MOODLE SUPPORT FOR LEARNING ANALYTICS – A TRAVEL GUIDE

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RESUMO

Learning Analytics (LA) is a business intelligence project for the Educational domain which provides indicators of the students' evolution in his learning pathway. The analysis of the LA data results assists teachers to identify any student which may be struggling in a given subject. This information empowers the teachers' initiative to customize their teaching strategies according to each student knowledge level and features. Moodle provides different forms to support LA. This paper provides an overview of the main options, features and functionality of the LA implementation in Moodle. The idea is to assist new users that intend to use LA to support processes of decision making regarding learning aspects.

Palavras-chave: Learning Analytics, Moodle, Distance Education

Moodle Support for Learning Analytics - A travel guide

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Abstract. *Learning Analytics (LA) is a business intelligence project for the Educational domain which provides indicators of the students' evolution in his learning pathway. The analysis of the LA data results assists teachers to identify any student which may be struggling in a given subject. This information empowers the teachers' initiative to customize their teaching strategies according to each student knowledge level and features. Moodle provides different forms to support LA. This paper provides an overview of the main options, features and functionality of the LA implementation in Moodle. The idea is to assist new users that intend to use LA to support processes of decision making regarding learning aspects.*

1. Introduction

According to the United Nations, the education quality is one of the main global problems, together with increasing inequality, food/water security, refugee crisis (65 million and rising), health-care quality, climate change, data privacy and others [Dougiamas 2017]. In this context, some efforts have been carried out to use Internet as a popular channel to promote education. Massive Open Online Courses (MOOC), which offer on-line courses to a large number of learners, are examples in this direction. According to [Chauhan and Goel 2017] recent reports has shown that around 58 million students are registered in MOOC courses around different platforms. MOOC's usage growth comes due to some important factors, such as reduced costs, flexible class schedules and improvement of mobility when taking classes [Allen and Seaman 2014]. With the increasing popularity of online learning, it becomes highly important to understand how to assist learners to succeed in online environments [Bodily and Verbert 2017]. In Brazil, the most used Learning Management System (LMS) is the Modular Object-Oriented Dynamic Learning Environment (Moodle). From the 81 thousand registered Moodle sites, Brazil occupies the fifth position in the ranking [Dougiamas 2017]. Learning Analytics (LA) is a technique that focus specifically on learners and their learning behaviors, gathering data from course management and student information

systems [van Barneveld et al. 2012]. The usage of LA in online learning can assist teachers to monitor the progress of their students in the learning process [Chauhan and Goel 2017]. This aspect allows a better coverage of the tutorial task by the teacher, what increases the chance of success of an on line course. The work in [Bloom 1984], for example, shows that individual tutoring is twice as effective as group teaching. Motivated by the contribution of LA in the success of online learning and Moodle's popularity in Brazil, this study investigates and presents the LA features of Moodle, including the Application Programming Interface (API) of Moodle for LA and an comparative analysis of a selection of Moodle's plugins for LA. The final goal of this study is to empower teachers and tutors with relevant information about students progress in their learning pathway so that they can act, if needed, to ensure the success of learners. This article is organized as follows: Section 2 presents a literature review of works related to our research subject. Section 3 presents the study methodology. Section 4 presents LA concepts. Section 5 presents the LA features of Moodle. Section 6 presents the Moodle API. Section 7 presents an overview of the Moodle LA plugins. Section 8 presents the findings and recommendations of this study. Finally, Section 9 presents the conclusion and research directions.

2. Related work

There are some studies that present the state of art of Learning Analytics in different parts of the world, such as the study of [Lemos et al. 2017] where a systematic mapping of Learning Analytics in Latin America countries is discussed. In this work, the majority of the papers found were focused only on theoretical aspects of LA and a few of them analyzed the application and deployment of LA tools or products. The study in [Spröck et al. 2017] shows a initiative to form a network called Latin-American Network of Learning Analytics (LALA), which is an alliance in Latin America to support the cooperation between universities in some Latin America countries regarding the application of LA and related experiences. The study in [Chauhan and Goel 2017] focuses on Learning Analytics features in the Learning Management Systems for the learner. In his study, 11 e-learning platforms are analyzed according to the presence of specific LA features.

3. Methodology

As our study focuses on the LA characteristics on MOODLE for teachers/tutors, we have mostly searched for information in the documentation provided by the Moodle official site. In November 2017, the 3.4 version of Moodle was launched. From this version, an API for learning analytics has been incorporated in the Moodle core [Moodle 2018b]. The Moodle API will be presented in section 6. A number of LA plugins is also available for

Moodle for diverse purposes, different types and subjects. Some plugins are part of the standard distribution (standard plugins) and others are third-party plugins (available from the Plugins Directory) [Moodle 2018c]. We have selected the plugins according to the following criteria: (1) Plugins for learning analytics, (2) Available for version 3.4, (3) Purpose related to administrating role, (4) Third-party plugins. The plugins search, using such criteria, returned 5 LA plugins that will be described in section 7.

4. Learning Analytics

Learning analytics has different definitions. Among them we can find the following definitions for LA: Development of methods that binds educational data sets to support the learning process; Usage of intelligent data, learner-produced data, and analysis models to identify information and social connections and to predict and advise on learning; Survey, collection, analysis and data reporting on learners and their contexts for purposes of understanding and optimizing learning and the environments in which it takes place. Combining these views, LA can be defined as the gathering, processing and analysis of students-related data and their corresponding learning pathway to support the comprehension and optimization of the learning process for the learners and stakeholders [Okewu and Daramola 2017]. By means of LA Techniques, a large amount of educational data (which can be gathered in different forms) can be obtained and processed, as for instance: classifications, activities, interactions, behaviors, communications and compromises, approval index, academic performance, retention rate, knowledge area of the study plan, context of the student and the learning pathway. These data can be analyzed in order to find patterns and establish indicators of interest. These patterns and indicators, together with the basic and traditional reports, would serve to predict performance problems, enrich the educational experience, better promote programs and activities to groups of students (in order to better adjust them to their needs), increase ratings, approval ratings and retention rates, improve academic performance, personalize the teaching and learning process, reduce the administrative burden in the classrooms, facilitate the global and local development of the university community, identify the knowledge areas of the study plan of the educational program which presents a high level of learning difficulties or low levels of academic performance, as well as high dropout levels [Sprock et al. 2017]. However, gathering these data is not a simple task, because, ethics and security reasons must be considered for data collection and data analyses, further details in [Carneiro et al. 2017]. In Latin America, there is a proposal to create a Latin-American Research Network related to Learning Analytics (LALA). The LALA has the participation of 7 Latin American countries (Argentina, Brazil, Chile, Colombia, Ecuador, Mexico and Venezuela) represented by a group of researchers from 13 Higher Education Institutions of these countries. This

academical network shares a common interest which is finding solutions to similar problems through knowledge management. The main goal of LALA is sharing experiences with the usage of LA, such as identifying patterns to be able to establish indicators on the learning pathway [Sprock et al. 2017].

5. Moodle

In this section, the LA features in Moodle are presented. According to [Chauhan and Goel 2017], there are two main forms of LA support to the users of a LMS - visualization and recommendation. Visualization provides learners self-reflection and provides teachers/tutors help to interpret informations for decision making. Recommendation are provided by Automatic recommender or adaptive systems about which learning resources might be more suitable for the learners without requiring any interference from learner or instructor. Moodle Version 3.4 has the following LA features: an API to build indicators and prediction models for third-party Moodle plugins; Two built-in prediction models: "Students at risk of dropping out" and "No Teaching"; A set of student engagement indicators based on the Community of Inquiry; Built-in tools to evaluate models against the data of a wide range of sites and courses. The limitations of this Moodle release for LA are – to be able of making predictions, the prediction model requires a previous training on a site with preceding completed courses (usage of course completion feature recommended); this model can only be used in courses with a fixed start and end dates and is not designed to work with rolling enrollment courses [Moodle 2018a]. This version comes also with an standard plugin called Inspire, which implements the prediction model "Students at risk of dropping out" [Moodle 2017].

6. Moodle LA API

The Moodle API for LA that is called Analytics API. This API offers Moodle site managers the possibility of defining prediction models that combine indicators and a target. Targets are the core of the definition of the model. They represent the consequence that the model tries to foresee (the dependent variable in supervised learning) and also determine which action is going to be performed depending on the obtained predictions. Indicators are defined as the predictor value or the independent variable (in supervised learning). To be able to evaluate if the prediction models are accurate, Moodle internally trains a machine learning algorithm by using calculations based on the defined indicators within the site data. When the new data that correspond to the defined criteria for the model are available, Moodle starts predicting the probability that the target event will occur. Targets have the freedom to define which actions will be performed individually for each prediction, from sending messages or feeding reports to build new adaptive learning activities [Moodle 2018b].

6.1. Target and indicators as the main elements of the model

As explained above, the combination of target and indicators are the essential elements in a prediction model definition. The main characteristics of the targets and indicators are described below, as well as some examples for each of them. Target represent the event the model is attempting to predict. They depend on analyzers because analyzers provide them with the samples they need. They work for a single analyzer. Examples are: Students at risk of dropping out, Difficulties to pass a specific quiz. Indicators are values supposed to produce accurate predictions of the target . They are not limited to a single analyzer, facilitating its reuse in other models. Examples are: User views content, Average attempts required to pass quiz, user posts in any forum. Other elements of the API are - sample which is a set of calculations made using a selection of Moodle site data; analyzers which are the creators of the dataset files that will be sent to the machine learning processors; insights which are the predictions generated by the machine learning algorithm. The main components of the API and their interactions are shown in Figure 1.

Figure 1. API components - Adapted from : [Moodle 2018b]

7. Moodle LA plugins

LA is not only offered by the Moodle LA API, but there is also a number of Moodle standard and third-party plugins that provide analytics. These plugins are offered as reports, blocks and others. With the focus in tools that support the instructors in decision making, the plugins for LA supported in version 3.4, which were selected according to the criteria defined in section 3, are described in this section. The documentation source was

the official Moodle site, the Git Hub repository and the documentation provided by the Moodle partner that developed the plugin (in some cases).

7.1. Analytics Graphs

The Analytics Graphs plugin was created with the purpose to generate graphs that serve as parameter to facilitate the pedagogic decisions. It collects existing student activity data (that have always been available to teachers) from Moodle and displays it in various charts, providing a visual form. Through this graphs, it is possible to examine student activity in a course. The generated graphs (Grades Chart, Content Accesses Chart, Number of Active Users Chart, Assignment Submissions Chart and Hits distribution Char) possess zoom resources and facilitate the identification of the student, as well as his profile in the course. A list of non active students is shown and a fast communication through e-mail is offered via a button [Schmitt 2018].

7.2. Attendance

This plugin allows teachers to keep a record of attendance during class, avoiding, replacing or supplementing the use of traditional methods and allowing better monitoring by the teacher and the student. There are four status that can be attributed by the teacher to the status of a student, which are "Present", "Absent", "Late", or "Excused". In addition other status can be added. The teacher adds attendance as an activity of a course and defines which sections will track attendance. Students can also record their own attendance and a variety of different reports are available, if the sessions are set up for this [Marsden 2018].

7.3. Checkmark report

It is an extension to the module checkmark (provides information about the assignments completed by the students prior to a lesson) and shows the marks and grades for one or more checkmarks in a tabular form. The overview shows some information, which is the amount of marks, the grades and the percentage allocation. The checkmark report offers three different types of views for the information it makes available. The first is called overview and gives a complete chart. The second is called student overview and in it students can be individually inspected. The third is called user view and in it teachers and students have an immediate feedback of their status [Cooperation 2018] . Checkmark report optimizes the learning process because of its improved overview for all enrolled users.

7.4. Exabis competence - Competence grids

The plugin Exabis Competencies - Competence grids is a block plugin that works with the concept of digital competencies. This concept allows teachers and students to document their work by constructing a competence profile and work collaboratively. In Exabis, teachers can create digital competence grids in Moodle, share specific tasks and materials in the pedagogical framework with all students or certain students, providing

individualization. The teacher can follow the progress of the student by evaluating the competencies that the student has gained by completing the activities in Moodle. Competencies can be gained by the completion of course, participation in quizzes and assessments. All these options can be configured in the plugin[Riepl 2018].

7.5. Learning Plan

The Learning Plan is a plugin to facilitate the management of organizational learning. The plugin can be used as a database that contains information about the organization's learning initiatives. It can also be used as a platform for organizing structural learning. Each Learning Plan contains informations as start and end date, the learners and the status of the training. This tool brings together different forms of learning, such as online learning, presence learning, learning on the job. The learning plans can contain a set of courses and can be assigned to a individual learner or a group of learners[3i Logic LMS 2018].

The main characteristics of the selected plugins are shown below. The meaning of each column follows: (1) Plugin - the name of the plugin, (2) Scope - the comprehensiveness of the analyses, (3) Indicators - what information indicates the progress of the student, e.g percentage of course completion, (4) Action - which action the plugin offers, e.g. send an email , (5) Trigger - what event happens to start the action ? e.g. some activity is completed.

Table 1: Selected Plugins

Plugin	Scope	Indicators	Action	Trigger
Analytics Graphs	Course	Number of people who have accessed or not some content, who performed submissions, Hits distribution, who submitted assignments on time or late, who was active in a certain time of day	Send an email to the group that was selected based on their behavior in a course & manual	manual
Attendance	Course	Record attendance (present, late, excused, absent, etc)	Full report, monthly report, weekly report and daily report & manual	manual
Checkmark report	Course	Analyzes the marks and grades for one or more checkmarks	Generates reports with three types of view (overview, student overview, user/view)	manual
Exabis	Course	Quiz % to gain competence, interdisciplinary competencies independent of subjects, grading scale for assessment	Notification to users & learning materials submitted or assessments done	learning materials submitted or assessments done
Learning Plan	Training	progress status	Notification	manual

8. Findings and recommendations

After analyzing the Moodle third-party plugins and the Moodle API for LA, the main aspects will be highlighted below:

(1) plugins provide actions in the form of email, report, notification; (2) most plugins are designed to work in the scope of a course but there is also plugin for different scope, e.g. Learning Plan, that works in the scope of a whole training (that can contain a set of

courses); (3) the concept of soft skills is not popular, but it appears in the plugin Exabis; the concept of competencies appears in two plugins: Exabis and Learning Plan; the concept of participation appears in only one plugin, the Attendance plugin. One of the questions that researchers struggle with is "which data need to be captured and to provide accurate predictions ?"[Chauhan and Goel 2017]. Finding the answer for this question is the biggest motivation of the formation of network alliances such as the LALA [Sprock et al. 2017]. The LA models provided by Moodle, which were already evaluated as accurate in prediction making, can be used as reference for LA researches and help them in finding that answer as well as other questions that may appear regarding to the usage of LA in LMS.

8.1. Recommendation

For the purpose of providing information about the learning pathway of the student to the teacher/tutor it's recommended first to establish which are the targets/predictions they look for and analyze if they are already included in Moodle core. If this is not the case, the teacher/tutor can follow with the analyses of the plugins, to search for a plugin that provides the LA coverage needed, because each plugin has a specific purpose. Another point to be considered in this choice is that, in the case of the third-party plugins, it is not guaranteed that they will be supported in future Moodle versions.

9. Conclusions

Moodle does offer a large coverage to Learning Analytics. Since version 3.4, a wide coverage for Learning Analytics, in the form of, specific API for development of thirdparty plugins, built-in models, and standards tools, as well as, third-party tools for LA purposes are available in and for Moodle. Based on the statement in [Chauhan and Goel 2017], that LA in MOOCs are still in its infancy, it is pertinent to say that Moodle is, nowadays, the LMS with the largest LA coverage. Finally, the choice of prediction model or tool or LA feature available in Moodle will depend on the purpose of each institution, course, teacher, stakeholder. For future work it would be interesting to study the Moodle LA API and standard plugins in detail.

References

- 3i Logic LMS (2018). **Blocks: Learning plan**. Available at : Accessed on: March 12, 2018.
- Allen, I. and Seaman, J. (2014). Grade change: Tracking Online Education in the United States.
- Bloom, B. S. (1984). **The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring**. Educational Researcher, 13(6):4 – 16.

Bodily, R. and Verbert, K. (2017). **Review of research on student-facing learning analytics dashboards and educational recommender systems.** IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES, 10(4):405 – 418.

Chauhan, J. and Goel, A. (2017). **A Feature-based Analysis of MOOC for Learning Analytics.** IEEE Conferences, Proceeding IC3 '17.

Cooperation, A. A. M. (2018). **General plugins (local): Checkmark report.** Available at: .Accessed on March 16, 2018.

Dougiamas, M. (2017). **Moodle for the next ten years.** Conference. Presented at the MoodleMoot Conference, Germany.

Lemos, H., Cristian, Nunes, J. B. C., and Ochoa, X. (2017). **An initial review of Learning Analytics in Latin America.** IEEE, Proceeding LACLO 2017.

Marsden, D. (2018). **Activities: Attendance.** Available at: . Accessed on: March 10, 2018.

Moodle (2018a). **Analytics API.** Available at: . Accessed on: February 14, 2018.

Moodle (2018b). **moodleplugins.** Available at :. Accessed on: March 03, 2018.

Okewu, E. and Daramola, O. (2017). **Design of a Learning Analytics System for Academic Advising in Nigerian Universities.** IEEE.

Riepl, A. (2018). **Blocks: Exabis competencies - competence grids.** Available at :< https://moodle.org/plugins/block_exacomp>.

Schmitt, M. (2018). **Blocks: Analytics graphs.**Available at :. Acessed at : March 08, 2018.

Sprock, A. S., Vicari, R. M., Rincón, M. R., Silveira, I. F., Gallegos, J. P., Maldonado,J., and Toscano, A. (2017). **Latin-American Network of Learning Analytics - LALA.** IEEE, Proceeding LACLO 2017.

van Barneveld, A., Arnold, K. E., and Campbell, J. P. (2012). **Analytics in higher education:Establishing a common language.** ELI papers, 2012(1):1–11.