Supporting Teachers Supporting Students: Iterative Development of TIPS in a Teacher Dashboard

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Abstract: When implementing the Next Generation Science Standards, it is challenging for teachers to support students on inquiry practices; technological tools are a good solution to help inform teachers' pedagogical practices. In this study, we developed actionable, evidence-based Teacher Inquiry Practice Supports (TIPS) that are presented as fine-grained real-time alerts within the teacher dashboard Inq-Blotter. These TIPS aid teachers in providing detailed support to students in order to scaffold students' specific inquiry difficulties on the practices.

Introduction

Teachers, especially novice teachers (Sherin et al., 2011), often struggle with identifying and supporting students on inquiry practices, which are now considered instrumental to the Next Generation Science Standards (NGSS, 2013; Pruitt, 2014). Teacher dashboards (Dillenbourg et al., 2013) are useful in guiding teachers to identify struggling students. However, most dashboards designed for science (e.g., Acosta & Slotta, 2018; Matuk et al., 2016) use coarse data based on students' task completion (i.e., responses to multiple-choice questions) that are not actionable, nor can these data support teachers in realizing the NGSS. Inq-Blotter is a dashboard that provides fine-grained, actionable alerts to teachers on students' competencies on the inquiry practices in real time using patented, educational data-mined algorithms (Gobert et al., 2018). Prior research has shown that even with real-time inquiry alerts, some teachers still only provide low levels of support to students and often default to giving content support rather than support on the inquiry practices (Dickler et al., 2019). In light of these findings, it is necessary to provide teachers with additional guidance, or Teacher Inquiry Practice Supports (TIPS), in order to increase the likelihood of teachers providing higher-level help on the inquiry practices. In this study, we analyzed data from our prior studies to identify examples of effective teacher supports, and based on high-level exemplars, we developed TIPS that provide more detailed information in addition to existing alerts in Inq-Blotter to promote teachers' support of students' inquiry competencies.

Methods

Participants included 2 middle school teachers and 40 students. The students conducted NGSS-aligned inquiry investigations in the virtual environment Inq-ITS on the topics of Lunar Phases, Sound, Gravity, and Flower. While students worked, teachers used Inq-Blotter, alerting them of students' difficulties on inquiry practices of asking questions/hypothesizing, carrying out investigations/collecting data, and analyzing or interpreting data. These actionable alerts are triggered in real time by auto-scoring of inquiry practices (Gobert et al., 2018).

When teachers responded to an alert, interactions between teachers and students were recorded through a microphone on a tablet device with the dashboard system and were automatically integrated with the students' log files from the labs. Two researchers transcribed and coded 219 teacher-spoken segments within the recorded teacher-student conversations; 97% agreement between the researchers was obtained. The codes included four types of scaffolds provided by teachers (orienting, procedural, conceptual, and instrumental). Orienting scaffolds occurred when teachers guided students by reminding the students of the inquiry practice being completed. Conceptual scaffolds included definitions of the inquiry practice and explanations of the purpose of the practice. Procedural scaffolds involved explaining to students the steps involved in completing an inquiry practice. Instrumental scaffolds suggested exact actions to take in order to complete the practice.

Student improvement was then determined by calculating the difference in inquiry practice scores prior to receiving teacher support (e.g., 67% on analyzing data) and afterward (e.g., 100% on analyzing data). In order to develop a table of helpful teacher support segments based on inquiry practices and scaffold types, we filtered by whether students improved after being helped and selected teacher segments associated with positive improvement. Based on patterns in these segments, we then developed TIPS for each of the scaffolding types for each inquiry practice, which can be integrated into the dashboard alerts to help guide teacher support.

Results

Filtering the discourse associated with students' performance improvements resulted in the development of TIPS for each of the four types of support and the fine-grained subcomponents of each of the inquiry practices. Experts

advised on the design of the mock-up that shows TIPS in Inq-Blotter (see Figure 1). Upon pressing the TIPS button, the teacher may peruse through the sequence of supports according to the scaffolding types (see Figure 2) in order to select one of the TIPS, given their nuanced understanding of the student.

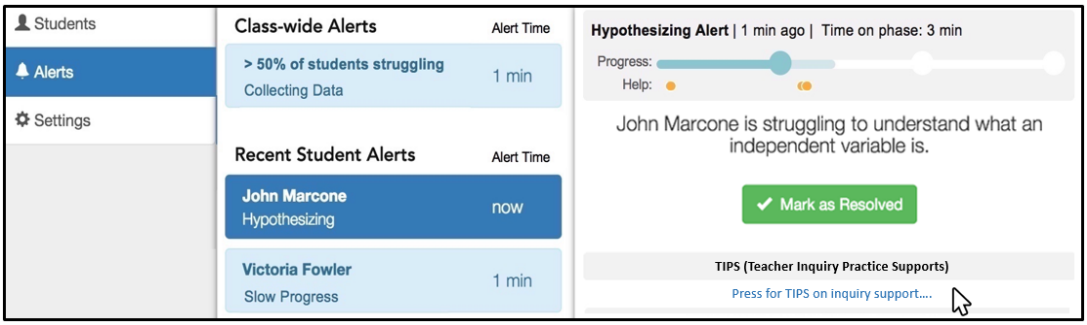

Figure 1. Mock-up of Inq-Blotter with TIPS button.

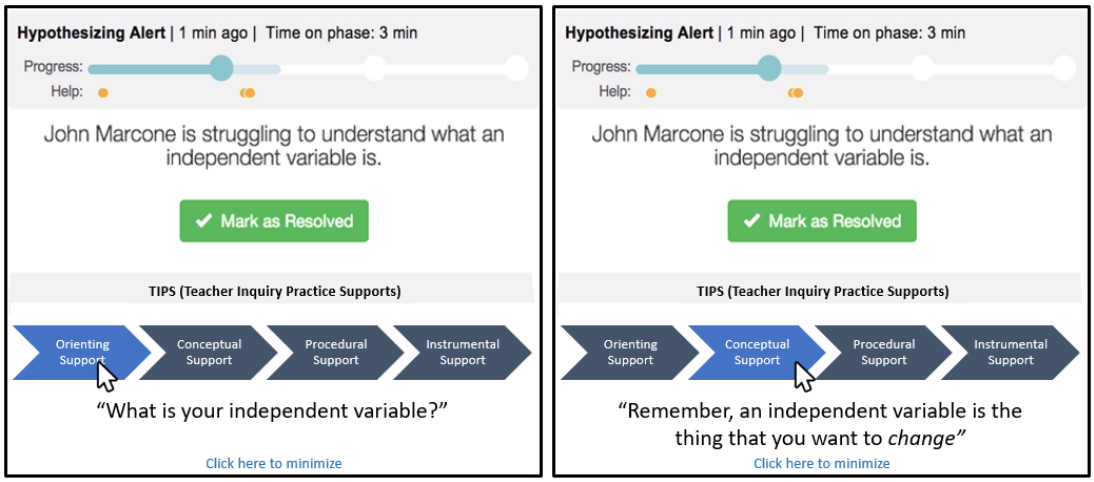

Figure 2. Mock-up of a sequence of TIPS on the hypothesizing inquiry practice.

Discussion

TIPS for each scaffolding type are currently in testing with middle school teachers. Results from these studies will inform new iterations of the teacher dashboard design and will be reported at the conference. These TIPS, if found to be successful at supporting teachers' pedagogical practices for the NGSS, will inform the design of actionable data-driven supports needed for teachers to realize the vision of the NGSS (2013).

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