed by the University of Aveiro, Portugal, in Mozambique. The project is fully supported by a platform developed by the *Projecto Matemática Ensino*. The aim of the project is to implement and maintain for a period of five years a network and to increase the use of computers and Internet as a tool to improve the teaching of Mathematics and Portuguese in Mozambique. It is a nationwide project as it will be carried through with ten centres spread for all the country and intends to involve permanently about 25.000 students and professors of more than 30 schools. The challenge of the project is to achieve the self-sustainability of the network after the end of the project.

Keywords: information systems, assessment, assisted learning, self-learning, b-learning, informal leaning

1. Introduction

Since the appearance of the first computer systems, people have studied ways to apply them to education. Everyday new software tools are developed from e-Books to complete course management systems.

In a general way, the existing tools focus mainly on their technological components, thus forgetting educational aspects. For example, most of them allow construction of discussion forums, document sharing, works delivery, etc. The centralization of these technologies is useful; however they were not idealized for educational purposes. The use of new information technologies in teaching/learning cannot be restricted to the above written.

While accepted from users, these applications should register every interaction between the application and users. Obtaining results of this interaction is very important to both teachers and students, because in this way they have access to what knowledge was transmitted and how it was learned.

Projecto Matemática Ensino (PmatE) has developed a set of tools that allow its users to diagnosis their abilities. It is based on a learning philosophy by evaluation and it complements both the manual and classroom, never substituting or diminishing the important role that the professor has in traditional education.

All applications are based on randomly generated questions called models. When inserted in the system, models are catalogued in accordance with a rigid structure that offers SA3C one of its more important characteristics: the qualitative evaluation.

[†] PENSAS@MOZ Project is supported by the Portuguese Cooperation/ IPAD – Instituto Português de Apoio do Desenvolvimento.

The use of computer systems for exams raises serious logistic problems. Usually the computer science laboratories are prepared to function as classrooms, so there are many computers in those rooms. To prevent fraud during exams not all computers available are used by students leading to an under use of these computer resources.

The common solution is to create different exams using distribution mechanisms between all computers. This means that teachers have to make several similar exams. PmatE's model concept solves this problem automatically guaranteeing that two computers side by side will have different concretizations of the same problem. All questions have a group of parameters - randomly generated - that make it very difficult to have two exams exactly the same while maintaining the level of difficulty and type of questions.

2. PmatE

PmatE is a project in Mathematics teaching and develops educational software available only in the Internet. Since 1990, the purpose of PmatE is to create a platform of computer-aided teaching from primary school to undergraduate studies. The main aim of PmatE is to make Mathematics worth studying. In order to achieve this purpose PmatE has created Mathematics competitions, either on the Internet or in an event gathering students from hundred of schools in University of Aveiro. Students and teachers may use this software as a diagnosis in or out of the classroom. Learning for assessment is a rather uninteresting way of studying, but studying to win a game, to top all his schoolfellows, that is much more compelling.

Its main goal is to stimulate the searching for a mathematical challenge, which allows the students to have fun and to win prizes, at the same time that they obtain mathematical knowledge. This year, for the first time, thematic modules will be available, so that the students can train and develop their knowledge, which will help those preparing competitions.

The PmatE is also involved with higher education, through the TDmat, a diagnosis test in University of Aveiro, for all the first year students in sciences and technology that allows checking the knowledge and the basic competences acquired, diagnosing also the gaps and the fragilities that they reveal. It supports disciplines like Calculus I, II and III, supports also the discipline of Numerical Methods and digitalises contents of the discipline of Digital Systems.

It also maintains three projects for the Primary and Secondary School: the Gulbenkian EXI@mat, the INmat and the viver@matemática, an e-manual for the 6th degree that allies the traditional concept of school manual to a system of information in the Internet.

Decided betting on the internationalization, it has been developing activities in African Portuguese Speaking countries (PALOP) like Mozambique and São Tomé e Príncipe. Currently, and accordingly with Portuguese Cooperation, there are plans to extend the project to other African Portuguese Speaking countries like Angola, Guiné-Bissau and Cabo Verde. In Mozambique PmatE develops a project called PENSAS@MOZ – Platform to Assisted Learning of Mozambique.

3. PmatE Applications

PmatE applications can be of several different formats. It is possible to define applications intended for study purposes or for evaluation. It is also possible to configure the interface, in two test formats: one question per screen or several questions with scroll. The main difference between them resides in the fact that in the first case the student has to correctly answer the presented question to see the next screen, while in the second case the student has access to all questions at once and the freedom to navigate between all questions just as it would be with a hand written exam.

All applications have a common characteristic: an appealing nature to playfully apply acquired knowledge. This is implemented through simple mechanisms like the use of a timer on the screen, the concept of lives (such as in every computer game) or in a very subtle way, for example, one online access to the "Top 50" results. This philosophy has proven to be an excellent ally, in what concerns the need to have students study more and not just prior to exams.

Evaluation knowledge is an arduous task. Some existing applications allow automatic evaluation of exams. Most are based on the American format, with questions of true/false type or multiple choices [8].

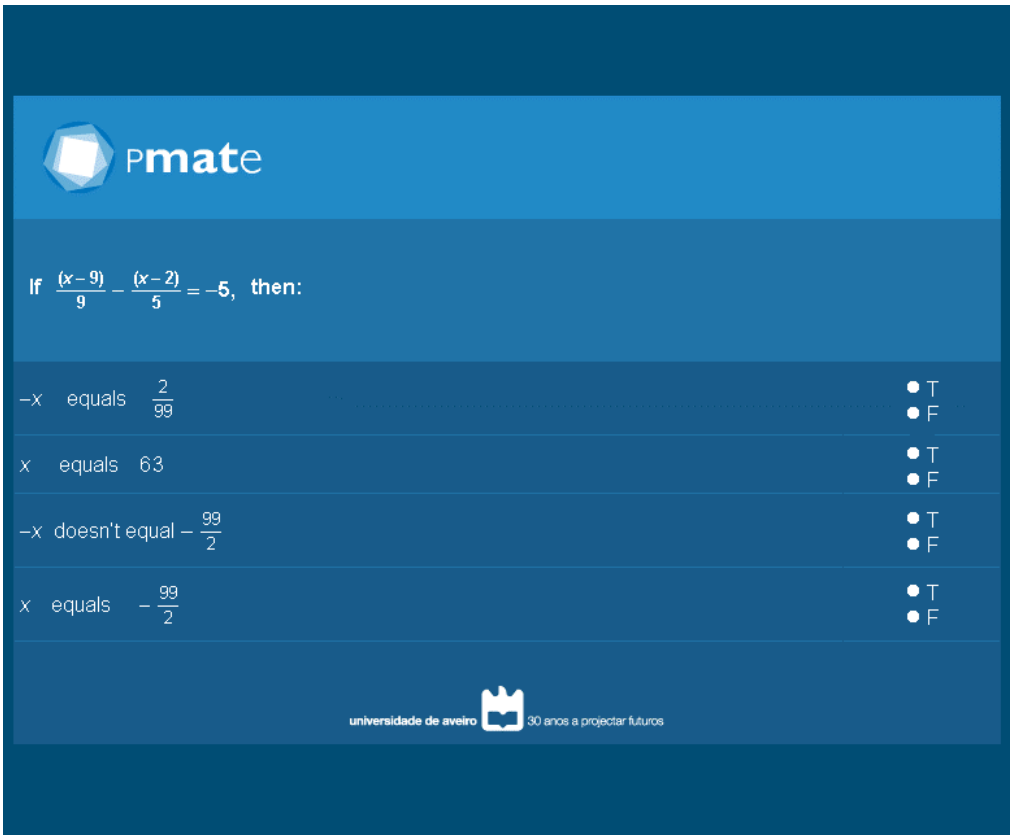

***Figure 1** - A concretization model example*

Generally it is possible for teachers to edit questions that compose an exam. The major problem of editing questions is representing math formulas on a computer that still is not a generalized subject.

Since all PmatE applications are based on the model concept [10], this type of problem does not exist. The models are programmed in accordance with a very unique philosophy and, in addition they use vanguard technologies of representing information. This is made possible by the use of an intermediate language developed by PmatE that allows model independence in the final representation. MathML is used to represent mathematical text, SVG language is applied for image representation.

4. The Mozambican scenario

PmatE Teachers worked together during the last five years with Mozambican teachers and developed a methodology for the elaboration of electronic learning contents. That scientific commission had given body to the entire project. The work made was:

- Study of the secondary education programs;
- Identification of the key subjects;

- Identification of the most common errors committed by the students;
- Creation of learning objects [11,12,13] (known to us as "questions generating models") related with these subjects;
- Elaboration of tests (through the grouping of some questions generating models related with that areas);
- Analysis of the student skills.

After the finish of the first phase, the scientific commission elects three major areas as the main target, to know: "Algebra and Functions", "Numbers and Calculus" and "Geometry". The basic abilities in analysis had been:

- Resolution of Equations and Inequalities;
- Algebraic manipulation of rational and irrational numbers;
- Basic Knowledge of geometry, line and plane;
- Translation of simple problems for an equation form;
- Interpretation simple functions graphs: linear and quadratic equation.

During the last four years, and to evaluate and consolidate the work made by the scientific commission, the PmatE, the Science and Technology Ministry and the Education & Culture Ministry carry out a competition for all students – Equamat@MOZ. The original idea was to do a national competition; nevertheless the national scope of the competition was very limited due to the lack of infrastructures out of Maputo.

Bearing that in mind and aiming the growth and dissemination of the communication and information technologies, the previous actors jointly with the Portuguese Cooperation, decided to create, a national infrastructure to be used by students all undergraduate levels - the PENSAS Project.

5. PENSAS Project Objectives

PENSAS Project has the following objectives:

1. teaching Mathematics;
2. development of Portuguese language;
3. increase the use of computers and Internet as a tool for Mathematics teaching; and
4. Building learning objects – so called models generated questions - to different classes.

Other specific objectives are the indicators of knowledge, teacher's training and qualification. The Portuguese Cooperation jointly with the Education Minister of Mozambique created a schools Network with at least one major school in each Mozambican province. To characterize these major schools we develop the concept of "dynamic school". A "dynamic school" has a laboratory with up to 20 computers connected permanently to the Internet and works as a gateway to the neighbour schools – so called "satellite schools". The dynamic school teachers must support the training of satellite schools teachers and the laboratory. The students and the teachers of the satellite schools should use regularly the laboratory and the learning materials.

Because the manuals in Mozambique are rare and very expensive we decided to create some small electronic manuals to circulate in the PENSAS Network. Those electronic manuals can be printed and carried home by the students and the contents are in accordance with the Mozambican studies program defined by the Education Ministry.

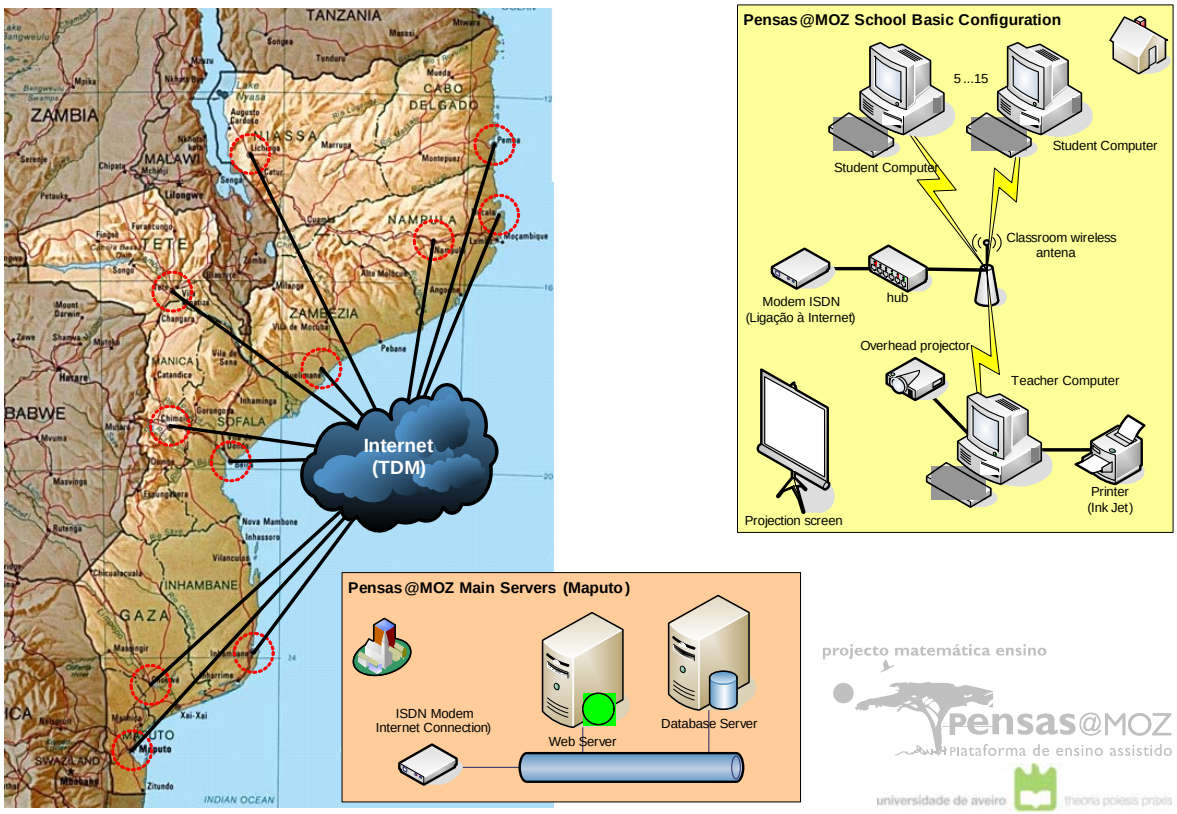

Figure 2 – PENSAS@MOZ architecture and configurations

6. Conclusions and Results

In the PENSAS Project, we can identify different ways of looking at results, depending on the considered actor: Student, Professor and Course Director.

- Student:
  - Through the "Tool to gauge the abilities profile acquired by the pupil", access to its difficulties diagnosis;
  - Best knowledge of Mathematics
- Professor:
  - Through the "Tool to gauge the abilities profile acquired by pupil", better knowledge of the acquired abilities by them and bigger capacity to work the difficulties;
  - Through the "Tool to gauge the abilities profile acquired by each course", illustrated performance in a secure way, and if necessary, help to deal with biggest difficulties.
- Course Director
  - Through the "Tool to gauge the abilities profile in the course", performance of its groups illustrated of one forms insurance.
  - Instrument for education orientation.

PENSAS Project creates in Mozambique a different way to look at the Internet and to put this in the centre of the education process.

In parallel with the installation of PENSAS Network Infrastructure we started, in a first phase, to train teachers in Mathematics – two mathematic teachers of each. In the near

future we plan to start the training of teachers in Portuguese and other courses in different contexts.

One recurrent question in Projects like this is the sustainability of the infrastructures' installed after their end – in December 2007 in this case. Now we are meeting with different Mozambican and Portuguese entities to imagine how to use the Pensas Network in different contexts. This is a challenge to us and if we succeed this will allow the self-sustainability of the Network after the end of the project. This is crucial not to break the expectative of our main users – the Mozambican children.

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