

# **GISMO: a Graphical Interactive Student Monitoring Tool for Course Management Systems**

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**Abstract.** This paper presents GISMO, a graphical interactive student monitoring and tracking system that extracts tracking data from an on-line course maintained with a Course Management System, and generates graphical representations that can be explored by course instructors to examine various aspects of distance students. GISMO uses techniques from Information Visualisation to render into an appropriate graphical manner the complex multidimensional student tracking data provided by the Course Management System. GISMO aims to help instructors to become aware of what is happening in their classes and provide a better support to their learners.

## **1 Introduction**

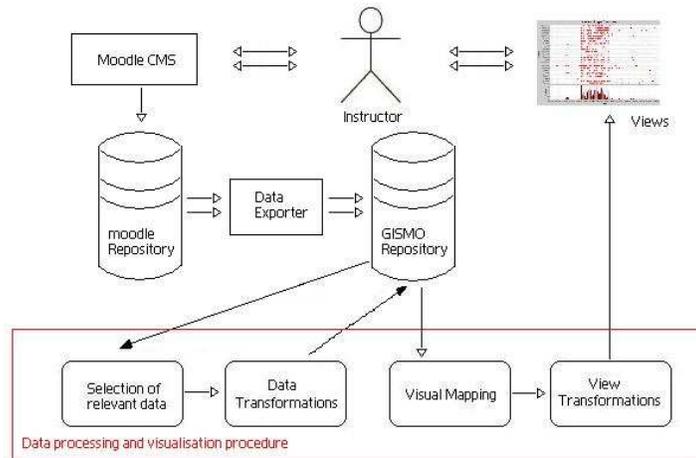
Course Management Systems (CMS) are a type of software applications that enables instructors to deliver information to students, produce content materials, prepare assignments and tests, engage discussions, and manage distance classes over the Internet. CMS have reached a great popularity in universities around the world for their benefits in providing Web-based distance education with the flexibility and the convenience of the client-server communication on the Web. Currently, the great majority of available CMS are represented by commercial products (WebCT and BlackBoard are the most popular). However, free and open source solutions such as Moodle have reached a reasonable level of maturity and several institutions are adopting them as alternative platforms to the commercial ones, whose end-user license are usually very expensive.

Educational research reveals a number of problems with using CMS in distance learning, e.g. students may feel isolated due to lack of contacts with instructor or with other students, can get lost in the course hyperspace, may lose their motivation, and often find it difficult to manage without institutional support (including help with technical problems) [2],[3],[6],[7],[10]. Educational research literature also shows how monitoring student learning is a crucial component of high quality education. Since instructors and students are not in the traditional face-to-face environment, new forms of student monitoring must be explored. The effective use of CMS requires that instructors are provided with appropriate means to diagnose problems so that they can take immediate actions to prevent or overcome that problem [5]. We considered the Moodle software in this work. Moodle's internal database stores a large log data of the students' activities

in a course and has a built-in student monitoring feature, called *activity report*, that enables the instructor to view some statistical data, such as the number of accesses made by the student to each resource, the history of pages visited, the number of hits for each day of the course. Instructors may use this information to monitor students' activities and to identify potential problems. However, this information is usually provided in a tabular format, often incomprehensible, with a poor logical organization, and is difficult to interpret. As a result, web log data is very rarely used by distance learning instructors. In this work, we follow the novel approach of using Information Visualisation (IV) [1],[8] techniques to graphically represent the vast amount of multidimensional data collected by the Moodle's activity report tool. We implemented a graphical student monitoring tool based on our experience with the CourseVis research [4]. The tool uses IV techniques to build graphical representations that instructors can manipulate, which may help them to gain an understanding of their learners and become aware of what is happening in distance classes.

## 2 GISMO - Graphical Interactive Student Monitoring System

GISMO is a student monitoring and tracking system that uses the students' tracking data from a Moodle, transforms the data into a form convenient for processing, and generates graphical representations that can be explored and manipulated by course instructors to examine social, cognitive, and behavioural aspects of distance students. The architecture of the tool is depicted in Fig. 1



**Fig. 1.** The GISMO system architecture

The *Data Exporter* collects any possible data regarding the activities done by students (tracking data) and exports this data into a MySQL database (*the GISMO repository*). This is the only module in GISMO that is dependent on the CMS. GISMO is

currently based on data imported from Moodle, but it can be adapted to support other CMS. In fact, the Data Exporter module is committed to fetch some data that is usually present in a wide range of CMS like moodle, claroline, fle3, mimerdesk, etc., such as discussions, accesses to the course, marks students receive in quizzes, and so on.

Data collected and stored in the repository must now be processed and presented to the instructor in a format that is easy to understand and communicated with clarity, precision and efficiency [9]. Some graphical representations were created to accomplish these issues.

To represent data in visual format we need to do some computations and transform the data into visual structures and representations. This step is performed in GISMO by the *Data Processing and Visualisation Procedure* (see Fig. 1). This “visualisation pipeline”, follows the well known “reference model for visualisation” proposed by Card et al.[1]. This model describes the creation of a graphical representation as mapping of data to visual form through a pipeline of four stages:

- *Selection of relevant input data*: repositories contain a huge quantity of data in relational format (data is stored in a DBMS). Depending on the representation we want to produce, only a subset of this data is relevant. This stage extracts from the repositories only data relevant to the particular representation. For each representation we have defined a specific set of data that is being extracted from this module.
- *Data transformation*: this step manipulates the selected data extracted from the repository and generates an intermediate format which may add further metadata of the abstract representation. Data provided by the CMS and stored into the repositories often need to be transformed to add additional information (for instance the data contain errors or missing values that must be addressed before the data can be visualised), or to perform some calculations (such as statistical calculations to add additional information).
- *Visualisation mapping*: transforms the preprocessed altered data into geometrical primitives with appropriate attributes, such as colour or opacity. Visualisation mapping is the core of the whole visualisation process. This process transforms the data from a format of relational tables into graphical structures to be processed by the human vision.
- *View transformation*: generates the image using the geometric primitives from the mapping process and specifying graphical parameters such as position and scale. These graphical parameters are controlled by the user interaction, to perform some graphical manipulation such as zooming, scaling, panning etc.

Modules in the visualisation pipeline are implemented in Java. In particular, views are implemented and delivered through the Web using a Java Applet.

### 3 GISMO Visualisations

In this section we will illustrate some graphical representations of GISMO.

Fig. 2 represents the welcome page of GISMO. As you can see, there are 3 different areas in the application:

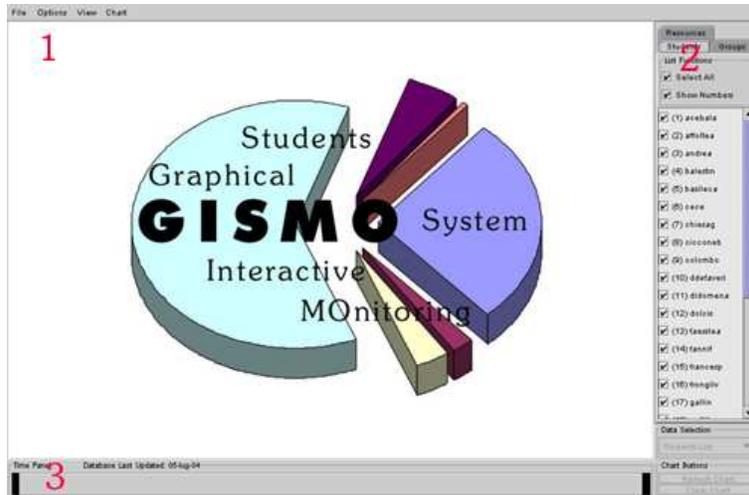


Fig. 2. The welcome page

- Chart Panel: charts are drawn on this panel.
- List Panel: contains a list of Students, Groups, Resources, etc. of the monitored course. For each list the instructor can select/deselect data to visualise.
- Time Panel: using this panel you can reduce the selection on time.

### 3.1 Login Overview

Fig. 3 shows the students' accesses to the course. Using this chart instructors can have an overview of all accesses performed by students. A simple matrix formed by students names (on Y axis) and dates of the course (on X axis) is used to represent the course accesses, where a corresponding mark represents at least one access to the course made by the student on the selected date. The instructor has an overview at a glance of the global accesses made by students to the course with a clear identification of patterns and trends, as well as information about the attendance of a specific student of the course. The histogram on the bottom shows the global number of hits to the course made by students on each date.

### 3.2 Discussion Overview

Fig. 4 shows data on discussions through the course. In this chart instructors can have an overview of all the discussions performed by students. For each student of the course it gives indications on the number of messages posted (with a square), number of messages read (with the circle) and finally the number of threads started by the student in the discussions (with the triangle).

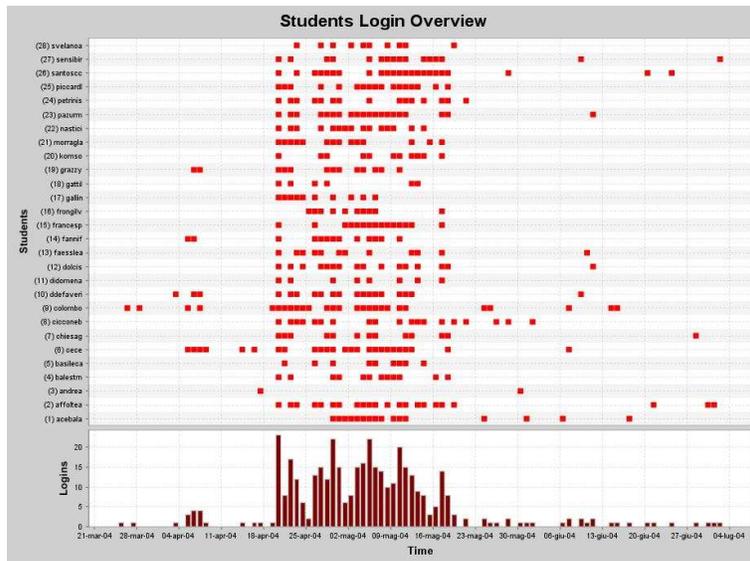


Fig. 3. Representation of the students' accesses to the course

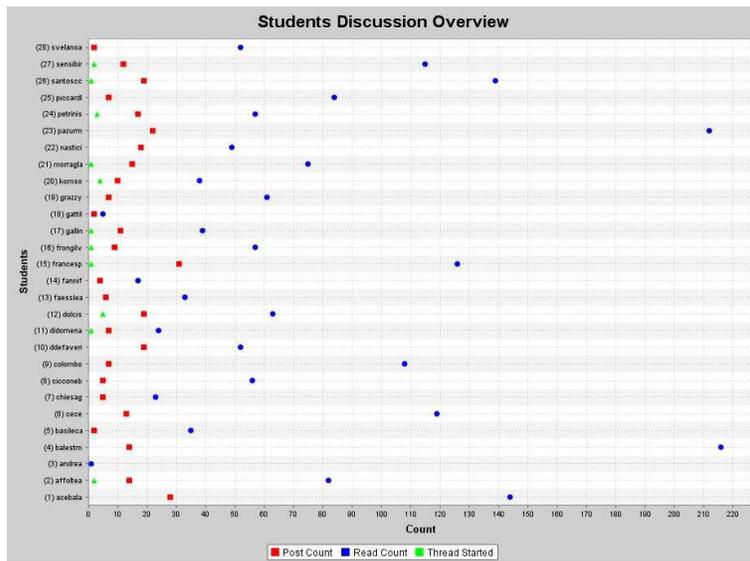
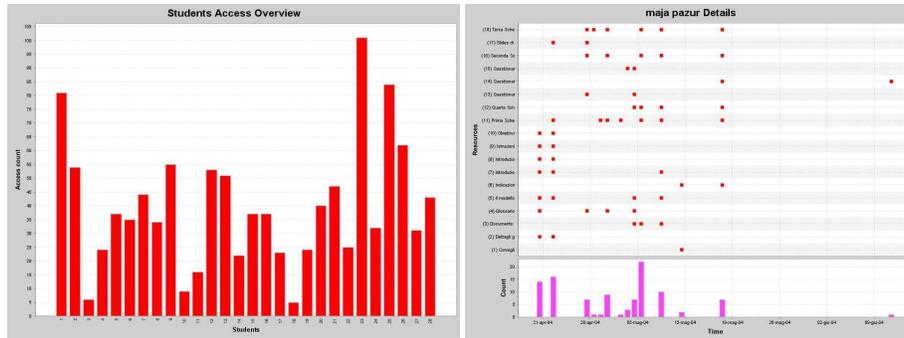


Fig. 4. Representation of the discussions



**Fig. 5.** Two examples of students accesses to resources. Image on the left represents the number of accesses made by students (X axis) on all course’s resources (Y axis). Image on the right shows the details on the resources accessed by a specific student on each date of the course

### 3.3 Students Accesses to Resources

With the chart represented in Fig. 5 on the left instructors can have an overview of the accesses of students on the course’s resources. By resource we mean any type of content that can be inserted into the course, such as a text page or a Power Point file. Students are represented on the X axis, resources are represented on the Y axis.

Instructors could also be interested in having the details on what resources were accessed by a student and when. Fig. 5 on the right gives this indication. It shows on which days the student visited a specific resource and how many times. The histogram on the bottom represents the total number of accesses made by the student to all course’s resources.

### 3.4 Resource Details

Chart in Figure 6 can be used by instructors to have details on how popular is every resource to the students of the course. It shows, for a specific resource, in which days students accessed this resource of the course and how many times. Chart on the top illustrates accesses for each student. The histogram on the bottom represents the sum of accesses made by students to the resource on each specific date.

## 4 Evaluation

An empirical evaluation of these graphical representations conducted with a sample of instructors revealed that graphical representations produced with GISMO might help instructors to identify individuals that need particular attention, to discover patterns and trends in accesses and discussions, and to reflect on their teaching practice. The description of this evaluation is out of the scope of this paper and it is described in details in [4].

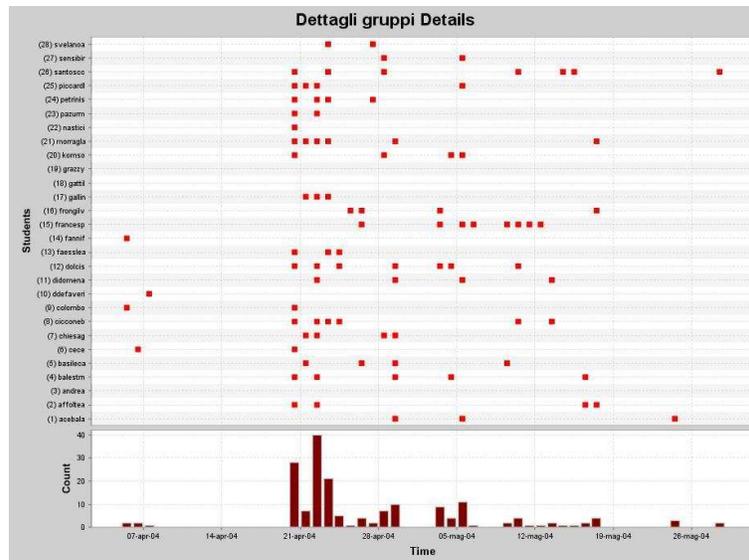


Fig. 6. Representation of the students' accesses to a particular resource of the course

## 5 Conclusions and future work

This paper presented a graphical interactive student monitoring and tracking system tool called GISMO that extracts tracking data from an on-line course maintained with Moodle, and generates graphical representations that can be explored by course instructors to examine various aspects of distance students. This work is only a part of a more wide European funded research project. More visualisations are going to be implemented in the near future, and we expect this tool to be integrated in the official Moodle's distribution site as an optional installable module.

## Acknowledgements

This work has been supported by the Swiss Office fédéral de l'éducation et de la science (OFES), grant N. UFES SOC/03/47, and it is part of the the research project "EDUKALIBRE, Libre software methods for E-Education" funded by the European Union in the years 2003 - 2005. (project N. 110330-CP-1-2003-1-ES-MINERVA-M). This project aims at the translation of the uses and procedures of libre software (free / open source software) to the creation of content suitable to be used as material for education. Special thanks to Luca Botturi for inventing the GISMO acronym.

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