LAe-R: A new learning analytics tool in Moodle for assessing students' performance

Ourania Petropoulou, Katerina Kasimatis, Ioannis Dimopoulos, and Symeon Retalis, *Member, IEEE*

Abstract— A challenging and demanding task for the teachers in e-learning environments is the assessment of students' performance. Several learning management systems (LMS) like Moodle offer several assessment tools such as quizzes, scales, "classic" rubrics, etc. In this paper, we present a new cloud based assessment tool, called Learning Analytics Enriched Rubric (LAe-R) which is seamlessly integrated into Moodle. LAe-R is based on the concept of the "enriched rubrics", which is becoming a popular assessment technique in education. This technique is a blend of marking criteria and grading levels of a "classic/traditional" rubric and performance indicators stemmed from analysis of learners' interaction and learning behavior in a LMS based e-learning environment. Finally, in this paper we present the findings of a case study scenario showed that LAe-R is a very usable tool and is highly appreciated by teachers and students.

Index Terms— LAe-R, Learning Analytics Tools, Students' assessment performance, Enriched Rubrics, cloud-based assessment tool

I. Introduction

Several systematic efforts have been made to reform school education in order to embed modern pedagogical methods such as inquiry based learning and computer supported collaborative problem solving. The ultimate challenge is to make the learning process more engaging and effective as well as to promote the "21st Century Life Skills", i.e. collaboration, problem solving skills, critical thinking, creativity, etc. These skills are nowadays considered important for individuals to function successfully as global citizens and workers in diverse ethnic and organizational cultures [1].

Along the way to meet this challenge, teachers enrich the traditional teaching paradigm by building a technology enhanced learning environment. Most often, they are using learning management systems (LMSs) as the cornerstone of such environments. So, they design well-orchestrated learning scripts which require from students to engage into sophisticated collaborative learning and problem solving activities such as individual and group tasks, co-acquisiting of knowledge and skills through collaboration and social networking, communication (synchronous or asynchronous), as well as use of various online educational resources, etc. [2]. Despite the proliferation of such teachers design initiatives, a key factor that is still missing relates to the design and application of modern assessment strategies tailored to probe the competencies and skills that these modern learning scripts try to enhance [3].

The assessment of students' performance in such technology enhanced learning scripts is a tiresome and a time-consuming process for the teachers, who should take into consideration a huge amount of performance indicators. The process of assessment involves designing appropriate authentic assessment activities and gathering information from a variety of sources such as discussions log files, project deliverables and co-creation activities in order to come up to a rich and meaningful understanding of student learning and behaviour in the learning environment.

As a result, students assessment needs to be related to participation, support for group activities, quality of contributions to the group deliverables, creativity in product development, helpfulness, etc. New assessment approaches and tools such as learning analytics, which help teachers to have a better understanding of students' online interactions have been proposed lately. Such learning analytics approaches and tools have also started being integrated into Moodle, which is one of the most popular open source systems [4,5,6].

The aim of this paper is to present a new cloud-based assessment tool, called Learning Analytics Enhanced Rubric (LAe-R), which has been developed as a Moodle plug-in (version 2.2+). It helps teachers to assess a number of key students' skills and competencies using an enhanced version of the existing "classic" rubric method. Thus, LAe-R allows a teacher to add types of criteria that are associated to traditional performance metrics (e.g. criteria associated to project deliverables) learning and interaction analysis indicators such as collaboration, grades to assignments or study of learning resources.

The structure of this paper is as follows. The next section gives a brief literature review of existing web-based learning analytics tools that interoperate with Moodle. Then, the Learning Analytics Enriched Rubric (LAe-R) tool is presented, followed by an examplar scenario of its application to which the tool is examined by a group of participating teachers, followed by its evaluation results.

Dr. O. Petropoulou, University of Piraeus, Department of Digital Systems. (rpetro@biomed.ntua.gr).
Prof. S. Retalis, University of Piraeus, Department of Digital Systems. (retal@unipi.gr).
MSc. I. Dimopoulos, University of Piraeus, Department of Digital Systems. (johndimopoulos@sch.gr).

Concluding remarks will be made about the use of the tool so far, as well as future plans regarding the tool's usage and functionality.

II. STATE OF THE ART OF MOODLE RELATED LEARNING ANALYTICS TOOLS

Long and Siemens (2011) define Learning Analytics (LA) as "the use of intelligent data, learner-produced data, and analysis models to discover information and social connections, and to predict and advise on learning" [7]. LA mainly intends to help teachers and students to involve based on the evaluation of educational data [8].

A number of LA tools (both online and standalone) exist. Some of them, which is the focus of this paper, that interoperate with Moodle have been proposed. These are the following:

1. *GISMO* is a visualization tool for Moodle, which uses log data, process them and finally produces graphical representations that can be used by teachers so as to examine social, cognitive and/or behavioral student interactions. The tool incorporates with Moodle as a supplement block within the graphics environment, visible only by the teacher. It provides analytic statistical representations and shows a general picture of the students as a whole, analyzing the more general learning process of all the students on all subjects [9]. It can also provide analytical statistic representations for specific students, resources and activities.

2. *MOCLog* is a sum of tools that are used for the analysis and presentation of log data within Moodle. The development of the tool was based on GISMO. Thus, some of GISMO's main components for the production of statistical reports for educators and students have been re-used. MOCLog attempts the analysis of interactions occurring in an online course so as to achieve better analysis of both the products and the educational process itself. It distinguishes among users according to their role within the system (cource manager – teacher – student) and presents different statistical reports tailored to these roles. So, the system's users have access to summative reports of interactions related to actions on educational resources and educational tools within specific subjects, such as quizzes, assignments, wikis, etc. [10].

3. *Excel Pivot Tables* is a tool that can be used for the production of learning statistics coming from Moodle. Moodle itself exports its data from the log files in spreadsheet form (Excel), through which the user can feed in data and create Pivot Tables. The graphic result is called 'summative table report'. With the aid of this tool the user can relatively easily and quickly organize in groups a great volume of data, sum up important information emerging from the data and execute immediately complex calculations on these data [11].

4. *Analytics and Recommendations* is installed within Moodle as a supplement block and can be used both by teachers and students. It is a tool for the visualization of students' involvement in each activity of an online course as well as a consultation tool, which can recommend activities to students so that they can improve their attainment. The tool uses tables and graphs, enriched with special colouring, so as to render the provided information easier to comprehend [12].

All the abovementioned tools offer several features that try to support teachers in evaluating aspects of the effectiveness of the online courses design for improving their quality and for identifying opportunities for interventions and improvements. None of them has been used for assessing students' performance. This open research and development topic is addressed by the cloud-based LAe-R tool.

III. LAE-R FUNCTIONALITY

Rubrics are becoming one of the most popular techniques for the assessment of students' performance. They are used to evaluate a wide range of skills, knowledge, abilities in various learning subjects and activities [13, 14]. The Enriched Rubrics (ER) share the same form as the 'classic' rubrics but also allow the inclusion of criteria related to performance indicators stemmed from analysis of learners' interaction and learning behavior in a LMS based online course [15].

As shown in table 1, the horizontal axis of an ER shows the graded levels of performance along with the respective grading scale used for each level.

Table 1. Sample of an assessment rubric

	Levels of performance (scale)			
	Exceptional Performance 3	Mediocre Performance 2	Low Performance 1	Results
Criterion 1				
Criterion 2		Performance Descriptors		
Criterion 3				

(Criteria or Dimensions — vertical axis label)

The vertical axis presents the assessment criteria, which derive from the analysis of students' interaction and their learning paths during an online lesson (e.g. total number of activities-messages per student/team, proportion of writing-reading messages per student/team, social network density, proportion of learning resources read by student/team, etc.). ERs systematize, organize and simplify the process of evaluating students' performance, providing concise and measurable assessment criteria (strongly linked to the learning objectives) for both the learning products and the complex learning process, while at the same time documenting the differential result in students' attainment using levels of grading [15].

The Learning Analytics Enriched Rubric (LAe-R) tool was created as a Moodle plug-in (version 2.2+). It is being integrated as an advanced grading method of Moodle. As shown in figure 1, when creating an ER, a teacher can add

types of criteria that are associated to learning and interaction analysis indicators such as collaboration, grades to assignments, study of learning resources.
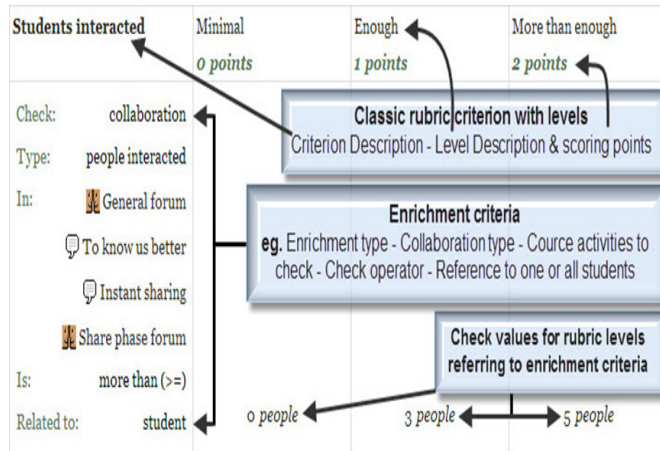

Figure 1. Screenshot of how a teacher can specify an assessment criterion in LAe-R.

For assessing students' performance with regards to "collaboration", the tool analyses and visualizes data such as forum posts (new or reply messages), chat messages and number of files attached to forum post messages. For assessing students' study behaviour, the tool analyses and visualizes the number of students' views upon specified learning recourses. Also, the students' performance in various assignments can be measured or aggregated by the LAe-R tool. By using "collaboration" and "studying of resources" indicators, the teacher can perform a quantitative evaluation on student performance, whereas using the "grades of previous assignments" a qualitative evaluation can be made, upon student assimilation of course material and/or adoption of educational objectives.

The Learning Analytics Enriched Rubric tool computes a benchmark for each criterion by collecting and mining the associated data from the Moodle log files and by exchanging data with other tasks as it is presented in Figure 2 below. Then, the appropriate rubric level gets selected [16].
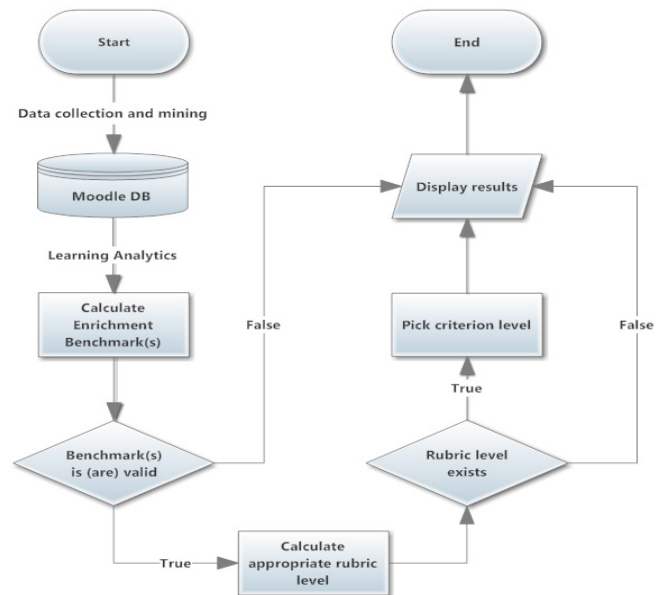

Figure 2. LAe-R automatic evaluation workflow

IV. CASE STUDY SCENARIO

32 MSc students, who were primary and secondary schools teachers, have evaluated LAe-R. All of them had experience in designing complex learning scripts for online courses. The case study was carried out in two phases: At first students were informed about the enriched assessment rubrics during a three hours lecture session. The concept of this new type of rubrics was presented along with examples that gave emphasis on learning interaction indicators. At the second phase, the students formed teams of two or three members. They were asked to:

1. Create complex CSCL scripts on various school subjects, using computer supported learning methods and/or inquiry based science learning methods, as well as instantiate them as Moodle courses

2. Design and submit enriched assessment rubrics for the assessment of students' performance in the Moodle courses which they have designed

The goal of this study was to evaluate the usability and acceptance of LAe-R by teachers-practitioners. As Figure 3 shows, the practitioners rated quite high the several usability aspects of the tool. Concerning LAe-R, teachers indicated that they felt comfortable using this tool. They were very satisfied by its interface. The majority of the participants stated that they found LAe-R very useful, quick and easy to work with. Using LAe-R for assessing students' performance in a pluralistic way seemed rather straightforward and effortless to the practitioners. Very good reviews were also noted for LAe-R's online help that contained detailed videos and files uploaded as Moodle docs.
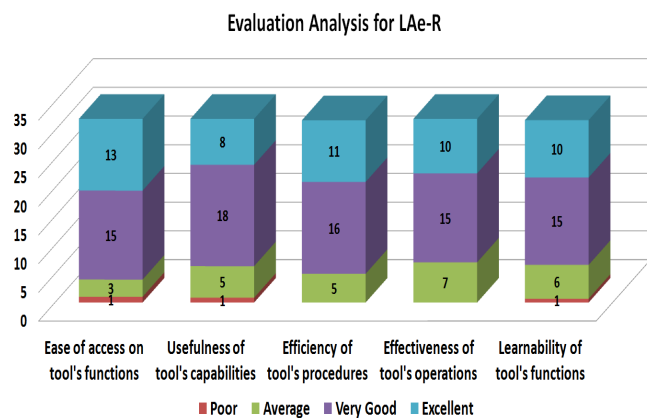
Figure3. Evaluation results about LAe-R tool's usability aspects in creating enriched rubrics with Interaction Analysis indicators

Furthermore, teachers-practitioners gave feedback comments via the open questions of the online questionnaire such as inclusion of:

- more criteria in an enriched rubric thus allowing a teacher to assess even more aspects of learning interaction in a Moodle course such as contribution to wikis.
- more sophisticated social network analysis indicators like the centrality of a social network could be added
- extra ways to visualize learning and interaction analysis indicators in pies or charts.

V. CONCLUSION AND PERSPECTIVES

Learning Analytics is an emerging new research field with many tools which offer many valuable services to educators for monitoring and tracking learners' interactions in online learning environments. This paper presented the cloud-based LAe-R tool which seems a very promising assessment tool that could fill-in the gap in holistically assessing students' performance in Moodle, using the wealth of learning analytics with learning and interaction analysis indicators. Currently, LAe-R has been established with the intention to support teachers in their ongoing formative assessment tasks, using a variety of learning and interaction analysis indicators embedded in criteria. Despite its advanced assessment features and specialized customization options, the tool was greatly accepted and adopted by educators.

Future work will include the enhancement of LAe-R, based on the practitioners' feedback, giving emphasis on visualization aspect and more indicators. Also, more field-testing will accompany teachers that will enact Moodle courses based on complex learning scripts from different disciplines. We also plan to enhance LAe-R with a recommendation component for students so that LAe-R could be used for formative evaluation as well.

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