

Developing Dynamic Dashboards for Classroom Orchestration

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Abstract: Classroom orchestration is a multifaceted pedagogical challenge, requiring teachers to simultaneously manage activities across multiple social levels and under various constraints. Teacher dashboards are commonly developed tools to aid orchestration; however, many fall short in real-time classrooms. To address this impediment, we used participatory design sessions with teachers to better understand their needs, based on which, we plan to build a dynamic dashboard with real-time actionable metrics.

Introduction

Classroom orchestration is the process of managing the flow of activities, student configurations across multiple social levels (individual, group, and class), materials, and class progression within a learning environment during its enactment. The need to monitor these various facets of the classroom in real-time and providing both conceptual and logistical support is challenging and places a heavy load on teachers (Dillenbourg et al., 2009). Dashboards have seen growing interest as a tool that can potentially reduce orchestration load as it provides a lens into classroom activity and progress, which is helpful because teachers cannot simultaneously attend to all groups in their classrooms (Matuk et al., 2015).

Teacher dashboards typically present data at three levels: progress of individual students, progress and participation patterns from groups, or trends across the whole class (Tissenbaum & Slotta, 2019). Different performance metrics can be useful for each level, e.g., participation metrics can provide insights on which group members are contributing to discussions (Martinez-Maldonado, 2019), whole-class metrics can alert the teacher which students need help, and individual progress metrics can provide insights if a particular student is off task or has a question (Dickler et al., 2021). Providing a lot of information while the class is in progress can overwhelm teachers and not all the information is always relevant (Tissenbaum & Slotta, 2019). We propose a dynamic dashboard that is customizable and addresses the changing needs in a classroom.

We conducted participatory design sessions with teachers to better understand their orchestration needs and inform our resulting dashboard designs. Participatory design necessitates teachers' involvement in the development of the technologies they will be implementing in their classrooms to ensure its usefulness and usability (Holstein et al., 2019; Matuk et al., 2015). In the first study, we asked teachers about what types of information might be most useful to them. We created mockups of a dashboard interface based on their input, and in the second study, showed the teachers the mockups and asked for their feedback on specific features.

Participatory design studies with teachers

Study 1

Our objective in the first study was to understand what dashboard features and progress metrics teachers would be most interested in, given different classroom situations. Eight middle school science teachers from the Midwestern U.S., with teaching experience between 9 and 34 years, participated in the initial study. It was conducted via Zoom over three sessions, each lasting two hours, with no more than three participants.

Teachers were presented with three scenarios focusing on: *individual students* (e.g., progress, focus, etc.), *groups* (e.g., participation patterns or off-task discussions), or the *whole class* (e.g., covering challenging material) and what information would allow them to best refine their classroom strategies. After the scenarios were verbally explained to the teachers, they placed the functionality they found most useful for each scenario on a blank tablet template. Researchers were available for further explanations on functionalities or scenarios.

Results

The teachers chose a maximum of nine functionalities across the 20 dashboards they created across different scenarios, including both *features* (e.g., messaging students) and *metrics* (e.g., question analysis). Different teachers chose different metrics depending on the presented scenario. For example, 100% of the teachers

thought a *close-ended question analysis* metric would be useful in the whole class, compared to 33% in the group, and 57% in the individual scenarios respectively. All the teachers chose the *student participation in groups* metric for the group scenario but none chose it for the individual and class scenarios. A 0% or 100% consensus was found in only nine out of the 45 possible functionality-scenario combinations (20%), together with a constant shift between selected functionalities, highlights the need for a dynamic dashboard.

We identified six key metrics based on the teachers' responses, i.e., at least one teacher requested a particular metric across all three scenarios, or more than 50% of the teachers requested that metric in at least one scenario. They are: (a) *Class Status* (a high-level insight on what is happening in the class as a whole), (b) *Group Progress* (which group is at which point in the activity), (c) *Group Participation* (amount of individual participation in group discussions), (d) *Close-ended Questions* (an overview of students' responses to close-ended questions (e.g., multiple choice)), (e) *Open-ended Questions* (insights on how students are utilizing science ideas and concepts in their essay writing, using different NLP techniques), (f) *On-task/Off-task Behavior* (granular insights on which students are off-task). As we need more time to determine how to capture off-task behavior (f), we used the first five metrics (a-e) to create low-fidelity dashboard designs.

Study 2

The aim of our second study was to get teachers' feedback on the initial dashboard designs based on the results of Study 1. Study 2 was conducted in-person with six teachers, four of whom had participated in Study 1. All were middle school science teachers in the Midwestern U.S. who had taught science for 7 to 34 years. We presented teachers with five dashboard designs visualizing information on class status, group progress, and individual progress. We found that teachers had differing ideas about the relative importance of specific information, in terms of when the information will be most useful and how they will use it in the classroom. Based on the teachers' feedback, we have been working on a generalizable framework that includes *what* information should be displayed, *when* the information should be displayed, *how* to visualize the information (charts, sounds), and *who* should have access to the information (teacher, assistant, etc.). This will enable us to design dashboards that are dynamic and customizable by teachers.

Conclusion and Future Directions

Our studies emphasize the importance of participatory design to co-create technologies that teachers would actually use in their classrooms and the need for a dynamic dashboard that teachers can customize to their specific needs. Future studies will focus on building a dynamic dashboard with the identified five key metrics (Class Status, Group Progress, Group Participation, Close-ended Questions, and Open-ended Questions).

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