Using Learning Analytics tools in Engineering Education

Miguel Á. Conde
Department of Mechanics, Computer Science and Aerospace Engineering.
University of Leon
León, Spain
miguel.conde@unileon.es

Ángel Hernández-García
Departamento de Ingeniería de Organización, Administración de Empresas y Estadística
Universidad Politécnica de Madrid
Madrid, Spain
angel.hernandez@upm.es

***Abstract*—This study describes an experience to assess the application of different sets of learning analytics tools to six only courses in Moodle virtual campuses of two Spanish Universities. The application of learning analytics covered four stages: identification of data and relevant techniques, tool selection, pilot testing and assessment of results. The main findings from the experience is that learning analytics tools are still too data-format and LMS version-dependent, and that teachers find the use of this kind of tools useful, but still difficult to use and interpret.**

Keywords—learning analytics, online courses, experience, multi-tool analysis

I. Introduction

Learning Management Systems (LMS) are one of the most popular educational technologies in Higher Education. LMS bring together a set of tools that help educational institutions to manage teaching and learning processes [1]. Furthermore, they have been successful in stimulating online engagement by teachers and learners. LMS provide teachers with means to manage curses, students, activities, resources and other elements involved in learning processes. In addition, they act as a meeting point for students and a guide to carry out their learning activities [2].

The present project analyzes information retrieved from LMS of courses at University of Leon and University of Salamanca. Both universities use Moodle in their virtual campuses. Moodle is one of the most popular LMSs in the world [3], especially in Higher Education contexts [4]. University of León has two instances of the LMS and the University of Salamanca one installation of the LMS. The different actors use Moodle for different purposes and goals. For instance, teachers use the LMS to publish content, to interact with their students, solve doubts, manage and assess students' work, etc.

Moodle registers each actor's interaction, or event that takes place in the LMS, storing the information in its database. That information about what occurs in a course is available for teachers and educational institutions. However, the great amount of records stored as raw data in the database makes its analysis and interpretation difficult and burdensome. Therefore, extracting knowledge and actionable information that allow observers to reach insightful conclusions and apply corrective measures, from mere observation of those data, is not practical. For example, the 114 students of the Operating Systems course generate around 35000 records during the one-semester course. A basic analysis of these records may provide information, such as the number of posts of a student in a forum, but this information is not enough to assess high-level concepts like participation levels of individual students during the course, the kind of interaction they have with their peers and the contents, the adequateness of the instructional content and course development, etc. Performing this type of analysis requires the application of a different set of tools and techniques. Learning analytics offers this kind of tools and methods.

Long and Siemens [5] define learning analytics as *"the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs"*. Thus, learning analytics facilitates discovery of "hidden" knowledge about teaching and learning processes in IT-mediated educational processes.

Learning analytics covers a broad set of tools and techniques, and allows teachers and students to obtain information about student progress, at-risk students, suitability of course contents and design, student, teacher and group interactions, etc. Institutions and instructors may then use that information to plan interventions and changes oriented toward helping students, redesign courses, adapt learning contents and methods, use specific tools, etc.

II. Description of the experience

The present experience aims to apply different types of learning analytics tools and techniques to the information collected from five different courses of the University of León: Programming I (first-year course in the Degree in Computer Science), Programming II (second-year course in the Degree in Computer Science), Operating Systems (second-year course in the Degree in Computer Science), Web Applications (third-year course in the Degree in Computer Science) and

Informatics (first-year in the Degree in Electronic Engineer). Additionally, and for comparative purposes, the experiences includes the data from the Software Engineering course (second-year course in the Degree in Computer Science at the University of Salamanca).

Table 1 summarizes the number of students, records and average actions per student in each of the six courses.

TABLE I. INFORMATION ABOUT THE SUBJECTS ANALYZED

Course	Students	Records	Av. actions per student
Programming I	153	50093	327,4
Programming II	94	29507	313,9
Operating Systems	110	36675	333,4
Web applications	52	7549	145,17
Informatics	84	24119	287,13

Retrieval and analysis of the information stored in the LMS database followed the following stages: 1) Identification of relevant data and choice of the appropriate learning analytics techniques; 2) Study, adaptation –if needed– and implementation of the different learning analytics tools; 3) Pilot testing; and 4) Evaluation of results. Tool selection (stage 2) covered 14 different. Pilot testing and evaluation of results finally included the following tools: Indicators, Engagement Analytics, GISMO, VeLA, GraphFES/Gephi, and ad-hoc tool that was developed to assess the acquisition of the teamwork competence.

III. Conclusions

The evaluation of results from this experience shows that the tools show a high dependence with the information format and the LMS version. Therefore, any changes affecting data format of LMS version would require moderate to dramatic changes in the different in tools –for example, some of the tools only work properly with specific versions of the Moodle platform.

In addition, there are important constraints for the application of these tools in institutional contexts. The institutions involved in this experience do not allow installation of new tools or plug-ins in their LMS, generally arguing security and data privacy reasons. Consequently, the analysis requires exporting the courses, creating controlled learning environments and replicating the course in the new environment for subsequent analysis.

Finally, it is worth noting that teachers' perceptions about the learning analytics tools were also asked, and their responses collected and analyzed. The great majority of instructors believe that the tools are useful, but also difficult to use, and that the information they return is generally hard to understand. Building on these results, there is still a wide margin of improvement in tool design and data visualizations that help effectively promoting the application of learning analytics in order to achieve the full potential of this kind of techniques for the improvement of educational processes.

References

[1] M. Á. Conde and F. J. García-Peñalvo, "Entornos Personales de Aprendizaje móviles y su aplicación en la enseñanza de Ingeniería del Software," presented at the Congreso Internacional sobre Aprendizaje, Innovación y Competitividad CINAIC 2013, Madrid, 2013.

[2] P. Avgeriou, A. Papasalouros, S. Retalis, and M. Skordalakis, "Towards a Pattern Language for Learning Management Systems," Educational Technology & Society, vol. 6, pp. 11-24, 2003.

[3] MoodleStats. (2013, 16/07/2013). Moodle Stats. Available: http://moodle.org/stats

[4] M. P. Prendes, "Plataformas de campus virtuales de Software Libre: Análisis compartivo de la situación actual de las Universidades Españoles.," Informe del proyecto EA-2008-0257 de la Secretaría de Estado de Universidades e Investigación2009.

[5] P. D. Long and G. Siemens, "Penetrating the fog: Analytics in learning and education," EDUCAUSE Review, vol. 46, iss. 5, pp. 31-40, 2011.