IMPROVING MOODLE WITH WIRIS AND M-QIT

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Abstract: Moodle is one of the most extended LMS. Moodle allows the collaborative learning where students and teachers collaborate on the daily work. But problems with Moodle arise in our scientific context. Although Moodle can preview LaTeX code, not all the possibilities of LaTeX are available and it is very good for scientific teachers but hard for students, so, the mathematical formulas are usually replaced by non-standard versions of them written in ASCII. Another problem with Moodle is the difficulty of reusing quizzes. We present two tools that improve Moodle in three aspects: representation of math formulas, mathematical computation, and improving the learning units for the students. WIRIS is a powerful editor and allows interacting by using mathematic formulas in an easy way and developing new learning units with mathematical computation via web; M-QIT is a new tool able to manage and reutilize quizzes and questions available in previous courses in Moodle.

1 OUR CONTEXT: MOODLE

In order to establish a meeting point for the students of the subject Numerical Methods of the Engineering Computer Science School in the University of Málaga, we developed *M*etNum (Mora, 2006) in the 2003-2004 academic year by using the former platform, existent in our University.

The basic tools we worked with in MetNum were distribution lists and forums, as a means to encourage and guide students daily work. In 2004-05 the University of Málaga choosed Moodle as LMS (Learning Management System), so MetNum was changed to Moodle (Dougiamas and Taylor, 2003) and the new tools provided by this platform have been exhaustively applied. See (Huertas, 2008) for similar experiencies.

Moodle (Brandl, 2005) is a free worldwide used LMS (http://moodle.org), so, since the first version of Moodle, born in August of 2002, until July of 2008, there existed more than 21 millions of registered users, spread over 46000 places and it is translated to more than 75 languages.

Some interesting characteristics are available: it allows managing the identification of students and observing their work, forums, quizzes, questions, glossaries, lessons, etc.

We present two tools that improve some problems found with Moodle: representation of math formulas, and improving the learning units for the students. For the first aspect we present how to work with WIRIS and for the second aspect we show M-QIT.

1.1 Representing Mathematical Knowledge

Problems with Moodle, in this point, arise when we try to obtain most from it in our mathematical and scientific context and specifically when the teachers and students want to transmit math knowledge. Improving the process of learning in our framework (a difficult subject for the students) is essential.

Caprotti et al. remark in (Caprotti, 2008) “mathematical instruction is a recognized key asset in our society and embracing technology in mathematics education is not only economically advantageous but also promotes better learning and understanding”.

In (Cohen, 2008), Cohen et al. discuss their efforts to bring mathematics to the Web. For this purpose, their group “has developed an ensemble of software tools, MathDox, which is now using within various (international) projects to produce webbased mathematical material with the potential of having a high impact in the world of math education”.

Also the authors cite several international projects which study how to represent mathematical expressions and propose the MathDox player and a set of

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friendly editors.

We would like to emphasize the ability of Moodle to make a direct preview of LaTeX code, which is usually used to present mathematical material, although not all the possibilities of LaTeX are available. LaTeX is very good for scientific teachers but hard for students, so in forums, etc, mathematical formulas are usually replaced by non-standard versions of them written in ASCII.

We show in this paper the use of WIRIS, a tool prepared to be integrated in Moodle, to solve this communication problem when we need to express mathematical formulas in the web.

1.2 Creating Material of Evaluation and Auto-evaluation

The National Mathematics Advisory Panel has concluded that certain tools, in particular systems for automated testing and assessment, can improve the performance of students.

In this point, we work in two directions to improve Moodle: creating new learning units that allow mathematical computation and an efficient manipulation of the quizzes of Moodle (new-modify-delete-import-export operations).

We show how WIRIS is a powerful calculator and it is possible to create self-evaluation learning units in Moodle.

And we propose M-QIT to reuse activities and facilities from some academic years to another one.

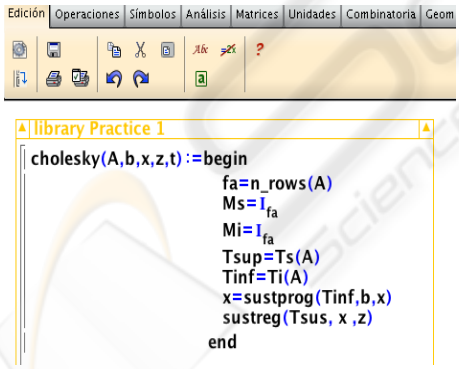

Figure 1: Example of method developed using WIRIS.

Thus, the only possibility to reusing them (for example quizzes and wikis made in an academic year are wanted to be used in the next one) is by making a backup of the course and deleting useless activities and facilities.

Similar difficulties arise when we want to change or to join activities from different subjects although they had been made by the same author.

The only possibility is to copy them, one by one, to a text file with a determined format (GIFT) and then modify and copy/paste them to the new subject.

2 WEB TOOLS TO IMPROVE MOODLE VERSATILITY

In this section, we present the two tools mentioned earlier, providing an exhaustive description of their details and the advantages which they proportionate in our context, and to the Moodle community.

2.1 WIRIS, a Tool for Incorporating Mathematics

In order to continue with the idea of social constructionist pedagogy, in our subject, materials must represent mathematical formulas in an easy way (allowing students to interact easily) and develop new learning units with mathematical computation via web.

Moodle only works with Maths at the level of representing formulas. It uses LateX or MathML to build math expressions. Moodle visualizes Latex using an applet.

Designing learning units for mathematics with real interaction is complicated. Teachers and students must speak the same language, and Moodle does not facilitate the communication. Therefore, it is not possible to use maths in Moodle to interact with the students.

In a second stage, if we claim to interact with students in an engineer career, the tools to be incorporated in the learning process must perform real mathematical computation and Moodle does not provide such ability. For us, it was an important goal and we searched a tool that solved the problem.

We emphasize that the solution is the WIRIS package (Eixarch, 2002) (http://www.wiris.com/). It is currently being used with (high) success in educational. environments in Spain, Luxemburg, Netherlands, Puerto Rico and Finland. Nowadays, WIRIS is a software family of products dedicated to mathematical calculation.

It allows us to express formulas in an easy way using a friendly interface and, as educational tool, it can be used for maths learning. And the most interesting point, now this tool is integrated in the LMS Moodle using a WIRIS Plugin.

We have two tools integrated in Moodle:

- WIRIS Editor is a powerful tool used via web, and permits the graphical edition of mathematical formulas. The editor is based on Java technology

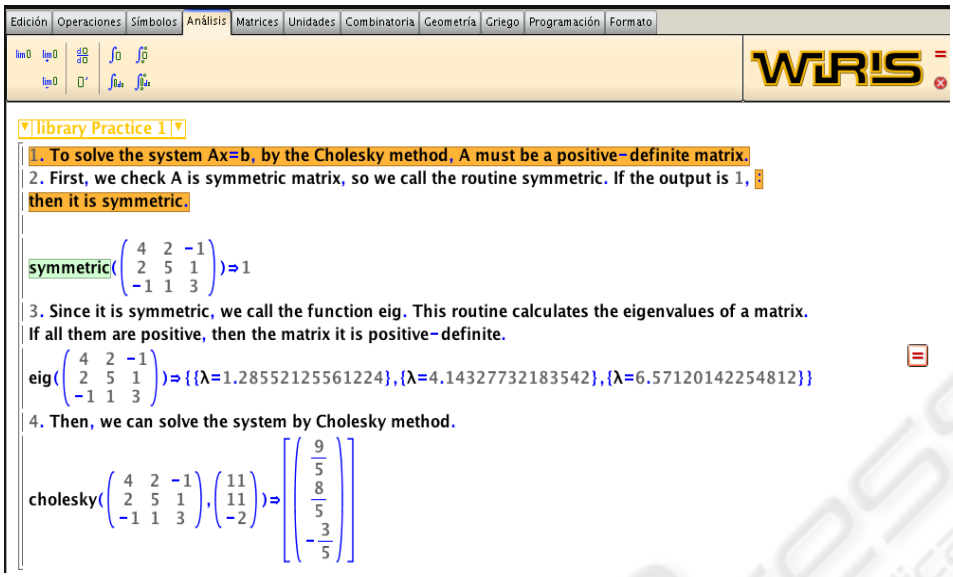

Figure 2: Working with WIRIS.

and therefore compatible with any browser (Explorer, Mozilla...) and on any platform (Windows, Linux, Mac). WIRIS Editor supports MathML and OpenMath standards.

- WIRIS CAS is a Computer Algebra System (CAS) designed for mathematical computations. Running in a browser connected to the Internet, the user has access to a powerful calculator: matrix calculus, integrals, derivatives, plotting graphics in two or three dimensions, etc.

If Moodle integrates the WIRIS Plugin, we can edit maths expressions and compute an integral in an easy way.

WIRIS incorporates libraries for Calculus, Algebra, and Statistics but not for numerical methods. A library incorporating routines of Numerical Methods has been developed for WIRIS and a collection of interactive problems has been proposed.

Students can interact using WIRIS in Moodle to check if the result of an exercise is correct and develop new routines in WIRIS to solve other exercises.

In Fig. 1 an example of the implementation of the Cholesky method using WIRIS is shown. We have designed lots of exercises of self-evaluation for the students (see Fig. 2).

In Moodle, the students found the material organized by themes and additional tools have been incorporated: forums, statistics, notes, calendar, user identification, etc.

WIRIS allows students to interact between them with a friendly interface. With WIRIS, they have a powerful tool to work with numerical methods.

Advantages of the new tool for the numerical methods subject that has been incorporated to Moodle:

- Students can represent mathematical formulas in a easy way with WIRIS.
- WIRIS allows developing new libraries of numerical methods using an easy programming language.
- Students can try to solve self-evaluation exercises, and have a powerful calculator.
- The only tool necessary is a web browser.

2.2 M-QIT, Moodle Quizzes Revisited

In this section, we present a new tool able to manage and reutilize quizzes and questions available in previous courses in Moodle, because managing questions and quizzes in Moodle is quite complex, mainly when one wants to re-use questions from previous years.

This application has been named M-QIT (which stands for Moodle-Quiz Integration Tool) and it is showed in Fig. 3.

M-QIT has been developed as a web application because, in this way, it is multi-platform, that is, it can be correctly viewed and executed in any web browser. This also allows M-QIT to be executed in a network environment. It is only necessary to get M-QIT installed in a web server.

There is no need to install any additional libraries on computers accessing the server, so all professors can directly make use of the application.

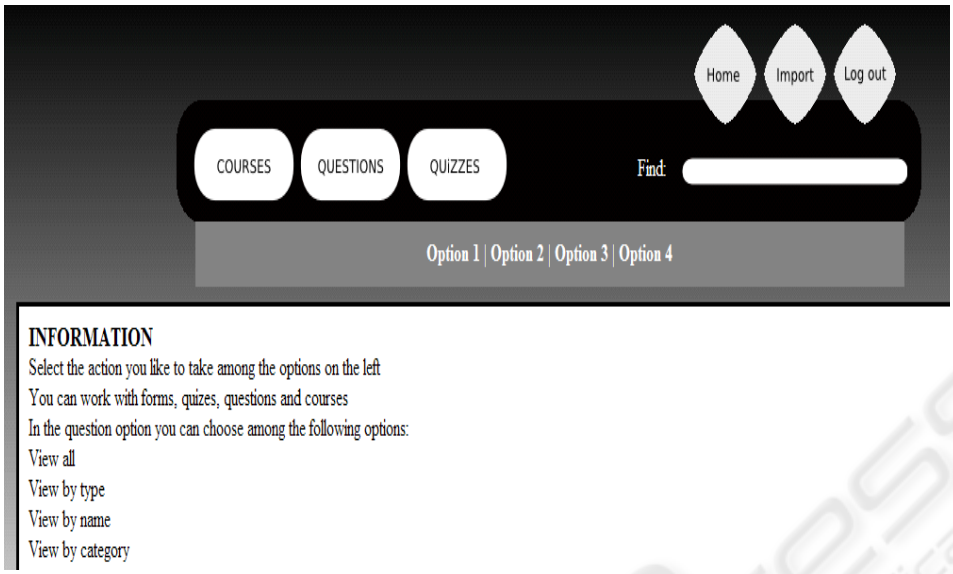

Figure 3: Main web page of M-QIT.

Since no exclusive or not standardized tools (such as flash) have been used in the development, no add-ons to the web browser are necessary for a correct visual display and usage of the developed tool, keeping it simple and functional.

M-QIT is an intermediate application in Moodle, since its purpose is to take information coming from Moodle and to return it modified. In order to obtain questions and quizzes, we make use of the backup copy that Moodle carries out in XML format.

This file contains all the necessary data to build a database with all the necessary information (questions, answers, quizzes, students, qualifications, etc.).

Once the database of the application is built, the most habitual actions to manage and to classify the information can be carried out. That is, questions and quizzes can be created, edited and deleted, by using a more intuitive and ordered environment. The basic process of the tool consists in:

- Creating a backup copy in Moodle, in ZIP format, to reduce the file size, and containing a file in XML format.
- Importing the ZIP file into the application: In this step, the information contained in the XML file becomes part of the application database.
- Managing the information: All the information in the database, with respect to quizzes and questions, can be used as desired in the application, since access to the tables containing questions, punctuations, answers, etc is facilitated.
- Exporting questions and/or quizzes: Once the information has been transformed or, simply, loaded on the database, it is ready to be exported and to become part of questions stored in Moodle again. The GIFT format is chosen as export format, since it is the one that allows exporting a greater number of types of questions, while other format do not allow them.

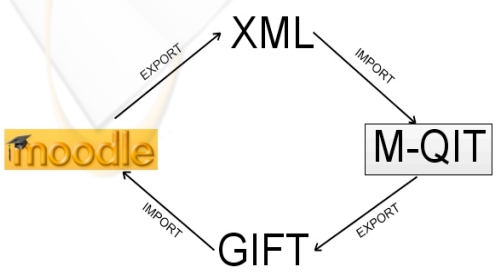

Figure 4: Graphical outline of the process of usage of M-QIT.

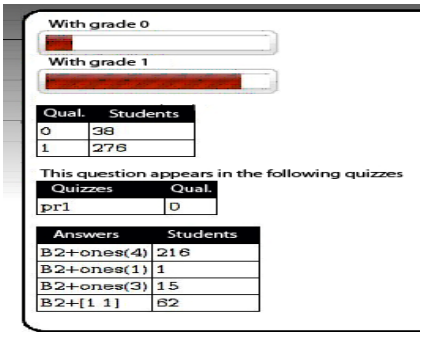

Figure 5: Statistics.

- Importation by Moodle: In the previous export phase, a text file is created in GIFT format, which can be imported by Moodle.

In Fig. 4, we show the import-export process and the communication with Moddle. The usage of M-QIT begins with the creation of a user. In addition, each user is subscribed to a series of courses which can edit, as well as its quizzes and questions. None of the users can display or edit questions or quizzes associated to courses to which he is not subscribed.

Together with the listing of questions, many options are also allowed, for the management of the questions:

- To delete: it deletes a question and its answers.
- To edit: it edits the selected question. Besides being able to modify the question, you can create a copy of the question.
- Answers: It allows modifying answers to the corresponding question. The edition of the answers will change in function of the question type.
- To export: This option allows exporting a question to be able to be used in Moodle. The export is carried out in GIFT format. Moodle does not allow some types of questions to be exported, and M-QIT will not be able to do so. The types of questions that cannot be exported are "Calculated" and "Multianswer".
- Statistics (see Fig. 5): Statistics make sense and have importance for past courses in Moodle, since statistics pick up information on the answers given by the students in the course carried out in Moodle. The information that can be found is:
  - Question qualifications are shown graphically and numerically. This allows knowing the number of students who obtained a certain qualification for this question.
  - Quizzes in which the question appears.
  - Answers given by students and number of students for each answer.

M-QIT allow us to manage groups of questions:

- To add marked to quiz: It allows adding the selected questions to a quiz. First, selecting the questions to be added, and later, choose the quiz.
- To delete marked: It is a quick way to delete several questions at the same time.
- To edit marked: It allows editing several questions at the same time.

Quizzes in our application are a bit different from Moodle quizzes. In Moodle, quizzes allow many options, since students carry out these quizzes. And, one can choose the number of attempts that can be made, the duration, the date in which the quiz is published to the students, etc.

However, in our manager, a quiz is simply a collection of questions, since quizzes organized in our manager are not answered on it, but they should be exported to Moodle to be able to be carried out.

In M-QIT, quizzes can be displayed from the courses in which the user is inscribed. When listing questions of the selected quiz (see reffig:figure6), there appear several:

- Quiz statistics: It shows statistical information related to the quiz. To be able to have this information, the quiz has had to be answered previously in Moodle by the students.
- To export selected: Same operation that in the option to export a single question, but for a group of chosen questions.
- To export and delete quizzes.
- To edit quiz and make a copy of the quiz.

We must note that question deletion only affects to the current quiz. If a question appears in two quizzes, when deleting this question in one of them, the question continues appearing in the other quiz.

In addition, M-QIT has a search engine. It is the quickest form of searching a question or a quiz. The search engine searches among question names and text, and among quiz names.

3 CONCLUSIONS

In this work we have presented two new tools, which improve the functionalities of Moodle.

First, the WIRIS package has been integrated into Moodle by means of a plugin, allowing the easy representation of math formulas, and providing the real mathematical computation needed in a virtual subject of an Engineering course.

WIRIS only provided a complete set of routines for fields such as Calculus, Algebra and Statistics, and then we developed the necessary routines for our subject, Numerical Methods, implemented in the easy-to-use WIRIS programming language.

Furthermore, students have now the possibility to perform self-evaluation exercises with the help of the multi-platform powerful calculator WIRIS CAS, a computation module inside the WIRIS package, which can be accessed via a new web portal, designed to be students meeting point and workplace.

Second, the M-QIT tool has been developed in order to make easier and more functional the man-

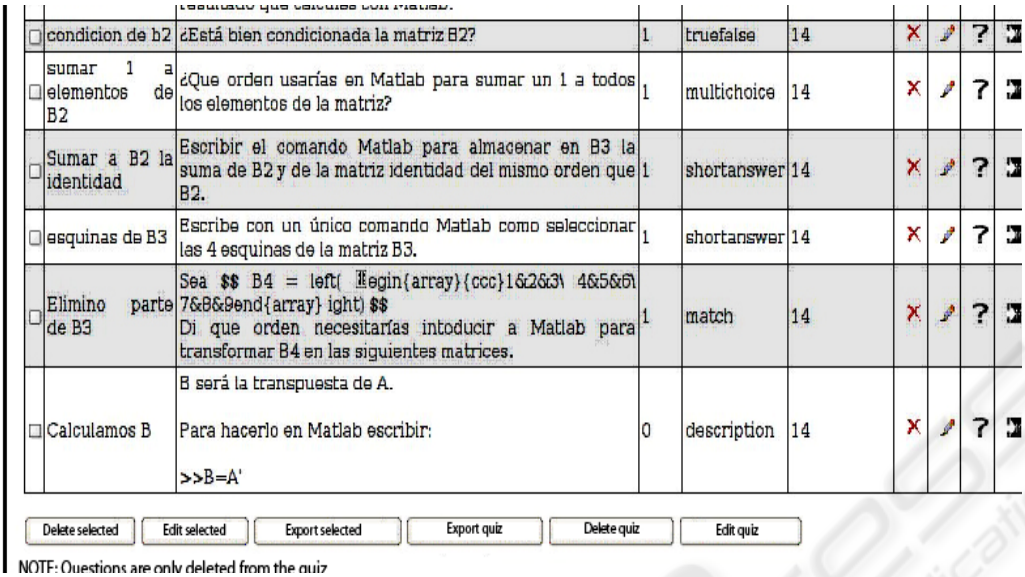

Figure 6: List of quizzes.

agement of Moodle quizzes and questions. In basic Moodle, this management is not oriented to the re-utilization of quizzes from past courses, and the only possibility for teachers is to import a complete backup of the corresponding past virtual course, and then deleting those quizzes and questions not interesting for the current one.

The integration of this tool as a standard Moodle module is one of our interests for future works. Also, an extension of M-QIT not only for quizzes and questions, but to glossaries, forums, and other Moodle activities is planned.

Regarding WIRIS, we will focus on providing new packages corresponding to other mathematical areas, such as Discrete Maths and Optimization.

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