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Designing transparent learning analytics dashboards

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Abstract

With the rise of hybrid or distance learning, we can collect a large amount of data regarding learners, creating a significant opportunity to improve the identification of learning behaviors and assist teachers in their activities. However, since learning analytics deal with learning traces, it is mandatory to meet strict ethical criteria to foster these technologies' adoption. In that context, trustworthy learning analytics recently became a new concern. Learning analytics tools that can claim to be trustworthy should, among other things, be comprehensible, user-friendly, and transparent. We present a user study aiming at identifying the main qualities of a transparent learning dashboard and we contribute to the promotion of more trustworthy learning analytics tools.

Keywords

Trustworthy Learning Analytics, Learning Indicators, Dashboard, Co-design

1. Introduction

Learning Analytics Dashboards (LAD) are known to facilitate learning problem detection [1] and assessment of learner's effort level or learning progress [2]. However, while Learning Analytics (LA) is a promising field, adoption of these technologies is still limited [3]. This could be explained by their lack of trustworthiness and relation to users' needs [4]. To become more trustworthy, LA systems should meet, among other things, the transparency criterion by being "comprehensible, useful, user-friendly, and easily accessible" to teachers and by integrating stakeholders during their conception [5]. That's why we ask ourselves **(RQ): How to design a learning analytics dashboard in order to meet the transparency dimension of trustworthy learning analytics?** To answer this question, we first assessed the comprehensibility of the LAD, by investigating teachers' social representations associated with the five learning indicators used to build visualizations. Then, we evaluated the LAD usability, and investigate its user-friendliness.

2. User study method

We conducted a user study with thirty french volunteer teachers. Twenty-four worked in higher education while six were high school teachers. We first identified teachers' representations associated with five common learning indicators [6]: (1) curiosity (individual's intrinsic motivation [7]), (2) engagement (learners' involvement in their learning process [8]), (3) reactivity (delay of

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response for different course-related events [9]), (4) performance (individual's level of learning), (5) regularity (investment in the learning task at regular and close time intervals [9]). To assess representations, we conducted semi-structured interviews during which we asked questions such as "What is a curious learner to you?", "How does a learner's curiosity manifest itself?", or "Could you describe a situation that you have experienced in your professional experience, which embodies the curiosity of a learner?".

Second, we assessed the dashboard's comprehensibility and usability. The evaluated LAD was designed during a previous project [10] through participatory co-design with French high school and middle school teachers. The LAD is divided into two parts: visualization of learners' overall activity (See Fig 1a) with a focus on effort in completing the educational tasks, and an individual visualization of learners' activity (See Fig 1b).



(a) Global view visualizations

(b) Individual view visualizations

Figure 1: Evaluated dashboard global and individual layout

To assess the dashboard's comprehensibility and usability, participants were asked to interact with the LAD according to four scenarios we created corresponding to the LAD main functionalities (teachers confirmed that they met some of their needs): (1) Find a learner who had not been consistent lately; (2) Build a group of three learners with various levels of curiosity; (3) Find a learner who had not performed well at the start of the course but whose performances increased with time; (4) Identify a week during which the majority of learners failed a test. Then, participants completed the System Usability Scale (SUS) [11], used to evaluate users' satisfaction by measuring the system usability.

3. Results

We conducted a lexical analysis of the interviews transcripts and completed this process with qualitative content analysis. We identified shared social representations when themes were found in more than 50% of the interviews. Results show that engagement, performance as well as curiosity are well understood and related to shared representations. Curiosity seems to be related to the idea of learners going beyond the course content, searching for information autonomously, and asking questions. Engagement relates to learners participating in class with

seriousness and commitment while the required work is done correctly. Finally, performance is associated with achieving good grades and good results on assessments. We could not identify representations for the other two indicators. They will need to be explicitly defined in the LAD.

The four scenarios were easily completed by participants. Participants were able to identify learners on the basis of a learning indicator (scenarios 1 and 3) very quickly (1 min 37s on average). They either started with the global view to identify learners of interest, then moved to the individual page of the learners to verify their hypothesis, or, in a less efficient way, went through each individual view to assess learners' behavior. To complete the second scenario, the majority of teachers naturally used "pedagogical proximity" by selecting the learning indicator of interest to compare learners, and the task was done in 1 min 27s on average. Finally, to identify an element concerning the whole group of learners (scenario 4), participants used the global view and needed less than 1 minute on average. The speed at which each task was completed, coupled with a high SUS score of 70,8 (SD = 13,5) out of 100, suggests the good usability and user-friendliness of the evaluated dashboard.

4. Conclusion

The purpose of this user study was to determine how to design a LAD according to the transparency dimension of trustworthiness. To achieve this goal, stakeholders were engaged in each step of the conception: identification of users' needs, design of the visualizations, user experience evaluation, and investigation of the understanding of the indicators. From participants' feedback and the barriers they met while interacting with the LAD, we proposed an enhanced version of the LAD dashboard (See Figure 2). The good acceptability of the LAD, coupled with its user-friendly interface shows that the system is comprehensible and useful, thus meeting the transparency criterion. Our user study thus highlights key elements enabling the design of trustworthy and transparent LAD: learning indicators must be well understood by the users and match their social representations. Otherwise, the definition of the terms used will need to be made explicit to ensure a good understanding. Also, the LAD functionality should be built on the basis of users' needs, and the user experience should be assessed with target users.



(a) Global view visualizations

(b) Individual view visualizations

Figure 2: Enhanced version of the dashboard

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