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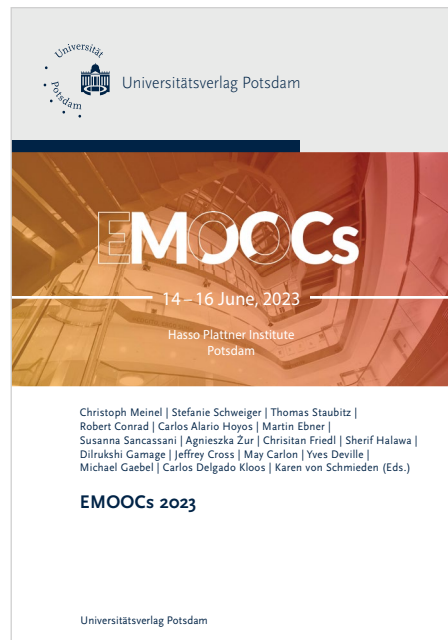
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EMOOCs 2023

Using Analytics in a Large Virtual Classroom for Open edX

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The main aim of this article is to explore how learning analytics and synchronous collaboration could improve course completion and learner outcomes in MOOCs, which traditionally have been delivered asynchronously. Based on our experience with developing BigBlueButton, a virtual classroom platform that provides educators with live analytics, this paper explores three scenarios with business focused MOOCs to improve outcomes and strengthen learned skills.

1 Introduction

BigBlueButton is an open-source virtual classroom platform that provides the educator – the teacher, instructor, or professor – with analytics that gives insight into student performance during the class. BigBlueButton is designed for education, covering scenarios of tutoring, small classes, group collaboration, and larger classes with hundreds of students. BigBlueButton integrates with Open edX via Learning Tools Interoperability 1.0/1.1 (LTI).

Open edX is an open-source learning management system (LMS) and online courseware platform. It empowers individuals and institutions to offer online education at scale, facilitates knowledge sharing, and fosters lifelong learning opportunities. Data-driven insights can be collected using Open edX to analyze data on learner interactions, performance, and progress. This data can be used by educators and administrators to refine teaching strategies.

Massive Open Online Courses (MOOCs), such as those enabled with Open edX, are open to thousands of students and, as such, are mostly conducted asynchronously. A challenge with the MOOC format is the average completion rate for online courses teeters around 5–15 % and the dropout rates are high [3].

This paper looks at how synchronous collaboration (virtual classes) with learning analytics could improve course completion rates of MOOCs, especially in the business context, and increase mastery of new skills.

2 The Challenge of Virtual Classrooms

During Covid-19, most virtual classes were taught using business-focused video platforms. These platforms focus on sharing screens and webcams with limited built-in assessment. However, the goal of the virtual classroom is not to meet, it is to *learn* [4]. In contrast, we designed BigBlueButton based on two foundations:

1. Based on pedagogical theory, BigBlueButton focuses on maximizing time for applied learning activities and receiving feedback during the class.

2. BigBlueButton provides live analytics to enable the educator to easily assess the performance of the class, and of individual students, leading to meaningful insight on which students were struggling (or excelling).

3 Applied Learning vs. Passive Learning

When students attend a class, whether in person or online, their goal is to efficiently achieve mastery. Pedagogy – the science of teaching and learning – tells us that our brains learn in stages. Bloom's Taxonomy describes six stages of learning that we "climb" towards mastery (referred hereafter as "Bloom's Staircase") [2].
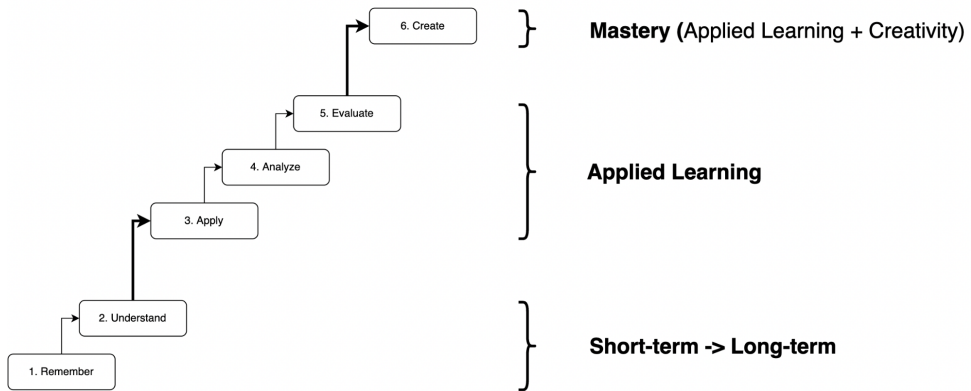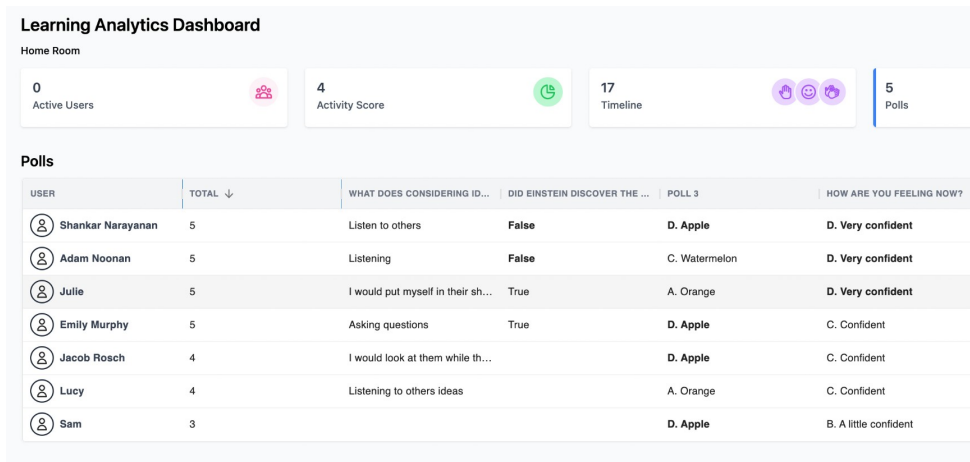

Figure 1: The six stages of Bloom's Staircase.

Three of Bloom's stages focus on applied learning – apply, analyze, and evaluate. Specifically, these stages focus on applying knowledge to a task, measuring the

outcomes, and judging the results ("Did I get the right answer/outcomes from the task?"). Applying knowledge takes mental effort, deep thinking, and a bit of struggle – and, importantly, that struggle creates new synapses in our brains. In contrast, passively watching a YouTube recording or a one-way class requires less engagement and, consequently, yields less learning.

Too much struggle, however, can be frustrating, especially if the student feels blocked. If a student receives timely feedback – either from the instructor (one-on-one) or peers – they can overcome the blockage, reach new levels of understanding, and climb Bloom's staircase. But how can the instructor know if students are struggling?

4 The Value of Learning Analytics in the Virtual Classrooms

Learning Analytics is defined as: "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" [6]. Using real-time analytics during the lecture, the instructor could see the results and summary of testing students and adjust the pace of their lecturing [5].

Learning Analytics Dashboard
Home Room

0 Active Users		4 Activity Score		17 Timeline		5 Polls

Polls

USER	TOTAL ↓	WHAT DOES CONSIDERING ID...	DID EINSTEIN DISCOVER THE ...	POLL 3	HOW ARE YOU FEELING NOW?
Shankar Narayanan	5	Listen to others	**False**	**D. Apple**	**D. Very confident**
Adam Noonan	5	Listening	**False**	C. Watermelon	**D. Very confident**
Julie	5	I would put myself in their sh...	True	A. Orange	**D. Very confident**
Emily Murphy	5	Asking questions	True	**D. Apple**	C. Confident
Jacob Rosch	4	I would look at them while th...		**D. Apple**	C. Confident
Lucy	4	Listening to others ideas		A. Orange	C. Confident
Sam	3			**D. Apple**	B. A little confident

Figure 2: A tabular view of BigBlueButton's Learning Analytics Dashboard showing answers to polls.

BigBlueButton provides the educator with a Learning Analytics Dashboard ("LAD") that gives data on attendance, participation, and learning (based on poll responses) (see Figure 2). BigBlueButton computes an "activity score" based on total time spent speaking, chatting, raising hands, using emojis, and responding to polls. Using this score, along with responses to pools, instructors can pinpoint which students may be struggling and give feedback in the moment.

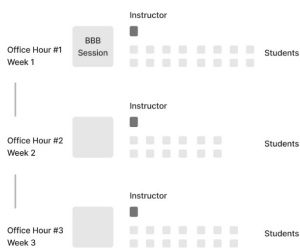# 5 Using Live Collaboration and Analytics to enhance a Business-focused MOOC

Both BigBlueButton and Open edX have analytics, and we see the potential for unifying analytics from both, giving educators a unified view of how students learn in both modalities: self-directed and virtual classrooms. A unified view would make it easier for educators to understand if and why students do not complete the course, achieve low learning outcomes, and ultimately give educators insight to improve the overall experience of the course.

We envision three scenarios where synchronous collaboration and analytics could benefit MOOCs:
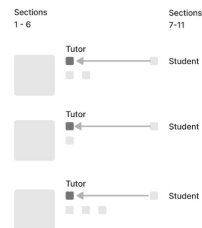

Figure 3: Three scenarios for synchronous learning in a MOOC

5.1 Scenario #1: Classes/Office Hours

Consider a company offering a MOOC on statistics. For virtual classes/office hours, analytics (not webcams) would help the educator gauge the effectiveness of applied learning activities during the class. For example:

- **Chat**: Ask students to give examples of where knowing the medium would be helpful. Students can also anonymously vote on the suggestions of others. *Analytics: Which students gave examples, up-voted other examples, and received the most votes for their example.*

- **Quiz**: Present a slide giving a list of numbers and asking, "Which number is the median?" *Analytics: Track which students correctly answered the quiz and how quickly they answered.*

- **Breakout rooms** (group assignment): Give each breakout room a random list of numbers and ask students in the breakout room to calculate the mean, median, and mode. *Analytics: live monitoring of activity in each breakout room discussion (talking, chatting, using the whiteboard).*

For large classes, the analytics could plot groups of students along two axes: activity and formative assessment (i.e. quiz results), giving the educator a way of seeing if the whole class, or groups, are struggling.

Figure 4: Design for measuring activity vs learning in a live class.

In Figure 4, halfway through the class at 30:32, the live analytics show the class separating into three groups: (1) students that have low participation and a low score on the formative assessment, (2) students who have participated in the activities, and are showing more progress, and (3) students who are participating

and who are showing good results in formative assessment. These live analytics would help the educator better adapt teaching for the remainder of the class.

5.2 Scenario #2: Group Projects

In this second scenario, the course could support group work. Based on social constructivism, the course would require (and track via analytics) synchronous sessions where students work together to apply their skills. The measurement for success is the time spent collaborating and grading the submission which could be shared with Open edX or with a Learning Record Store ("LRS") via xAPI.

5.3 Scenario #3: Student Tutors

In this third scenario, which is more novel, we envision structuring the MOOC so that students earlier in the course receive tutoring from students later in the course. Students who receive the tutoring would have lower drop-out rates, and students who give the tutoring would strengthen their understanding of the content. And as MOOCs have no specific enrollment, there will always be students at various stages of the course. This scenario is novel as no instructors are needed.

The analytics from the tutoring sessions (time tutoring and activity score) – along with exit scoring from students when the session ends – would provide Open edX enough data to credit the tutors for the time and assess performance.

An advantage of this approach is that students are expected to apply their knowledge, to receive help and to give help, thereby strengthening their understanding and ability to apply the knowledge in other areas of their job.

5.3.1 Deeper integration with Open edX

Integration of Open edX and BigBlueButton, both open-source platforms and focused on improving learner outcomes, offer opportunities to share analytics and give educators deeper insights into how learners are interacting with each other and with course content, and, at the course level, identify areas for improvement. For example, today Open edX supports analytics for text, video, and assessment components (see Figure 5).

This dashboard is computed by aggregate grading and scores along with active logins to last activities. Such analytics could be extended by incorporating analytics from synchronous sessions outlined in the previous scenarios.

With the onset of COVID-19 Anant Agarwal, the chief open education officer of 2U/edX, said that the future of learning is blended [1]. In fact, we need an online learning model to give students the option to progress at their own pace fully online. With Open edX as LMS, it is easy for students to look back on some
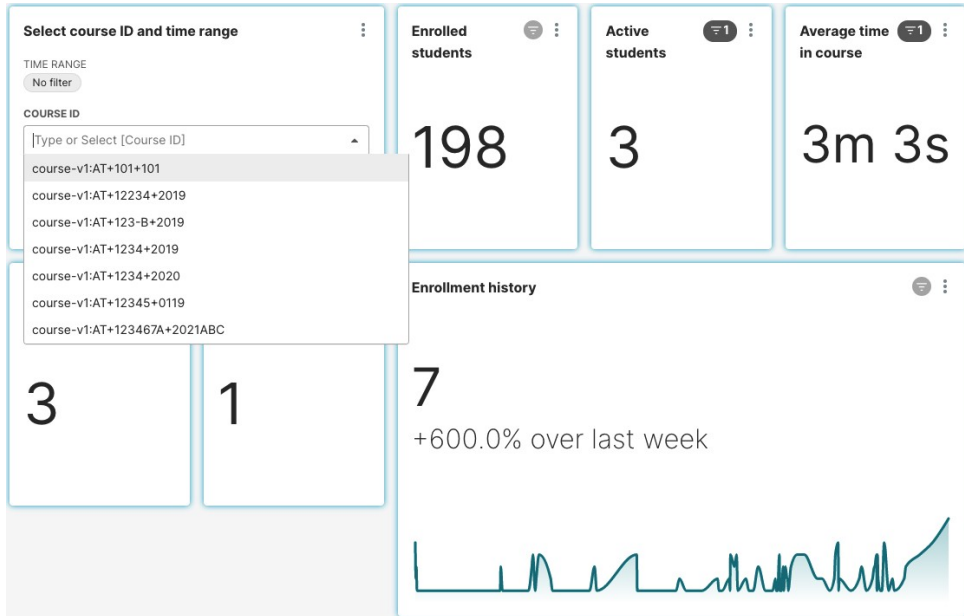
Figure 5: Dashboard analytics in Open edX.

materials and move ahead independently. Our belief is that education software should also enhance student collaboration.

While we don't want to counter Agarwal's statement that he did so much for online education, today, after almost three years of Covid, we would say that "**the future of learning is collaboration.**"

6 Conclusion

We see potential for improving course completion and learning outcomes by building analytics and synchronous collaboration into MOOCS. By aggregating analytics from BigBlueButton and Open edX together, for example, we can give educators and administrators a unified view of how the students learn in both modalities – self-directed and virtual classroom – and, in turn, improve the overall effectiveness of MOOCs for companies.

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