USING LEARNING ANALYTICS DURING A VIRTUAL CLASS

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Summary

This paper shares research by the BigBlueButton project on how it deconstructs the complexity of delivering effective virtual classrooms into four key foundations and seven use cases. We apply this framework to two EDEN's workshop objectives and explore the use of learning analytics during a virtual class to improve student outcomes.

Keywords:

Virtual classroom, e-learning, online learning, learning analytics, Bloom's Taxonomy.

Introduction

Delivering an effective virtual classroom is a complex undertaking. During the pandemic, when moving classes online quickly, many schools reached for familiar video conferencing tools that included Zoom, Teams, and Meet (referred hereafter as "generic video conferencing systems"). These systems emphasized sharing of audio, video, and screen sharing, but offered limited built-in support for the pedagogy of teaching and learning. Ramachandran (2022) showed this overreliance on video ultimately leads to "zoom fatigue." When video is the primary form of assessment, if students decline to share their video, the instructor is left teaching to the screen and hoping that students are learning. A video conferencing system does not make an effective virtual classroom, but how should today's virtual classrooms evolve beyond video?

To answer this question, we reflected on the challenge given for the 2022 EDEN workshops (and highlight two key objectives):

> *… to explore the consequences of emergency remote teaching and learning as well as to tackle the new approaches in **creating learning environments that should be smarter**, more inclusive, and involve emerging technologies that will boost the digital skills of students and give them a more p**ersonalized experience**.*

Four foundations of a successful virtual classroom

Since 2020, the BigBlueButton project has held more than 20 focus groups with educators, students, and members of our open-source community towards understanding how the virtual classroom could (and should) evolve. The research allowed us to deconstruct the complexity of delivering an effective virtual classroom into four areas: *management, relationships, engagement,* and *assessment.*

We map the two EDEN objectives into this framework.

	As an **instructor**, I want to …
Management	**setup and manage my classroom for success**
Relationships	**establish presence and trust with and between students**
Engagement	**effectively** engage and **activate** their minds for learning (EDEN: "creating learning environments that should be smarter")
Assessment	**assess their progress** and **give timely feedback**

Table 1: Instructor user stories for the foundations of a successful virtual classroom.

	As a **student**, I want to …
Management Relationships	feel **comfortable** to participate
Engagement	**efficiently** master new skills
Assessment	**receive help** when I am struggling (EDEN: "personalized experience)

Table 2: Student user stories for the foundations of a successful virtual classroom.

Is a virtual class more effective when students actively apply their knowledge during class?

Yes. Bloom's Taxonomy shows that our brain goes through stages of learning (Bloom & Krathwol,1956) (referred hereafter as "the learning journey").

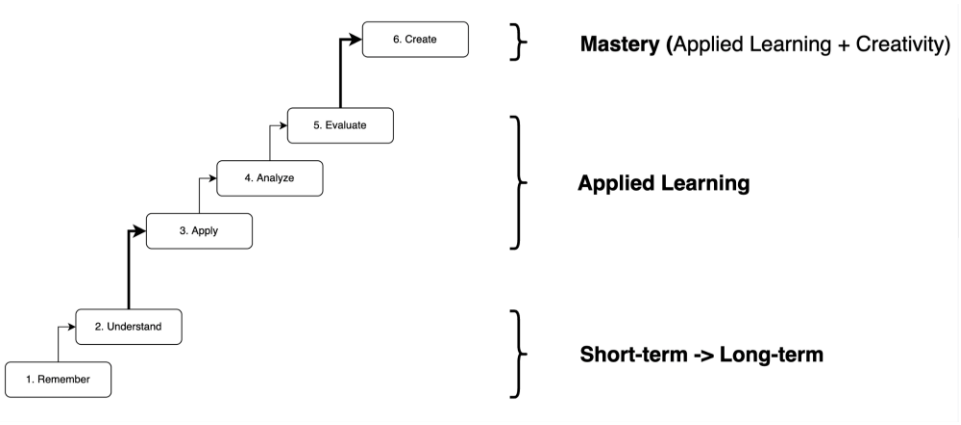

Figure 1. Three types of learning in Bloom's Taxonomy

Bloom's taxonomy shows that students cannot achieve mastery without going through the middle stages of applied learning. It follows that a virtual classroom if the instructor can help the student move through these stages during the live class.

Is a virtual class more effective when students receive help during the class?

If a student could receive a few minutes of personalized help during the live class – either individually or as a group – the student would perceive a higher value from attending the virtual class. How can the instructor know if a student is struggling? The answer is learning analytics.

The role of Learning Analytics in virtual classrooms

The Society for Learning Analytics Research (SoLAR) defines 'Learning Analytics' 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" (2021).

Nguyen et al. (2021) provides an overview of theory-based design principles in Learning Analytics Information Systems (LAIS). The first principle is that LAIS "should have features that allow for the reporting of actionable information about learners and their learning" (Nguyen et al., 2021, p. 545). The second principle is that LAIS "should generate reports in a timely matter." The third and last principle is that LAIS "should be available and accessible to both data clients and data subjects at any time and be able to interoperate with any learning and teaching system, including virtual learning environments (VLEs), and allow the integration of different data sources." 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 (Atsushi et al., 2018).

The following diagram shows the role of learning analytics before, during, and after the instructor engages the students.

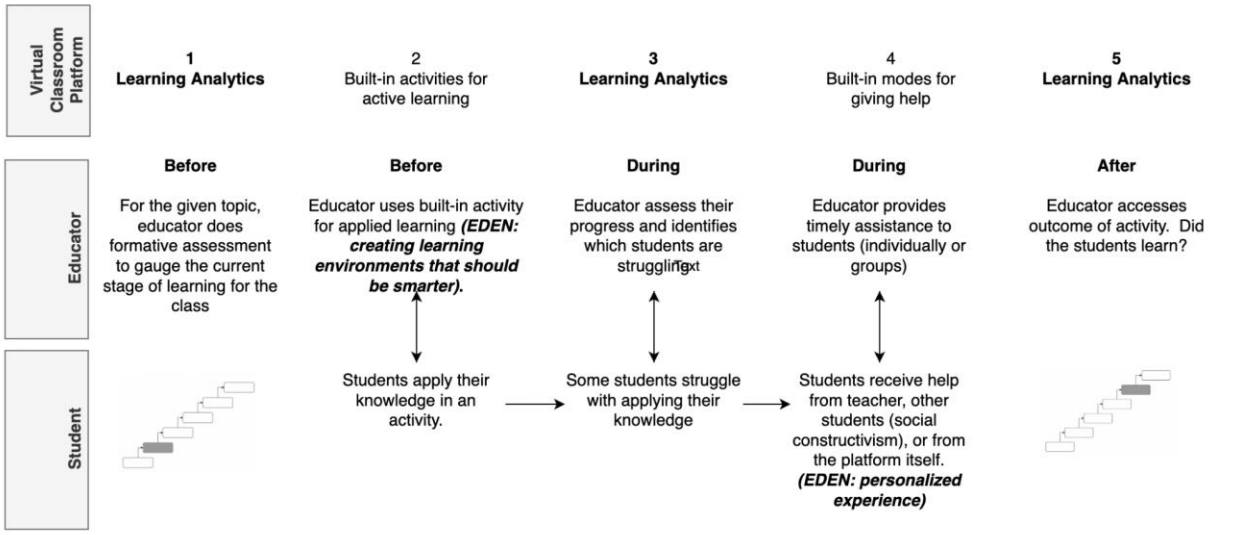

Figure 2. The role of the virtual classroom, the activities of the instructor, and the student's learning.

Consider the following scenario: an instructor is teaching a class of 25 students in basic statistics. At the end of the previous class, the instructor introduced the concepts of *mean* (average value), *median* (middle value), and *mode* (value that occurs most often). After the class finished, the instructor asked that students read a section of material in the LMS, watch a brief video on basic statistics, and complete a 5-minute quiz in preparation for the next class.

1. Learning Analytics (before)

Learning Analytics should enable the instructor to quickly assess the preparedness of students. Specifically, the learning analytics should help the instructor determine:

1. Which students are absent from the class?
2. Which students have
    a. Visited the page in the LMS
    b. Watched the video
    c. Completed assignment along with their score

2. Built-in activities (before)

The virtual classroom should have a built-in set of activities for the instructor to help students move through the learning journey. Each activity should generate learning analytics. Examples:

- **Chat:** Ask students to give examples of where they would calculate the median. Students can also anonymously vote on the suggestions of others. *Analytics: which students answered, voted for the other suggestions, and received the most votes for their example.*
- **Polling:** Show a slide with a list of numbers with the mean, median, and mode and ask which one of these numbers is the most useful? *Analytics: which students responded to the poll (this may be subjective based on the context, so there is no right answer).*

- **Quiz:** Present a slide giving a list of numbers and prompt in a quiz "Which number is the median?". Analytics: which students correctly answered the quiz and how quickly did they answer.
- **Breakout rooms (group assignment):** Show a slide with a list of numbers. Put students into breakout groups and ask them to calculate the mean, median, and mode. *Analytics: live monitoring of activity in each breakout room discussions (talking, chatting, using the whiteboard)? Which breakout rooms have submitted the correct answer (or not)?*
- **Individual writing/whiteboard:** Show a slide with a list of numbers. Put students into an "individual activity mode" for 5 minutes where they can't collaborate with each other, but the instructor can see all the individual whiteboard activity. Students are asked to work out the correct answer and submit it. Any student that does not give the correct answer within 4 minutes will be automatically given a hint. *Analytics: live monitoring of individual activity with tracking of which students calculated the correct answer within the allotted time (with or without the hint)*

All these activities generate learning analytics that can help the instructor assess students' performance during the live class.

3. Live analytics (during)

All the analytics derived from the activities should be visible and summarized, such as in a dashboard with graphs, with the ability to drill down into the underlying data, such as:

- A relative activity score (based on talking, responding to questions, raising hand, etc.) to gauge student participation.
- A table showing which students gave correct answers to the quiz questions.
- A scatter plot with two axes: speed of response and correctness of answers.
- A timeline view showing student participation according to time and the currently displayed slide. (The instructor might have two slides explaining the same concepts, but participation was higher in one of them.)

4. Modes for giving help (during)

Using the analytics from engagement activities, the instructor can assess if the class, a group, or individual students are struggling, and give timely help.

5. Live learning analytics (after)

As in Step 3, the analytics should enable the instructor to assess the overall outcome of the activity (did all students, even if they needed a bit of help, get the right answer in the end)?

Conclusion

We conclude the virtual classroom should provide built-in engagement tools to help the students move through the learning journey. These tools should generate analytics that enable the instructor to easily assess students learning outcomes before, during, and after each activity. The analytics should also enable the instructor to pinpoint those students that are struggling, and the platform should make it easy to render group or one-on-one assistance.

From the student's perspective, this assistance provides a personalized experience and reinforces the value of attending and participating in the virtual class.

From the instructor's perspective, the learning analytics ensure there is no "back of the classroom." The instructor is not reliant on webcams. All students are visible to the instructor through the learning analytics, and the analytics should be shared with the LMS.

We note that this paper is not exhaustive in exploring the potential of learning analytics. Points of discussion for further exploration would include the following questions:

1. What other built-in activities (beyond those listed herein) should the virtual classroom support to foster active learning?
2. What learning analytics could be derived from these activities?
3. How could the virtual classroom display and summarize the learning analytics to make it easier for the instructor to gain insight from them to adjust their teaching in the moment and identify students at risk?

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