Using Participatory Design Studies to Collaboratively Create Teacher Dashboards

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Abstract. Classroom orchestration requires teachers to concurrently manage multiple activities across multiple social levels (individual, group, and class) and under various constraints. Real-time dashboards can support teachers; however, designing actionable dashboards is a huge challenge. This paper describes a participatory design study to identify and inform critical features of a dashboard for displaying relevant, actionable, real-time data. We leveraged a Sense-Assess-Act framework to present dashboard mockups to teachers for feedback. Although the participating teachers differed in how they would use the presented information (during class or after class as a post hoc analysis tool), two common emerging themes were that they wanted to use the data to a) better support their students and b) to make broader instructional decisions. We present data from our study and propose a customizable, mobile dashboard, that can be adapted to a teacher's specific needs at a specific time, to help them better facilitate learning activities.

Keywords: Teacher Dashboard, Participatory Design, Orchestration.

1 Introduction

Classroom orchestration requires teachers to navigate multiple activities, often simultaneously, across multiple social levels, i.e., at the *individual* (e.g., writing), *group* (e.g., collaborative problem solving), and *class* (e.g., classroom discussion) levels [2, 7]. Activities may be distributed across multiple tools (e.g., notebooks, simulations, etc.) and artifacts (e.g., laptops), with additional constraints such as curriculum and time adding to the pedagogical complexity. Real-time orchestration tools have the potential to support teachers in providing timely assistance [4, 7]. Multimodal data on student activities can be collected and analyzed to provide an overview of their progress in the form of a visual display, known as the teacher dashboard [5, 8]. The goal of dashboards is to help teachers make quick, data-driven decisions in the classroom; however, studies suggest limited success in authentic learning environments. Commonly identified

challenges include, displaying static information, not providing actionable information, the inability to navigate across multiple social levels, potential conflicts with learning goals, time constraints, and the degree of teacher involvement in the design [5, 6, 8].

AI-based adaptive dashboards can augment teacher instruction [4] by providing visualizations of critical real-time data on complex states [1], assisting with adaptive decision-making, and identifying attention areas. AI algorithms can be applied to assess progress based on features sensed within the environment and correspondingly inform dashboard visualizations. We leveraged the Adaptive System framework outlined by Feigh et al. [3] to provide design guidelines for AI-based teacher dashboards. The authors describe three processing states of AI-based adaptive systems: sensing (i.e., perceiving) aspects of the environment, assessing (i.e., selecting) the current state and how to respond, and acting by providing information within a human-AI shared interface that can then inform human action. They provide a taxonomy of adaptations of four categories: *What* (what information to show), *When* (when to show it, e.g., during or after class), *Who* (who should see a specific information, e.g., teachers, classroom assistants, etc.), and *How* (e.g., visual or auditory). We placed this framework in the context of a classroom environment, with teachers able to choose an intervention based on information from the system, paired with observations of classroom dynamics.

2 Methods

We used a user-centered participatory design approach [4, 5], where teachers and researchers actively co-created dashboard designs. We created mockups based on the most-requested metrics from a preliminary study and presented them to six middle school science teachers in a Midwestern U.S. state (with 7-34 years of teaching experience). Our mock-ups (see Fig. 1) were implemented using JavaScript and React.

Fig. 1. Mock-up screens presented in the participatory design session: (a) Class Status, (b) Group Progress, (c) Participation, (d) Short-answer Questions, and (e) Essay Questions

After reviewing each screen, teachers wrote responses to a set of questions. We then asked them to elaborate to discuss multiple perspectives. Data from audio and video recordings, written responses, and field notes were triangulated to analyze the feedback.

3 Results and Discussion

We summarize our results based on the categories mentioned earlier.

***What* information should be presented?** Teachers had differing preferences for: i) a high-level class overview, ii) a group view, and iii) fine-grained individual data. For example, 83% of the teachers said they would use the Group Progress metrics (Fig. 1b) to identify which groups need support, while 33% also asked for individual data. Teachers also illuminated potential uses to promote classroom equity, such as using Participation metrics (Fig. 1c) to provide opportunities for all voices to be heard, help special education staff better assist special needs or ELL (English Language Learners) students.

***When* should the information be presented?** Depending on the situation, some teachers preferred real-time information during class to provide immediate support, while others said they would like to review the data as a post hoc analysis tool. For example, 33% teachers said they would use the Group Progress screen (Fig. 1b) during class to identify who is stuck and prioritize helping them, to give new tasks to students who are ahead, or even promote collaboration, e.g., "*You could easily ask somebody who's done with the work to take on a teaching role to help a student.*"; whereas 66% would also like this data after class to adjust their next lesson. This implies that teachers not only have individual preferences for *when* they would like to see/use the data but also have different ways in *how* they will act, highlighting the need for a customizable dashboard.

The multifaceted nature of teaching requires fluid orchestration between social levels [2, 6], requiring dashboards to adaptively present relevant information at the appropriate time. Despite individual preferences, common emerging themes were that teachers wanted to leverage the information to a) better support students, and b) to improve their lessons, two characteristics reflected in other studies [1, 5, 9].

***How* should the information be presented?** Teachers requested mobility, as they wanted to access information while navigating the classroom and not be tethered to their desks. Our goal is to make the dashboard available on an iPad or tablet. We also discussed sending notification-style alerts as well as a vibration alert to be less intrusive.

3.1 Design Decisions and Future Directions

Our next steps are to add three features in our dashboard. First, a dashboard that can assess the teacher's specific needs at specific times and adaptively present relevant, actionable information. Teachers should be able to make decisions about what information is displayed for each lesson, which could be based on specific learning goals, e.g., if the goal is for students to understand key science ideas the teacher can choose metrics related to question performance (Fig. 1d) or essay writing (Fig. 1e). We plan to collect data about pertinent goals and features during classroom use, which can

then be used to create a catalogue to provide teachers with customizable options. Second, is to display trends across classes. Our teachers usually teach 2-5 classes. Providing comparable trends across classes will highlight the similarities or differences for specific metrics, e.g., were most students unable to answer a particular question? If so, do teachers need to rephrase the question and/or follow up with a class discussion? Third, we are combining various metrics, such as social interaction and completion, to provide more comprehensive information for teachers to make decisions.

This study highlighted the importance of effectively using teacher input to co-create a classroom orchestration tool, helping us make concrete design decisions based on their needs and feedback. As preferences of what data types they want to see and use are highly specific to the individual teacher and specific situation, it indicates the need for a dynamic customizable dashboard. Our future work aims to design and test dashboard prototypes in actual classroom settings, to better understand the AI dashboard as a useful decision-making and real-time support tool.

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