Towards a self-assessment tool for teachers to improve LMS mastery based on Teaching Analytics

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Abstract. While learning management systems have spread for the last decades, many teachers still struggle to fully operate an LMS within their teaching, beyond its role of a simple resources repository. To elicit these learning situations, we suggest a web environment based on teaching analytics to provide teachers with self and social awareness of their own practices on the LMS. This article focuses on the behavioral model we designed on the strength of (i) a qualitative analysis from interviews we had with several pedagogical engineers and (ii) a quantitative analysis we carried out on three years of teachers' activities on an LMS at the scale of the University. This model describes teachers' practices through six major explainable axes: evaluation, reflection, communication, resources, collaboration as well as interactivity and gamification. It can be used by the institution to detect particular teachers who may be in need of specific individual support or conversely, experts of a particular usage of the LMS who could bring constructive criticism for its improvement. While instrumented in our environment, this model enables supplying teachers with self-assessment, automatic feedback and peer recommendations in order to encourage them to improve their skills with the LMS.

Keywords: Teaching analytics · Learning Management System · Self-assessment · Peer recommendation · Clustering analysis · Principal Component Analysis.

1 Introduction

The trend of using Learning Management Systems (LMS) is now spreading quickly across all areas of education. Most universities offer LMSs as a "one size fits all" technology solution for all teachers of any discipline. However, many teachers face several difficulties to integrate these platforms into their practices. The main problems of teachers appear to be technical or organizational, due to the lack of support and the lack of time devoted to its learning [2]. Furthermore, most universities are hiring pedagogical engineers (PE), especially to support and train teachers in order to ensure a proper use of their LMS and ensure their pedagogical fit. With few PE compared to teachers, the formers struggle

to support every teacher. For instance, in France, these problems were one of the reasons that led the Ministry of Higher Education to launch the HyPE-13 project(Hybridizing and Sharing Teachings). It aims to accompany teachers and students towards success by promoting the hybridization of training.

On the other hand, the use of LMS allows the capture of large amounts of quantitative data concerning the behavior of users and designers, and thus paves the way for Learning and Teaching Analytics (LA, TA). In our University, the LMS has been in place for more than 10 years. However, the University is facing the same issues we identified previously (LMS use expectations are not met and only 5 PE have to deal with more than 600 teachers). Our main objective is then to provide teachers with personal and social awareness [3], in order for them to engage in learning situations that aim at improving their LMS skills.

To reach this objective, we propose the design and the instrumentalisation of a teachers' behavior model to support their self-assessment and leverage peer-learning through automatic recommendations. We address here two first research questions: (i) How to model the exploitation of an LMS a teacher does and could do in an intelligible way ? (ii) What TA indicators can be instrument from this model to support self-assessment and enable feedback and recommendations?

2 Related work

Some researchers have focused on TA to understand how teachers deliver their lessons. For instance, to support the teacher inquiry process, [7] identified TA as a necessary component, exploited in synergy with Learning Analytics (LA). For this purpose, [5] used TA to automatically extract teachers' actions. To get out of the dependence on the technological context, [1] proposed a theoretical referential of good e-learning practices (DISC), while [4] empirically built a model to describe hybrid learning systems. On the other hand, some studies have been conducted to analyze teachers' behavior for different purposes as [8] aimed to uncover course design archetypes across multiple institutions and identified 5 groups consider courses with: mainly content and low interactions, one-way communication, strong peer interactions, more evaluation activities and those with a balance between content, communication and evaluation. Or, [6] that proposed a method to automatically certify teachers' skills from LMS data and they were able to identify 6 types of courses based on teachers' practices (non-active, submission, deposit, communicative, evaluative, balance). Overall, these different studies show the importance of using analytical tools on the actions of teachers themselves, but it appears that the use of these behaviors for self-assessment has not yet been explored. In addition, they depict current platform usage, with the rejection of unused variables and cannot adapt to expected future uses.

3 Methodology

In order to qualify the current and expected teachers' uses of the LMS, we applied a quantitatively driven mixed method. We started with a quantitative

analysis to deduce statistically different profiles of LMS use, in order to find groups of teachers or profiles of interest, based on the LMS log data. We performed a Principal Component Analysis (PCA) and a clustering analysis . PCA analysis allows to highlight diversity of the dataset in a reduced set of variables (components) while the clustering one aims to regroup the different instances of the dataset regarding their similarity. Afterwards, we conducted semi-structured interviews (i.e. : qualitative interview) with 3 female engineers on the same day (each lasted 40 to 50 minutes). In a series of open-ended questions prepared in advance to guide our interview, we collected information to improve the quantitative study which was analyzed by 2 researchers. This qualitative method was chosen because we needed the interviewee to answer freely, express a specific point of view, and bring out potential new working hypotheses.

We then performed a second quantitative analysis using the same previous method to address the engineer's comments by adding or modifying some variables. In order to design a behavior model that can handle both present and future expected usages of the LMS, we merge both results we obtained from this latest analysis and those we obtained from the interviews. Particularly, some of the discussed LMS features are still not used enough to appear in the results of the quantitative analysis. Moreover, the choice of the model axes (i.e.: the structure and how variables are grouped by axis) is also based on the results of the last PCA analysis and those of the qualitative interviews.

Finally, this model allowed to design several TA metrics. We applied clustering methods (K-Means, Dbscan, Agglomerative clustering and Gaussian Mixture) to be able to provide a social awareness based and defined interpretable scores to offer a more detailed personal awareness. Based on these metrics, we eventually designed a tool mainly dedicated to teachers, that supports self-assessment and awareness, but also can provide automatic peer recommendations using our model and metrics.

4 Teachers' behavior Model

4.1 Model definition

Through the intersection of the qualitative and quantitative studies, we designed a teacher behavioral model. It describes along six axes the behavior of teachers in a comprehensive way, and includes features that can be used to represent the current or potential use of the platform. The first axis (a.1 - Evaluation) represents the different tools used by the teacher to assess his students (quiz, assignemnt, attendance, calendar, grade). The second axis (a.2 - Reflection) concerns the LMS features that can provide teachers with a way to get feedback from students on their teaching and the digital resources they use (survey and choice). The third axis (a.3 - Communication) is devoted to the different means of communication used by the teacher to facilitate the transfer of information to the students and to improve the sharing between them (forum and chat). The fourth axis (a.4 - Resources) refers to the diversity of resources the teacher provides to students, and include then the file, book, folder, page, glossary and

url features. Whereas the fifth one (a.5- Collaboration) concerns the promotion of collaboration between students with different LMS features (workshop, wiki, via, choice and data), the last axis (a.6 - Interactivity and Gamification) gathers the interactive or playful activities used by teachers to animate their courses and make them more attractive (lesson, course format, img, gallery, game and lti).

4.2 Teaching Analytics indicators

Based on the teachers' behavior model derived from the quantitative and qualitative analysis, we designed two TA metrics for awareness and self-assessment. The first metric is the LMS usage trends, it provides teachers with a current view by axis of their position relative to their colleagues. It was calculated by testing several clustering algorithms, and the results allowed teachers to identify the axes on which they are active and those on which they are not. The second metric propose two complementary scores for self-awareness to measure how the teacher profits from the LMS, based on the complete model we designed : (a) The score of curiosity that indicates the teacher's degree of curiosity according to each axis, takes into account the number of non null variables over all the teacher's courses. It aims to encourage to discover other LMS features within the axis.(b) The score of regularity that considers how often teachers exploit the features related to an axis with respect to their courses. In other terms, it helps validating a skill based on the repetition of practice.

4.3 Model and metrics exploitation

We started the development of a tool to engage teachers into learning situations regarding the different axes of our model. The main dashboard is represented in Figure 1. Once logged, the teacher can have an overview of his situation. Each axis is detailed within a card, with a different background color and subtitle whether the teacher was clusterized as active or inactive, and including the two different scores of curiosity and regularity. In the bottom right corner of the figure, we provide a radar visualisation that sums up the two scores for the teacher to have a quick comparative view of the different axes. Moreover, according to the different metrics our system can provide several automatic recommendations to improve the teacher's skill by recommending an active teacher if there is one, otherwise the system uses a fallback and recommends the PE.

5 Conclusion and perspectives

In this paper, we designed a behavioral model of teachers based on a qualitative analysis from interviews we had with three PE and a quantitative analysis we performed on teachers' activities on the University's LMS. This model describes teachers' practices through six major axes of mastery: evaluation, reflection, communication, resource, collaboration as well as interactivity and gamification. From this model, we designed several TA indicators. We proposed clustering

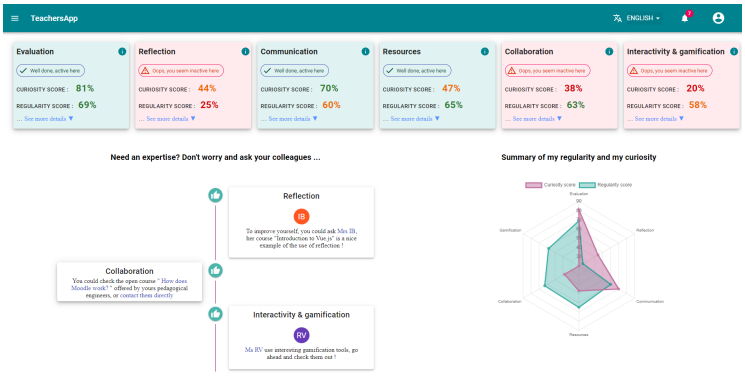

Fig. 1. Teacher dashboard for self-assessment and recommendations

models to make out non active and active teachers in a particular axis, as a metric for social awareness. For self-awareness, we took into account the complete model, including variables that relate unused features so far, into two different scores also proposed by axis (score of curiosity and score of regularity). However, our study presents several limitations. We have integrated all teacher traces on the University's LMS to analyze their behavior, knowing that many teachers use other technologies to manage their teaching, whom we do not have access to. Moreover, our study does not take into account what happens in a class, outside the technological environment and considers all teachers in the same way regardless of context. We will continue in the short term to refine our model with the inclusion and analysis of new features that would consolidate our axes and also our TA indicators. Indeed, once the first version of the tool will be operational, we will experiment it at the scale of our University to evaluate its usability, the interest teachers will show in it, and then test whether it allows inducing learning situations and if recommendations are followed and relevant.

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