An Outcome-based Dashboard for Moodle and Open EdX

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ABSTRACT
This poster presents a cross-platform learning analytics dashboard on Moodle and Open edX for monitoring outcome-based learning progress. The dashboard visualizes students' interactions with the platforms in near real-time, aiming to help teachers and students monitor students' learning progress. The dashboard has been used in four large-size general education courses in a comprehensive university in Hong Kong, undergoing evaluation and improvement.

CCS Concepts
• Human-centered computing → Visual analytics •Applied computing → Learning management systems

Keywords
Moodle; Open edX; outcome-based learning; dashboard

1. INTRODUCTION
Learning Management Systems (LMS) such as Moodle record learners' interactions with various course components, providing opportunities to monitor students' progress in near real-time. In response to the need of outcome-based learning [1], a Learning Analytics (LA) dashboard was developed to visualize students' learning progress towards course learning outcomes. Based on online behavior logs recorded in the LMS, the dashboard may help teachers identify at-risk students and decide on possible interventions [2][3]. It also can provide near real-time feedback to students, facilitating self-monitoring and self-assessment during the entire period of the course [4]. This poster demonstrates the dashboard implemented in Moodle and Open edX, particularly the system architecture, analytic functions, visualizations, and preliminary evaluations with teachers and students.

2. SYSTEM ARCHITECTURE
The dashboard on Moodle adopts the Model-View-Controller (MVC) paradigm. The view is responsible for all visualizations while the controller requests data from the server using AJAX and feeds the data to the view. The server side is mainly responsible for statistics calculation based on user activities recorded in Moodle. The calculated results are stored in a database for efficient retrieval. On edX, XBlock is the fundamental component to build online sources. Our dashboard, XAct, is implemented as one of the customized XBlocks. Similar to the Moodle dashboard, XAct server can fetch data from the edX database and transfer analyzed results to the client through AJAX. Through visualizations generated with the D3 library, XAct supports students to check his/her own online learning behaviours in near real-time.

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3. ANALYTICAL FUNCTIONS
On both platforms, teachers first link course components (e.g., video, quiz) to course outcomes through a HTML block page (Moodle) or XBlock edit mode (Open edX). On Moodle, student actions including *view, submit, create, start, review*, and *update* performed on linked components are counted. On Open edX, click streams such as video interactions, page reading and quiz answering recorded in the system are calculated for visualizations. A student's learning progress on a course component is calculated in a relative manner, against a statistic upper limit of student activities on this component. To avoid effects of outliers, the upper limit is calculated as "3rd quartile + 1.5* interquartile range of activity counts of all students". Students with an activity count exceeding the upper limit will be given a full score (i.e., 100%). The progress towards a learning outcome is the aggregation of progress scores of all components linked to that outcome. To prevent students from "gaming" the system, restrictions on frequencies of actions performed on various types of components (e.g., forums) are added.

4. VISUALIZATIONS
4.1 Progress Towards Learning Outcomes
On Moodle, the dashboard is shown as a Block on the course homepage where a student's progress towards each course learning outcome is shown using a traffic-light metaphor: green for good progress; yellow for fair and red for poor (Figure 1). This block also contains a link to a detailed "personal report" page. The same colour codes are applicable to all pages.

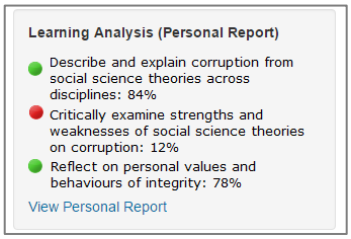

Figure 1. Student's view of the Moodle block on course page

The personal report page lists all learning outcomes of the course. For each outcome the student's progress and the class average are both shown for easy comparison (Figure 2).

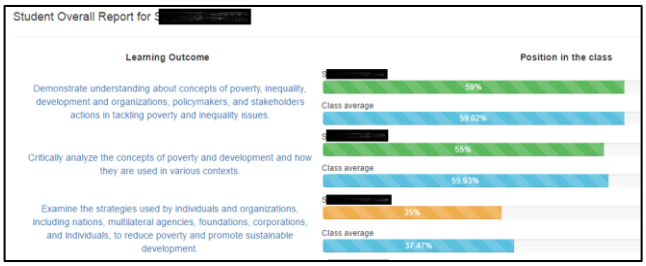

Figure 2. Student' activeness on each outcome (Moodle)

Similarly, the XAct presents a vertical-bar chart to show each student's progress towards each learning outcome (Figure 3).

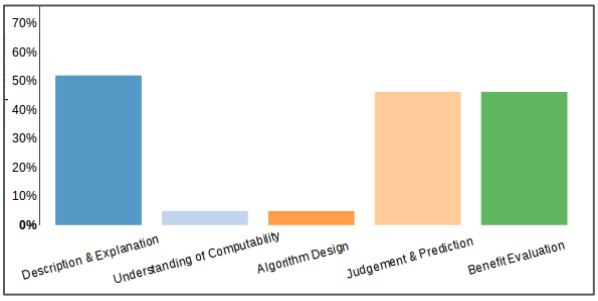

Figure 3. Student' progress on each outcome (Open edX)

4.2 Progress on Course Components/Topics

On Moodle, clicking a learning outcome on a student report (Figure 2) leads to the student's progress in each course component linked to that outcome (Figure 4). Similarly, on Open edX, a chart represents how much content on each topic a student has ever interacted with (Figure 5). Instructors can configure which course components are relevant to which topics. As Open edX is a video-centric learning environment, most topics include video and quizzes. It is thus deemed that progress on topics would be more informative. In addition, another component-based visualization is implemented in the XAct dashboard (Figure 6), showing how a student consumed different types of learning contents.

Figure 4. Student progress on course components (Moodle)

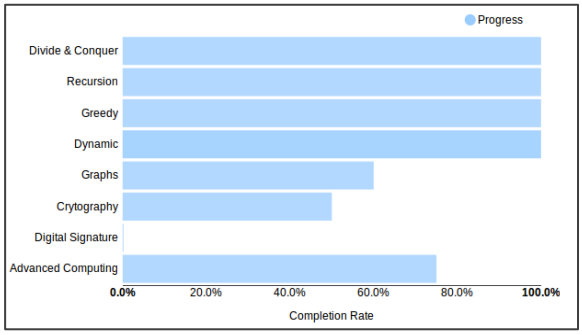

Figure 5. Student progress on course topics (Open edX)

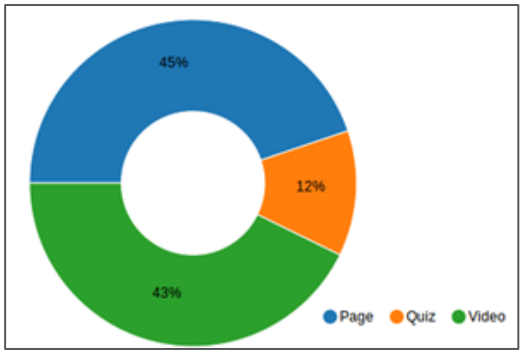

Figure 6. Activities on main course components (Open edX)

4.3 Teachers' Views

On Moodle, teachers also have access to visualizations for the overall class progress. These visualizations show the class average progress towards course learning outcomes, in forms like Figures 2 and 4. Instructors can also click into a list of individual students' progresses either on an outcome or a component (Figure 7) where the student name is linked to that student's individual report (Figures 2 and 4). In this way, instructors can observe progresses of the class as a whole and those of individual students. Particularly, students with a below-average progress can be easily identified and pedagogical interventions can be applied to them.

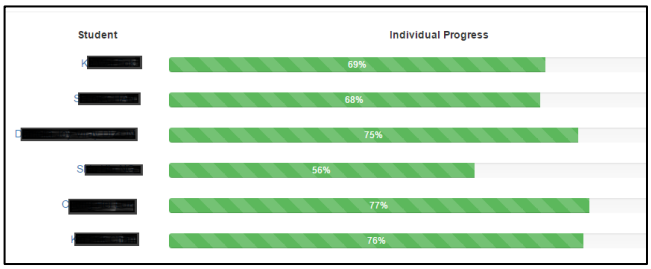

Figure 7. All-student report of progress (Moodle)

5. EVALUATION

The Moodle dashboard has been used in three general education courses, in the areas of Political Science, Social Work, and Education, each with about 120 students. A 4-minute instructional video was played to the students in-class, teaching them how to use the dashboard. To measure the effectiveness of the dashboard, students were surveyed in the first and last lectures, and some are invited to participate in follow-up interviews. The Open edX version has been deployed in a technological general education course towards the end of the course. 89 of the 120 students have accessed the dashboard 711 times, within 8 days, and checked the dashboard for 1.73 minute on average. Some students reported to have used the dashboard to identify missed contents in the course. Views of some peripheral (e.g. tutorial) videos have increased significantly after introducing the dashboard. These indicate that students have used this dashboard for self-checking of learning task completions, and the dashboard has served its purposes. A user survey has been conducted and data are currently under analysis.

ACKNOWLEDGMENTS

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