Teachers' orchestration needs during the shift to remote learning

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Abstract. Transitioning from in-person to remote instruction has forced teachers to navigate unexpected constraints while providing meaningful learning experiences for their students. This transition has drastically changed how teachers orchestrate learning for their students. To explore these unique orchestration challenges, we used needs finding and validation activities to explore middle school teachers' emergent needs and constraints during the unplanned shift to remote instruction. Our findings highlight the need for informative, real-time tools, issues with workload and burnout, and concerns with students feeling disconnected. The contribution of this work includes insights from the early stages of our design process and reflections on how we might support teachers during remote learning and in navigating future emergency shifts.

Keywords: Participatory Design, COVID-19, K-12 Teaching, Orchestration.

1 Introduction and Background

The transition from in-person to remote instruction has drastically changed how teachers *orchestrate learning*, meaning their *ability to manage variables in learning environments* [1]. Without the physical and contextual indicators of the classroom, teachers have lost a primary channel of information about their students, creating challenges to their typical orchestration. This shift has introduced new variables, never considered part of a teachers' orchestration (e.g., students' internet access at home [2]). Throughout this paper, we use the terminology *remote instruction*, recognizing the context of crisis, specifically, *emergency online teaching during the pandemic*. By using this term, we acknowledge the differences between remote instruction during the pandemic and traditional online learning. Remote instruction was rushed, did not allow teachers to sufficiently plan, and caused stress and trauma for teachers [3].

While some of the orchestration challenges teachers are experiencing during the pandemic are new, many stem from existing inequities that have been exacerbated by the pandemic [4]. Centering teachers in the design of tools can reposition them as having power in addressing new and existing orchestration challenges. Previous research on orchestration tools have focused on in-person learning environments (e.g., [5–7]), yet there remains a need to investigate how existing and future tools work in remote contexts, to account for future emergencies (e.g., future pandemic or natural disasters) or accessibility for students who need to rapidly shift to remote instruction.

Given the unique challenges of teacher orchestration amidst the COVID-19 pandemic and the potential future shifts to remote instruction, we ask *what are the unique orchestration challenges teachers face amidst the shift to remote instruction?*

2 Methods

2.1 Learning Context

We report on needs finding and concept validation activities with teachers who use Carnegie Learning's adaptive learning system called *MATHia* [8]. *MATHia* is an intelligent tutoring system (ITS) for middle and high school mathematics in which students learn math content through multi-step, complex problems. Within the *MATHia* system, the teacher has access to reports about the students' overall progress and a classroom orchestration tool called *LiveLab*. Designed for in-person classroom use, *LiveLab* directs teachers' attention to students who may need monitoring.

2.2 Participants

The participants were six middle school math teachers from six school districts across the United States. Three were teaching remotely and three were teaching in a hybrid model. These teachers had a range from four to thirty years of experience teaching. Five teachers used *MATHia* as a regular component of their teaching pre-COVID-19 and all were using it in their remote instruction.

2.3 Design and procedures

We conducted six, hour-long sessions with one teacher. During sessions, we first conducted semi-structured interviews with open-ended questions to understand how teachers had adapted to remote instruction since the pandemic began and uncover emergent constraints when using *MATHia* in a remote setting. Second, we conducted a storyboard-based speed dating exercise [9]. We asked the teachers for feedback on storyboard concepts regarding how they identified students who need help, how they might receive this information, and what they needed to reach out to students.

2.4 Data collection and analysis

Sessions were held and recorded over a video platform, resulting in approximately six hours of video recording, which were transcribed for analysis. We analyzed the interviews using thematic analysis [10], allowing themes to emerge naturally regarding our research question rather than assigning predefined codes. This allowed us to evaluate the data considering the needs and challenges of orchestration learning during the pandemic rather than reproducing themes reported in the literature that do not reflect these new complexities. To create these themes, we used Affinity Diagramming [11], a design method for clustering and re-clustering quotes from interviews to identify emerging themes. The data used in the clustering were on-topic dialogue from interviews as individual quotes. Across these six interviews, we analyzed 242 quotes extracted from transcripts.

3   Results

To answer our research question, we extracted seven high-level themes, using the methods described above.

Learning process: "I wish I could see what they're doing." All teachers described frustration when it came to identifying what students needed or how they were doing. One teacher who taught remotely explained, *"I would definitely say that's one of my weaknesses right now is figuring out skills that students are struggling with. And then like working backwards and solidifying those skills, and helping them understand, I just can't see it."* Several teachers noted the value in being able to see students' actions like in-person instruction. Teachers described requesting screenshots or asking students to share their screens during meetings. Not all students engaged one-on-one with teachers. One fully remote teacher said, *"You know, there's always five kids that stick out in a class. And when you can't see these kids, how do you know? In a classroom, you can walk around. They can't avoid you. And I feel like they can avoid you right now."*

Real-time: "I want to know as soon as possible." Teachers shared concerns that they could not identify and correct problems immediately as they could in-person. Not being able to pinpoint misconceptions quickly meant they could be missing moments of struggle until an assessment. Teachers also described missing the ability to quickly provide praise and support. One teacher remarked, *"Encouragement is a huge part of learning, saying, 'hey, you're moving in the right direction!'"* Identifying these moments to praise and reward students is hard during remote instruction.

Collaboration: "Use each other to support each other." All teachers emphasized the importance of using group work during remote learning. They each had their own method of facilitating remote collaboration that was largely impacted by factors out of their control, including the technology their school offered, internet access, or class size. Some teachers described using virtual break-out rooms, a feature of video conferencing software, to facilitate small group work, while others explained their refusal to use such tools for issues such as bullying. One teacher felt without supervision online collaboration was not yet feasible for her classes. Even though this teacher described the benefits of using collaboration.

Technology limitations: "It's just too much!" All teachers faced limitations of technology including *students' technology management* and *internet access*. Even though many students were familiar with technology, the transition to managing multiple websites and learning platforms from home was challenging. One remote teacher described responses she got from a survey to ask how students were doing, *"I had the kids answer a question, like what's going well and what's not. And a lot of them just said, 'It's just too much! It's Google classroom, it's Google forms, it's MATHia. We don't know where to go.' You know, and I don't have an answer for them."* All teachers touched on internet constraints during the interviews. Several reported most of their students had internet access, but every class had a few students who struggled to

get access or had limitations due to rural locations. One teacher who saw her students two days a week in person explained, *"I mean. I haven't asked [about access] and I keep meaning to... I haven't asked them, but it's like I haven't asked because there is too many other things."* This comment represents issues around internet access but also workload.

Teacher load: "I have two classrooms going all the time." All participating teachers noted the high demands and exhaustion of teaching during the pandemic. There was a consensus about feelings of stress and burnout. A teacher who taught in a hybrid context depicted her increased teaching load, *"In reality, it's twice as much. I have two classrooms going all the time. Yeah, all the time! Two classrooms!"* She and the two other teachers with hybrid classes explained, managing a group of students in person and at home was overwhelming.

Teachers wanted information as soon as possible, but on their terms, to have agency over how best to allocate their time. They requested designs to customize the information they received and when and how it was delivered. There was excitement regarding designs that could support teachers. One teacher justified many of her choices as being in *"survival mode"* and strongly requested the designs discussed to be implemented soon as it was encouraging to discuss tools that could alleviate stress.

Transition to remote: "We can't do this every day." One constraint that contributed to the high workload of teachers was the issue that lessons and tools were not designed for remote instruction, such as *LiveLab*. The teachers who used *LiveLab* before the start of the pandemic described how their interactions with the tool changed. One teacher who taught remotely explained, *"So I'm not using [LiveLab] too much this year so far simply because I don't know that they're all on at the same time nor can I see their screens at the same time."*

Student interactions: "They are disconnected." Teachers also acknowledged challenges regarding students, including *issues of engagement* and *communication*. One hybrid teacher, summarized her interactions with her students, *"We're four weeks into the school year, which means, you know, I've seen these kids and they ought to kind of be lightening up a little bit... It is almost sad. They are disconnected."* This theme of feeling disconnected resonated with many teachers, describing many barriers (e.g., distractions at home and disengaged students). Some teachers acknowledged positive components of communications; one remote teacher explained her school district provided time daily to work with her students, which resulted in positive interactions with many students (even though not all students were willing to meet). For other teachers, their communication varied by the tools supplied by their school districts and the students' willingness to engage.

4 Discussion and Conclusions

In this paper, we contribute insights from our initial design process regarding *challenges teachers have experienced during the transition to remote instruction*. We

argue some of our findings have implications regarding how we might support teachers in remote learning and in navigating future emergency shifts to remote learning. Teachers expressed needs for real-time tools to provide additional details about *what students were doing and what they needed help with*, reiterating findings from previous studies [1, 5, 7]. These issues were exacerbated during remote learning by teachers' loss of ability to monitor students for valuable physical cues. Our findings also highlighted that *LiveLab*, developed specifically for in-person awareness and monitoring did not directly transfer to remote teaching, demonstrating a need to explore how orchestration tools might be designed to support shifts in different learning environments. These findings highlight important future work for designers of orchestration technology regarding *how technology might support teachers in future remote teaching contexts* and *how future tools might be developed to support seamless shifts between in-person and remote instruction?*

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