



User Experience Study using a System for Generating MultiModal Learning Analytics Dashboards

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ABSTRACT

In the article, we present a Web-based System called M2LADS, which supports the integration and visualization of multimodal data recorded in user experiences (UX) in a Learning Analytics (LA) system in the form of Web-based Dashboards. Based on the edBB platform, the multimodal data gathered contains biometric and behavioral signals including electroencephalogram data to measure learners' cognitive attention, heart rate for affective measures and visual attention from the video recordings. Additionally, learners' static background data and their learning performance measures are tracked using LOGGE tool. M2LADS provides opportunities to capture learners' holistic experience during their interactions with the learning analytic system in order to improve the system and the user experience of the learners.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**.

KEYWORDS

Biometrics and Behavior, Dashboard, e-Learning, MOOC, Multimodal Learning Analytics, User Experience (UX)

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1 INTRODUCTION

Massive Open Online Courses (MOOCs) are a valuable source of educational content in online learning and are increasingly endorsed and recognized by official institutions [5]. These institutions are developing Learning Analytics (LA) approaches [4] to improve these online practices. This is the case of Universidad Autónoma de Madrid (UAM), where we have developed a LA system for their MOOCs at edX¹ platform with two main objectives: to provide MOOCs instructors with the ability to track their learners and thus be able to intervene in their learners' learning processes and to

¹<https://www.edx.org/>

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provide feedback to MOOC learners to enhance their motivation, persistence and course participation in the MOOC. This system is called edX-LIMS [1], which is the abbreviation for "System for Learning Interventions and Its Monitoring for edX MOOCs". edX-LIMS provides instructors with an Instructor Web Dashboard where they can monitor their learners. Additionally, each learner is provided with a Learner Web Dashboard where they can visualize their performance in the MOOCs.

Capturing multimodal data can be an excellent way to gain valuable information about how learners interact with the Dashboards and how they feel about doing so. With this data, we can analyze patterns and trends that allow you to simplify and improve the information displayed through multimodal learning analytics (MMLA) [3], which in turn could improve the user experience and increase system efficiency. In addition, it may identify areas that need improvement and fine-tuning to help learners get the maximum benefit from the information displayed on their dashboards.

For the integration of this multimodal data we have developed another system called M2LADS, which is an acronym for "System for Generating Multimodal Learning Analytics Dashboards". Thanks to the dashboards generated by M2LADS, MOOC instructors can perform in-depth analysis to better understand when learners are focused as they navigate through the dashboards offered by edX-LIMS. They can also identify the content that captures their attention, among other things, during a user experience session (UX) [6]. In short, the M2LADS system complements the information available in LA platforms such as edX-LIMS and allows for the analysis of factors related to the cognitive and emotional state of learners.

2 THE APPROACH: M2LADS

2.1 edBB Data

The edBB platform has been used to monitor learners during the user experience (UX) session [2]. We use video data from 3 different position, electroencephalogram data (for measuring attention, meditation and brain waves), heart rate data from a smartwatch, mouse and keyboard data and visual attention data from an eye-tracker.

All data captured from the edBB platform are processed by the M2LADS system to generate synchronized graphs and videos.

2.2 Additional data with LOGGE tool

This tool stores additional information related to the monitored learner (e.g. sex, hand used with the mouse, etc.) and records the interactions that the learners are doing during the UX session.

2.3 M2LADS

M2LADS is composed of three modules following a Model-View-Controller (MVC) approach:

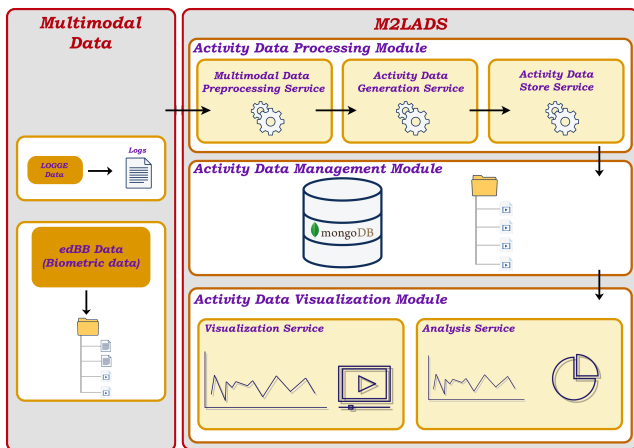


Figure 1: M2LADS Architecture/Modules

- Activity Data Processing Module (Controller): This module allows for the extraction, cleaning, selection and preprocessing of the multimodal data recorded during the UX to extract the learner’s Activity Data.
- Activity Data Management Module (Model): This module provides connectivity with MongoDB where biometric data are stored and the directories with the audiovisual files.
- Activity Data Visualization Module (View): In this module, the system creates a visualization per learner, i.e., a dashboard that reflects user activity data during the UX. To achieve this, it generates and organizes visual components (graphs) using the Dash² framework. The dashboards are composed with several graphs that display the learner’s attention, meditation, heart rate, and neural waves over the UX session classified by the activity that the user was doing. It also includes several videos, such as the screen captured during the UX, different webcam videos, and user fixation areas video from the eye-tracker. All these elements in the dashboard are synchronized. Besides, there are graphs which display an analysis of the previous data and correlations among the values of the biometric signals.

3 RESULTS

M2LADS has been tested with learners of a MOOC entitled “Introduction to Web Application Development” available on the edX platform and offered by the UAM. Some of these learners have been recorded during a UX session with their dashboard generated by edX-LIMS. The objective is to monitor 20 learner (10 women and 10 men)

In an initial research (Fig. 2) we have compared the attention level between a learner with a high probability of passing the course (learner 1) and a learner taking the course for several months and at risk of dropping out the course (learner 2). We have seen that the learner with a high probability of passing the course shows higher attention levels, especially when interacting with the graphs.

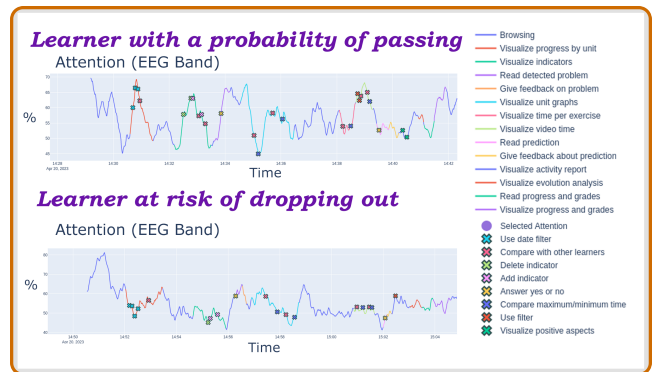


Figure 2: Comparison of two learners’ attention levels

4 CONCLUSIONS

The paper presents a fully equipped MMLA lab that integrates M2LADS, the LOGGE tool and the edBB platform. We have used this lab to conduct user experiences in the context of learner interaction with a Learning Analytics system. This approach has allowed us to improve the learners’ learning experience. The developed system will allow incorporating new parameters to the Learning Analytics approaches and advance the knowledge for the use of Learning Analytics systems in the context of MOOCs.

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²<https://plotly.com/dash/>