Using the Inq-Blotter Dashboard to Support Teachers and Students on Science Practices

Rachel Dickler & Amy Adair

Rutgers University Graduate School of Education

GSE Brown Bag

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Presentation Outline

- Background and Prior Work
- Research Studies
  - Study 1: Inq-Blotter
  - Teacher Inquiry Practice Supports (TIPS) Development
  - Study 2: Inq-Blotter with TIPS
- Discussion and Future Research

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- **Background and Prior Work**

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Background

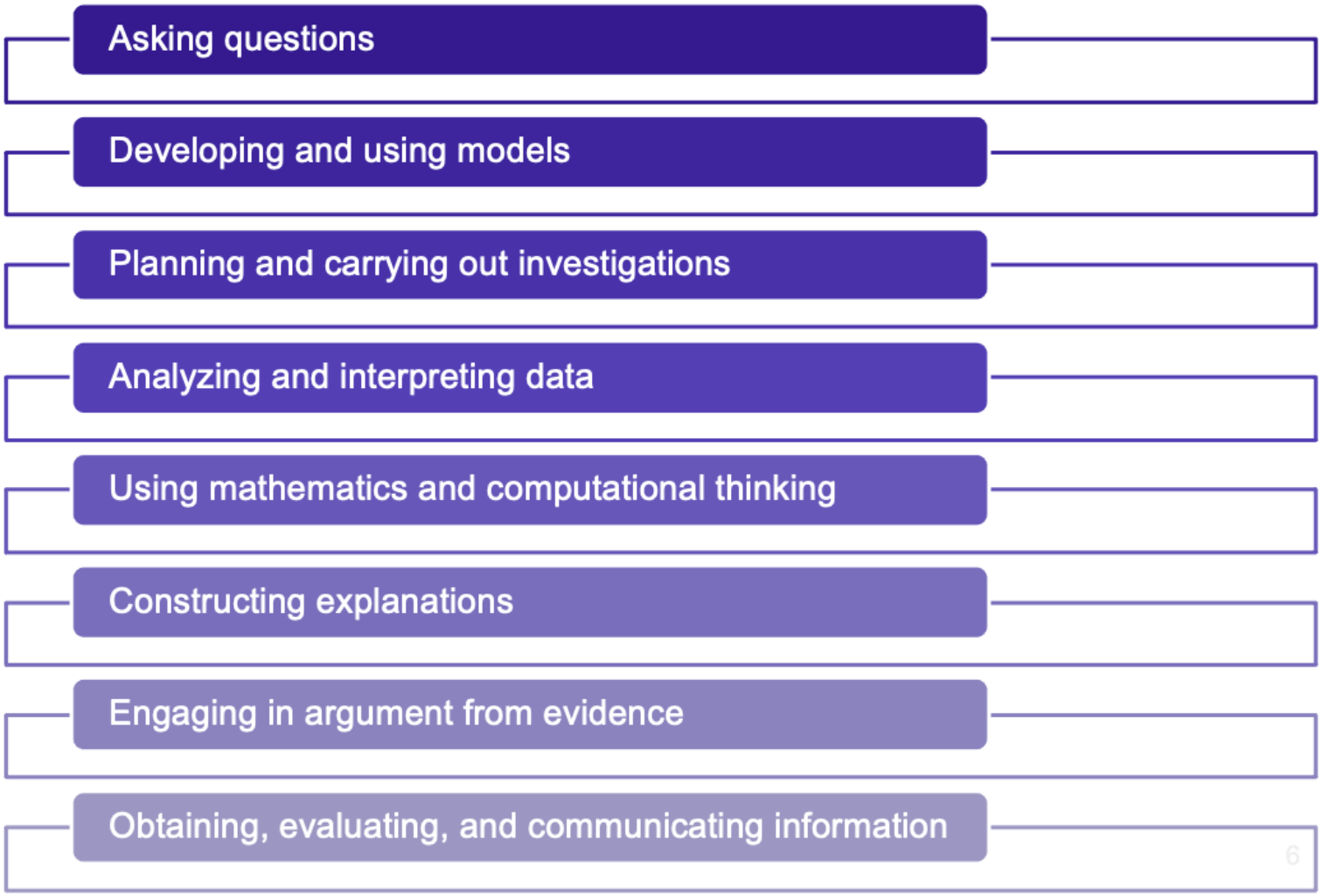
- The number of opportunities in Science, Technology, Engineering, and Mathematics (STEM) are increasing

- Students in the United States are under performing in STEM on international benchmarks
  - Ranking 26th in Science and 40th in Math on PISA

- National reform efforts attempt to direct focus towards inquiry
  - e.g., Next Generation Science Standards

(NGSS,2013; NRC, 2012; Pruitt, 2014; OECD, 2016a, 2016b)

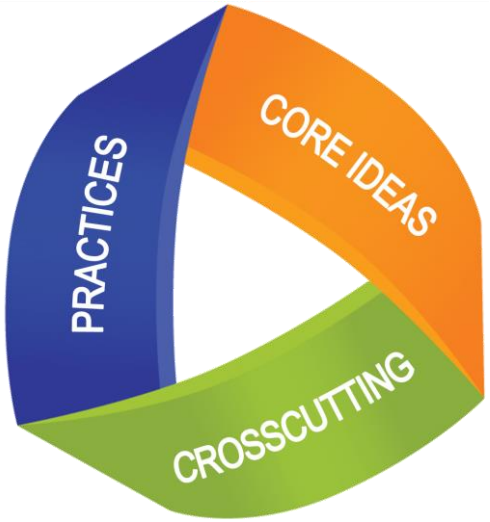
Science Inquiry Practices



(NGSS, 2013; NRC, 2012)

Assessing and Supporting Inquiry

- Inquiry practices are difficult to operationalize and measure
- Inquiry practices are challenging
- Science inquiry is multi-dimensional
  - Procedural understandings
  - Conceptual understandings
  - Content understandings, etc.



(NGSS,2013; NRC, 2012; Pruitt, 2014)

Technologies for Science Inquiry

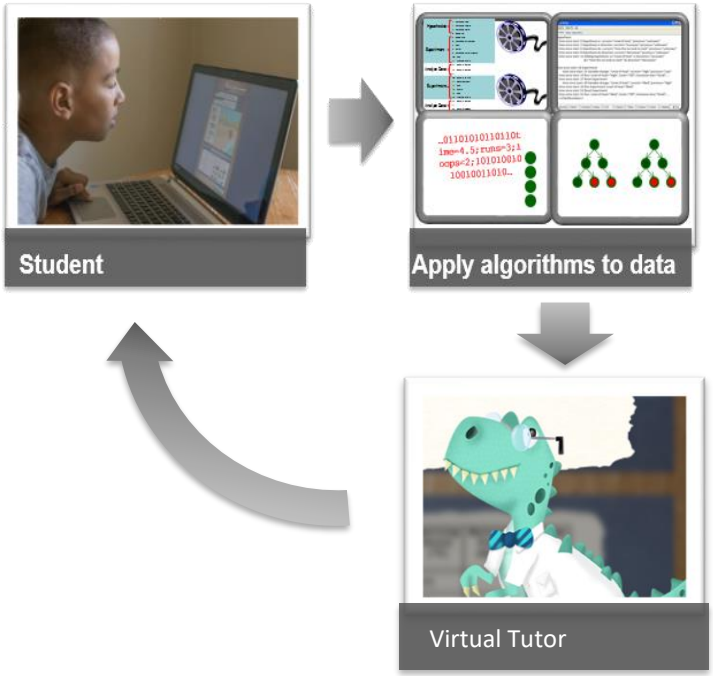
- Online science environments can automatically assess and support students

- Teacher **dashboards** allow for monitoring students within online environments through:
  - Reports of student activity and contributions
  - Visualizations of student scores on questions
  - Alerts on student progress, etc.

HOWARD Dashboard (Lajoie et al., 2021)

(Davenport et al., 2017; Linn et al., 2003; Matuk et al., 2016; Quellmalz et al., 2012; Raes & Schellens, 2016)

Inq-ITS (Inquiry Intelligent Tutoring System) & Inq-Blotter Teacher Dashboard



(Dickler et al., 2019a, 2019b; Gobert et al., 2014, 2016, 2019)

Prior Studies on Inq-ITS & Inq-Blotter

- Inq-ITS was explicitly designed to capture students' **sub-practice** performance
  - Inq-Blotter can then send fine-grained, actionable **alerts** to teachers with information at the sub-practice level

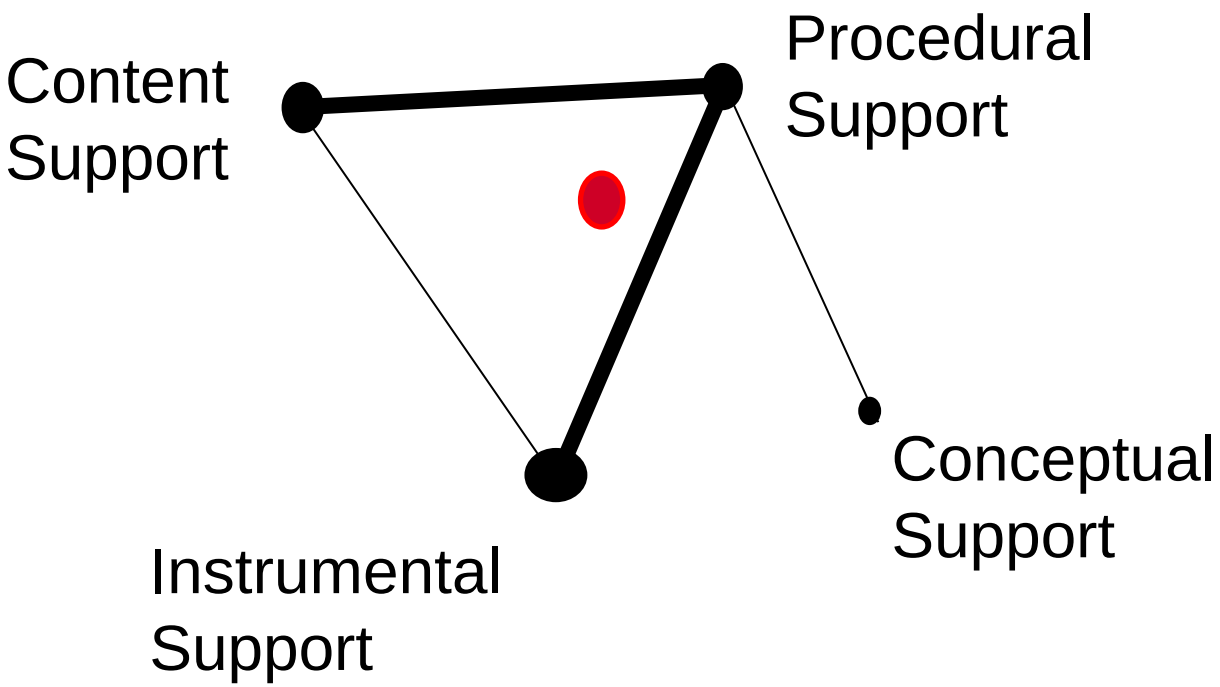
- When teachers use Inq-Blotter with real-time alerts, students significantly improve on science practices more than when no dashboard is available

- It is essential to also explore *how* the alerting dashboard is used

(Dickler et al., 2019a, 2020; Sao Pedro et al., 2019)

Epistemic Network Analysis (ENA)

- ENA is a method that is used to examine connections between coded qualitative data in networks



(Shaffer et al., 2016)

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Study 1: Inq-Blotter

RQ1) Are real-time alerts for inquiry practices associated with student improvement?

RQ2) Does the pattern of teacher support provided to students differ in relation to performance on practices?

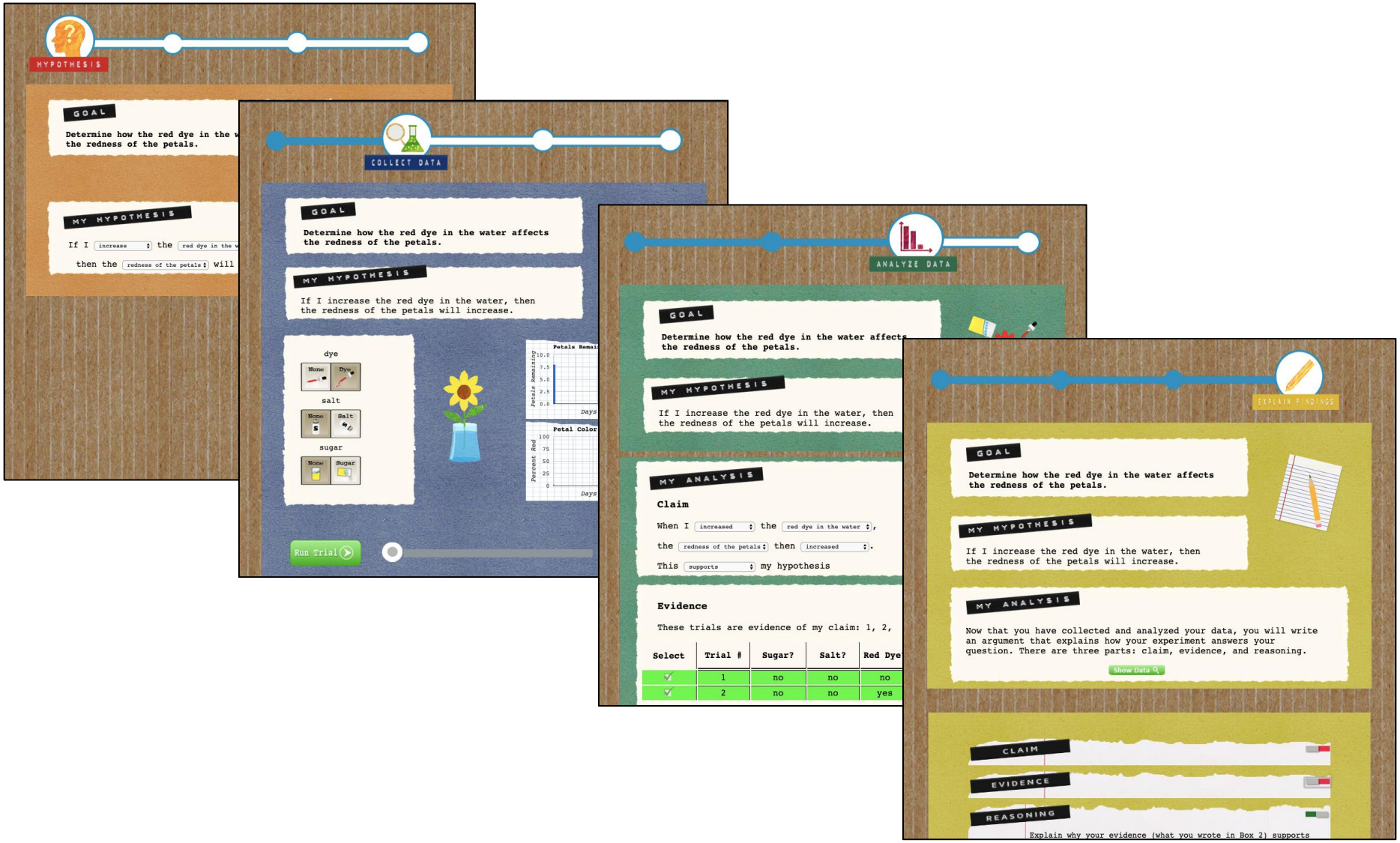
(Dickler, Gobert, & Sao Pedro, 2021)

Methods

- Participants:
  - 2 middle school teachers
  - 211 middle school students

- Procedure:
  - Students completed three Inq-ITS lab activities
  - Teachers used Inq-Blotter as students completed Inq-ITS labs
    - Audio data of interactions were recorded

Materials: Inq-ITS Virtual Lab Activity

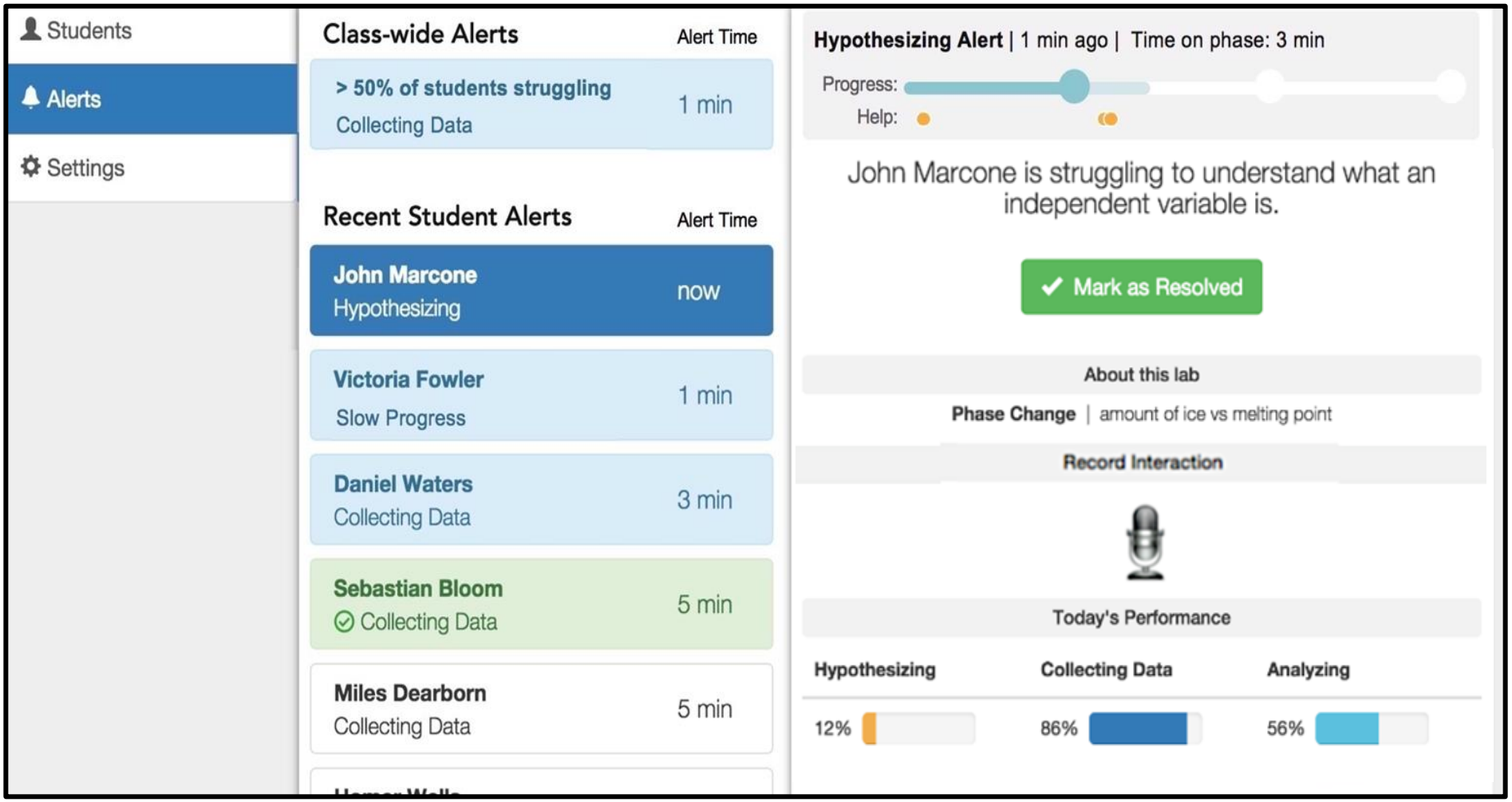


Measures: Inq-ITS Log Data

Inquiry Practice	Automatically Scored Sub-Practices
Asking Questions/ Hypothesizing	Selecting an independent variable (IV)
	Selecting a dependent variable (DV)
	Determining the target IV based on the goal
	Determining the target DV based on the goal
Carrying out Investigations/ Collecting Data	Designing a controlled experiment
	Running sufficient trials
	Testing the question/hypothesis
Analyzing and Interpreting Data	Identifying whether results support the initial hypothesis
	Making a claim regarding the target IV and DV
	Interpreting the relationship between the IV and DV
	Selecting sufficient trials to support the claim
	Selecting controlled trials to support the claim
	Selecting appropriate trials to support the claim
	Selecting trials that support the claim

(Gobert et al., 2013, 2018; Sao Pedro et al., 2013)

Materials: Inq-Blotter Teacher Dashboard



Measures: Inq-Blotter Log Data

- Log data from Inq-Blotter was examined in terms of:
  - alerts that appeared for the teacher
  - the student alerts accessed by the teacher
  - the content of alerts
  - timestamps

(Gobert et al., 2013, 2018)

Measures: Audio-Recordings

- *N* = 35 recordings were captured and transcribed
- Teacher turns were coded by two raters for types of supports provided
  - i.e., science practices, content, evaluative, etc.

(Gobert et al., 2013, 2018)

Teacher Discourse Codebook

Support Type	Definition
Orienting	Directing attention to a particular practice
Conceptual	Definition/explanation of an inquiry practice
Procedural	Information on the steps involved in an inquiry practice
Instrumental	The exact actions to take to complete the inquiry practice
Content (Comment)	A statement regarding scientific domain-related content
Content (Question)	Asking the student about scientific domain-related content
Evaluative	Statements regarding whether work is correct or incorrect

(Dickler et al., 2018, 2019a, 2019b, 2021)

Analyses: RQ1

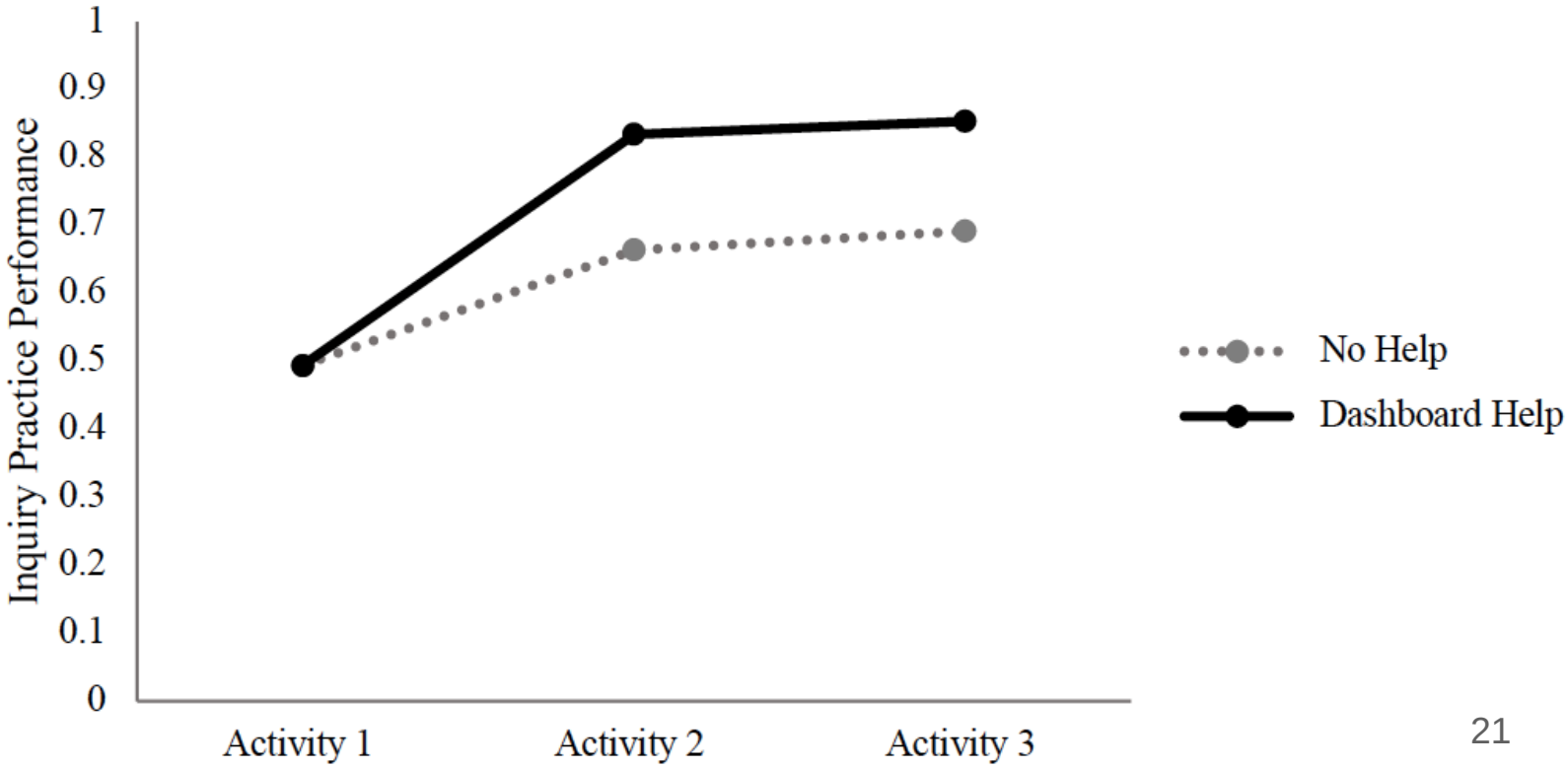
RQ1) Are real-time alerts for inquiry practices associated with student improvement?

- Triangulated log data from Inq-ITS and Inq-Blotter
  - Identified students who were helped (*n* = 35 students) and matched students who were **not** helped (*n* = 35 students)

- A Mixed Model Analysis of Variance (MM ANOVA) was used to compare student performance across activities between conditions
  - i.e., help versus no help

Results: RQ1

- The MM ANOVA revealed that students helped based on an alert had marginally significantly greater improvement across activities
  - i.e., interaction effect, $F(2, 136) = 2.60$, $p = 0.078$



Analyses: RQ2

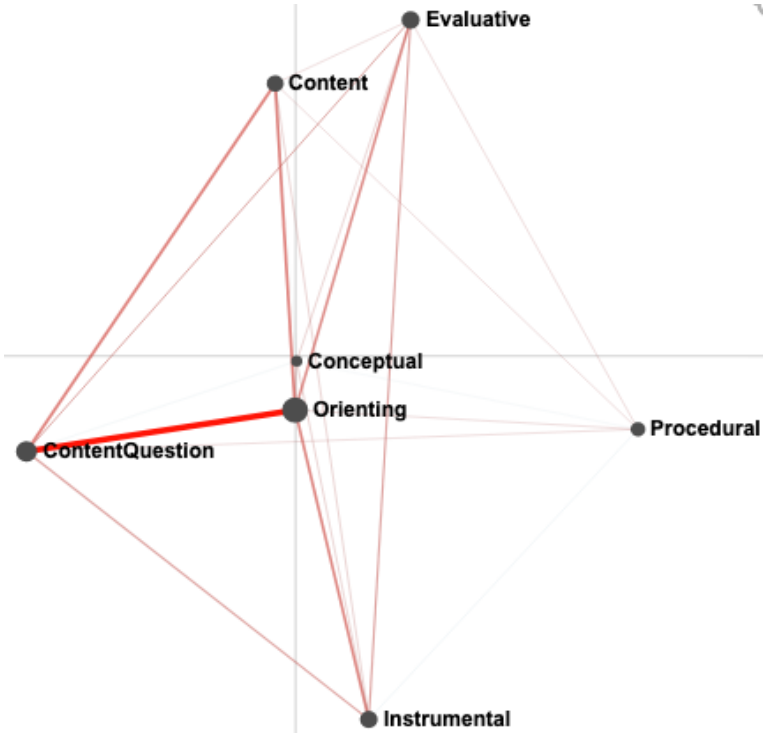
RQ2) Does the pattern of teacher support provided to students differ in relation to performance on practices?

- Triangulated log data with coded audio transcripts
- Compared patterns in support when helped students improved or did not improve on their next activity
  - Epistemic Network Analysis (ENA) was used to make quantitative and qualitative comparisons of patterns of support

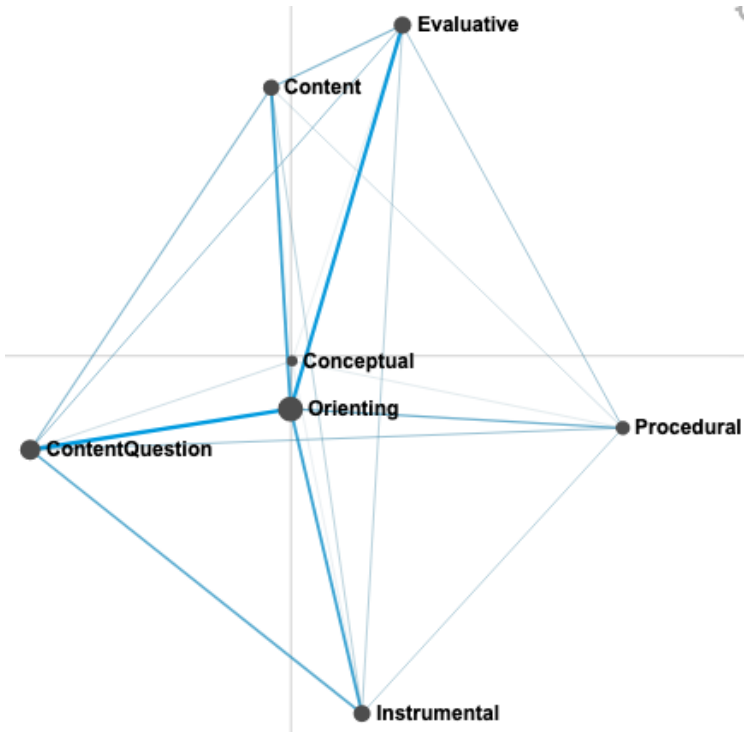
Results: RQ2

- The pattern of support associated with improvement was significantly different, $t(34) = 2.45$, $p = .04$

No Improvement



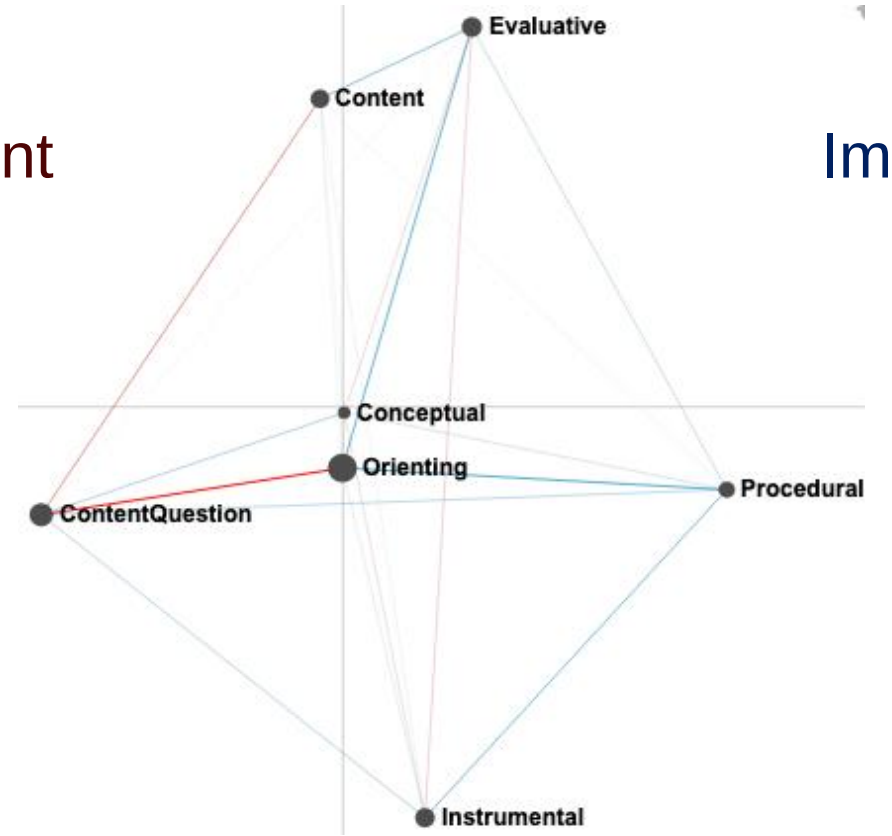
Improvement



Results: RQ2 (continued)

- Students who did *not* improve received combinations of lower-level/content supports more frequently

No Improvement



Improvement

Discussion

- The results of this study demonstrate the potential of an alerting dashboard to guide teacher support on inquiry practices
  - The majority of students who were helped by a teacher significantly improved and maintained their improvement

- The pattern of discursive support significantly differed by whether students improved or did not improve

- These findings have important implications for designing alerts to promote explicit practice support
  - Prior studies indicate potential of providing teachers with example prompts to guide interactions (e.g., Morris & Chi, 2010)

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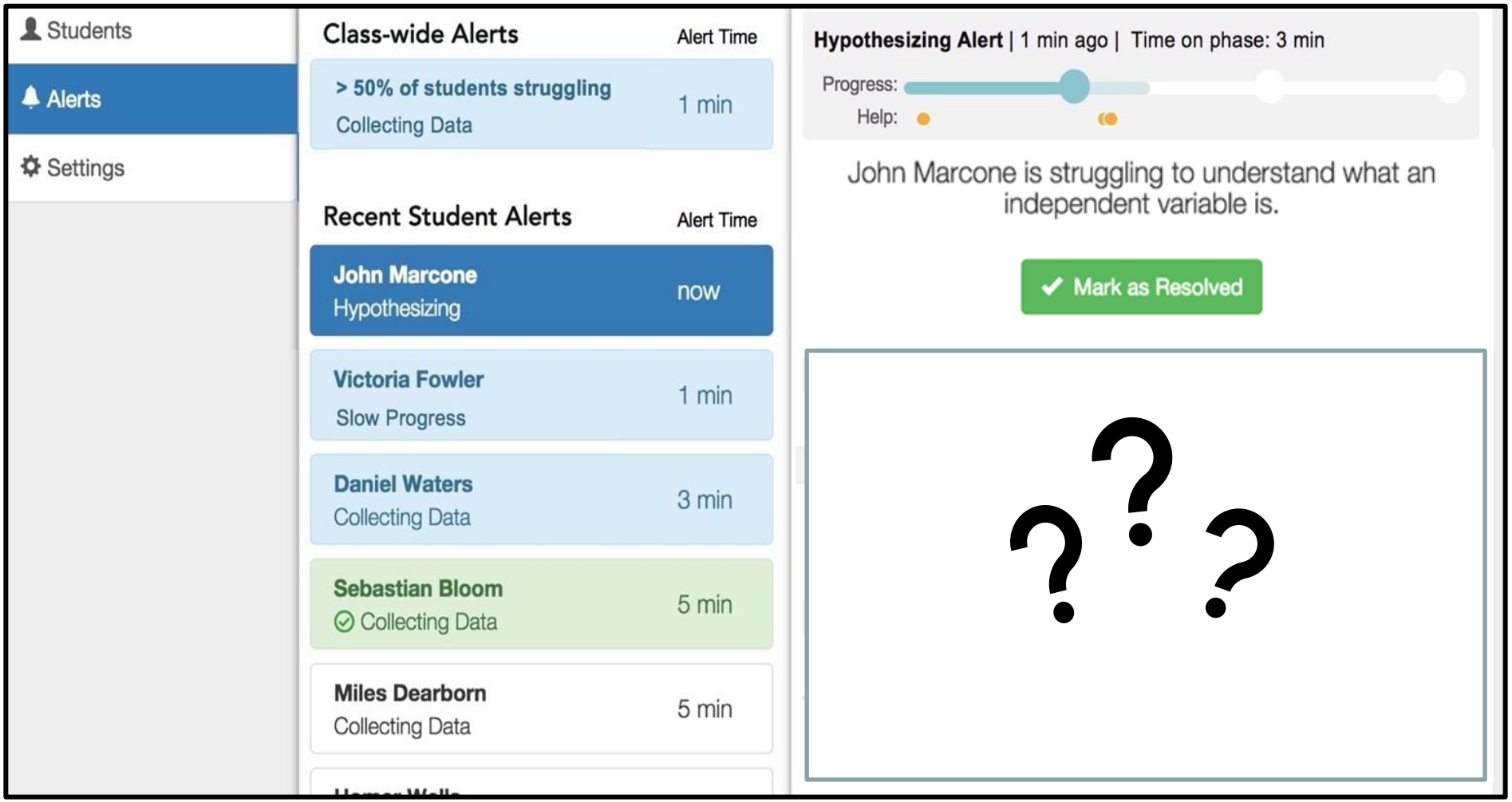
Motivation for Updated Inq-Blotter Alerts



TIPS Development

- **T**eacher **I**nquiry **P**ractice **S**upports – prompts directed at supporting the student's inquiry practices
  - TIPS are sent directly to the teacher within alerts in Inq-Blotter

- Four Categories of Support:
  - Orienting - direct student to a specific practice
  - Conceptual - define or explain an inquiry practice
  - Procedural - inform students of inquiry steps
  - Instrumental - give student exact actions to complete the practice

(Adair et al., 2020; Gobert et al., 2018)

TIPS Development (continued)

Obtained 219 teacher-spoken segments from recorded conversations with the 2 middle school teachers from Study 1

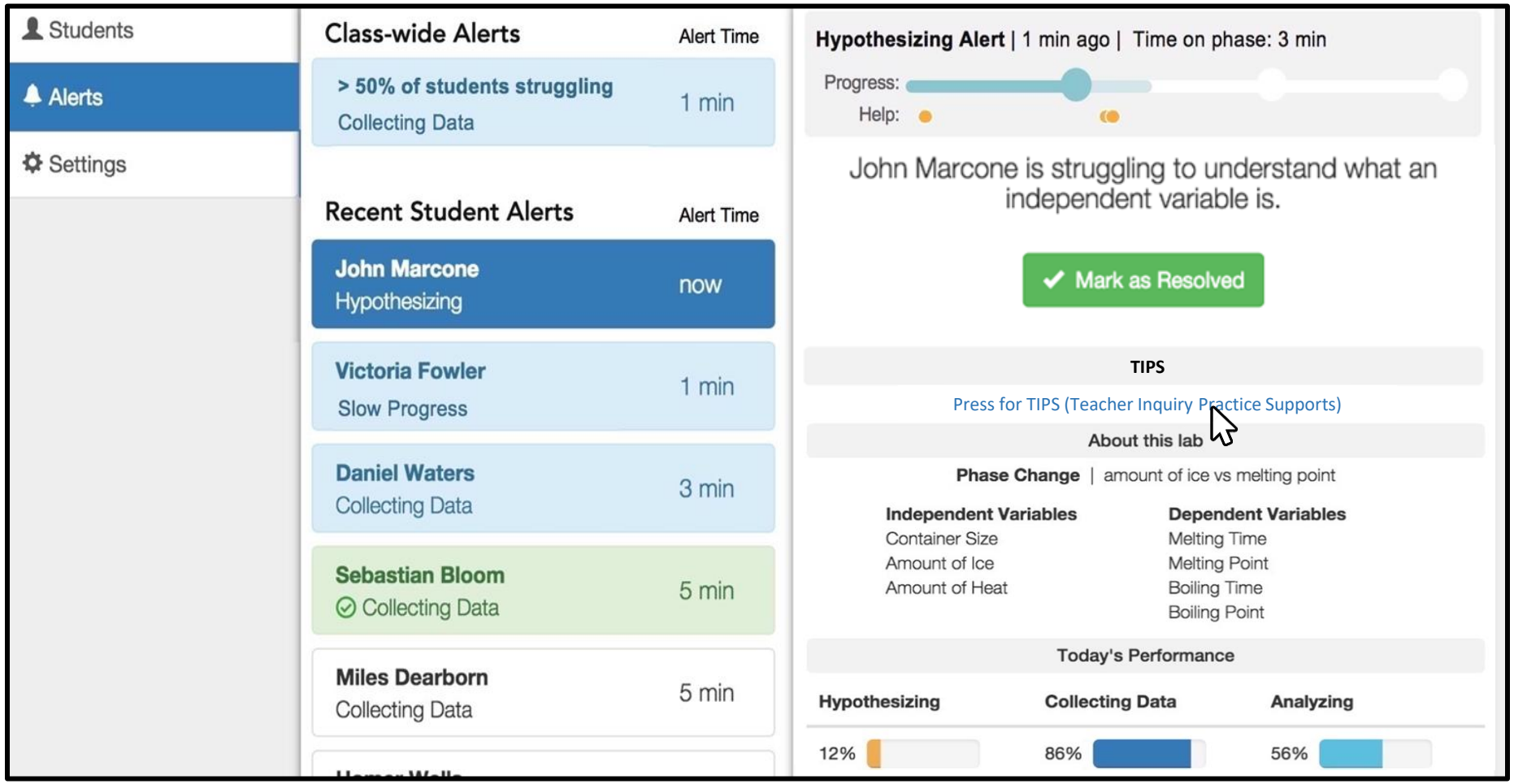
Used segments that had previously been coded for four categories of support (i.e., orienting, conceptual, instrumental, procedural)

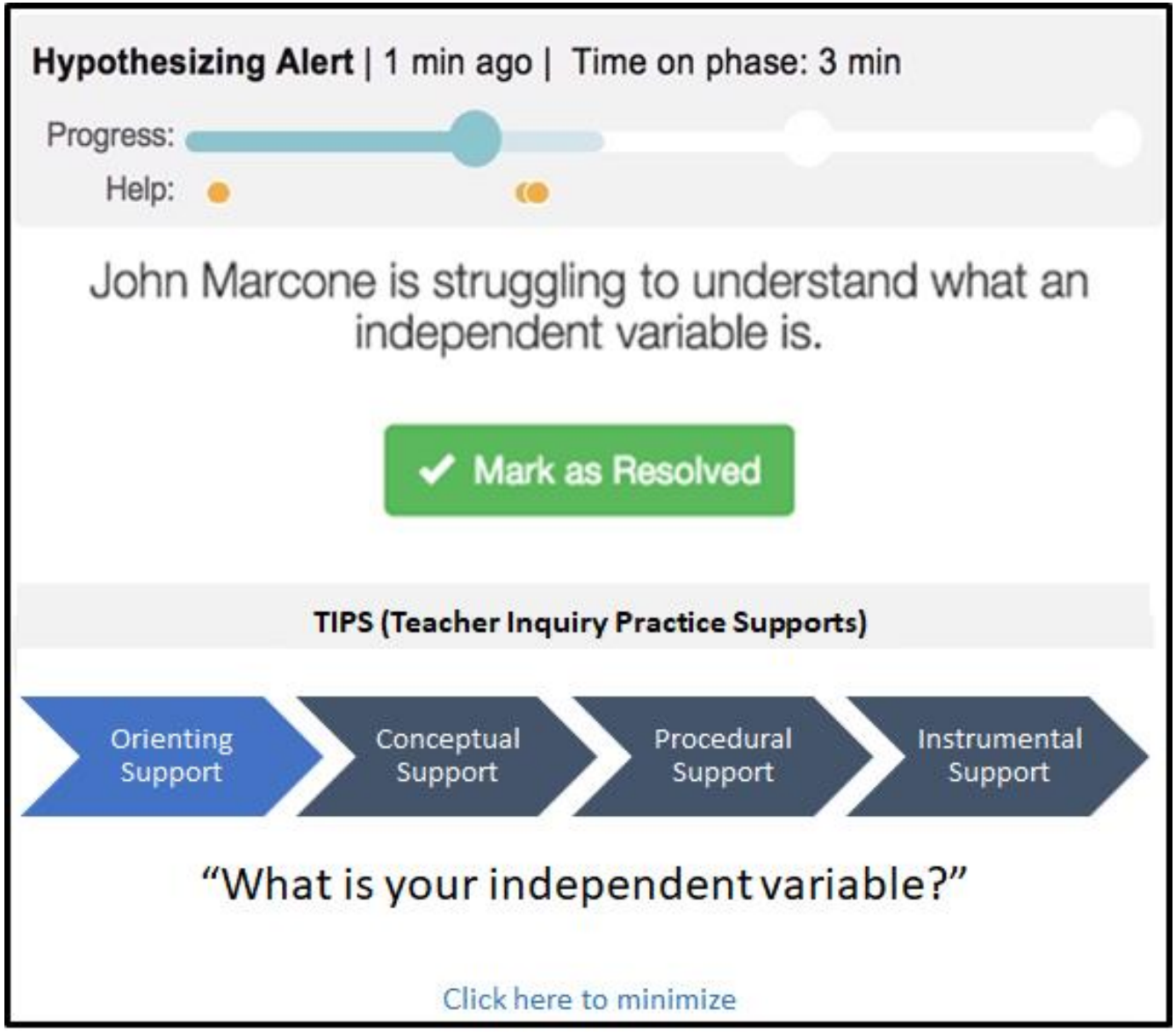
Filtered segments for which students improved on the practice after receiving support from the teacher

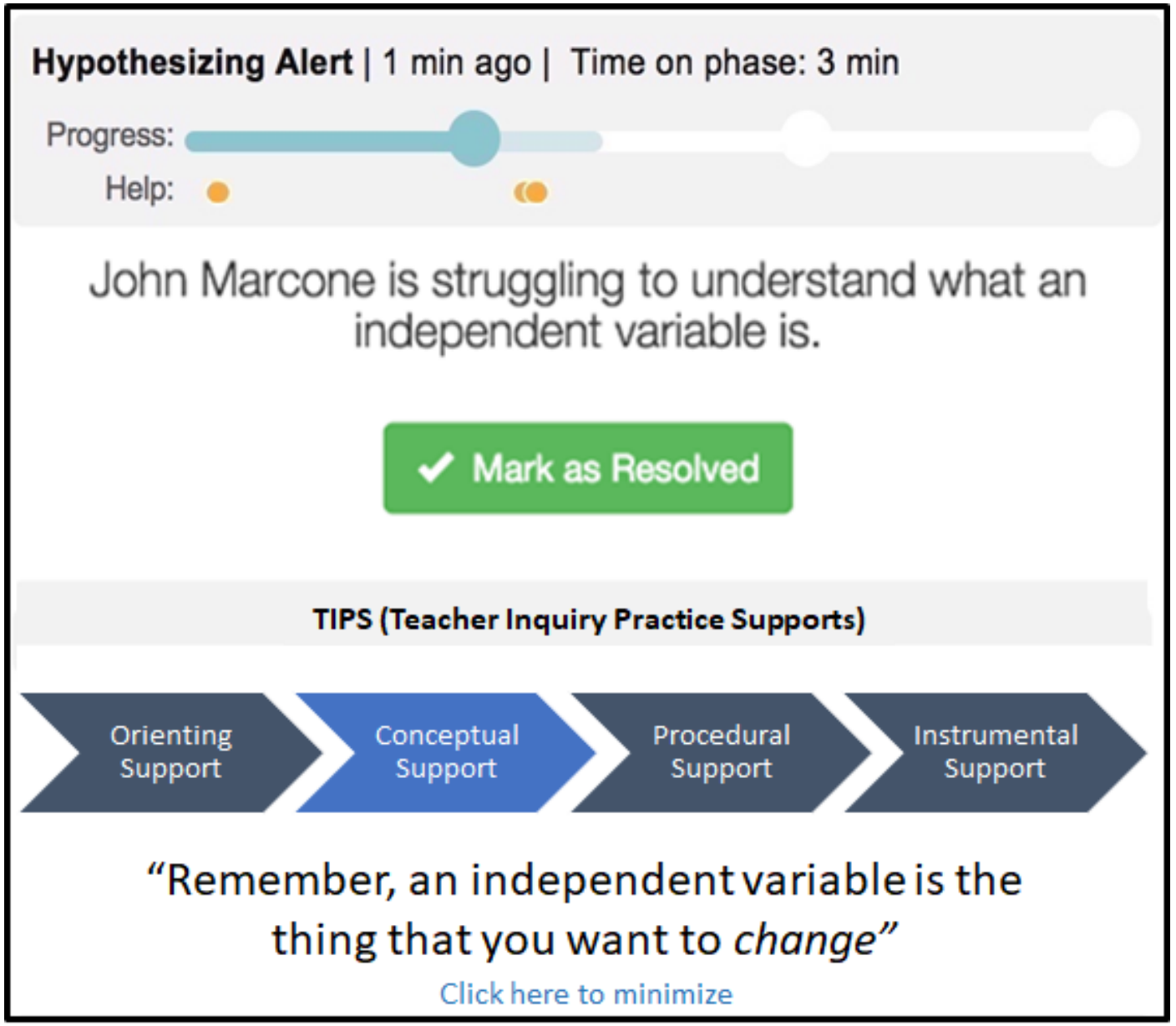
Constructed TIPS for each category of support based on filtered teacher segments

Embedded TIPS into the Inq-Blotter system

1. Teacher can select “Press for TIPS (Teacher Inquiry Practice Supports)” if she wants to access the prompts




Hypothesizing Alert | 1 min ago | Time on phase: 3 min
Progress:
Help:
John Marcone is struggling to understand what an independent variable is.
Mark as Resolved
TIPS (Teacher Inquiry Practice Supports)
Orienting Support
Conceptual Support
Procedural Support
Instrumental Support
"What is your independent variable?"
Click here to minimize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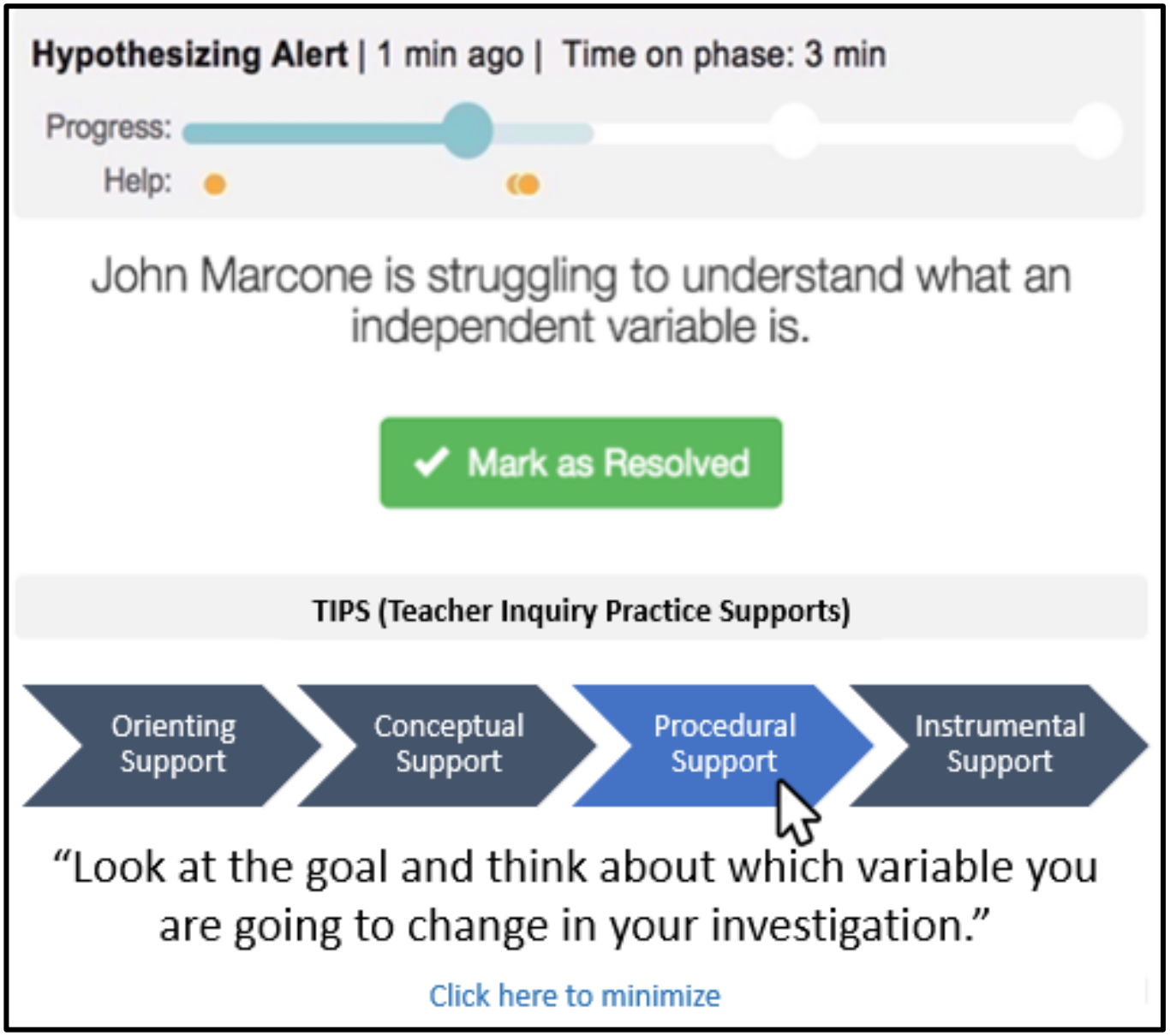
Progress:
Help:
John Marcone is struggling to understand what an independent variable is.
Mark as Resolved
TIPS (Teacher Inquiry Practice Supports)
Orienting Support
Conceptual Support
Procedural Support
Instrumental Support
"Remember, an independent variable is the thing that you want to *change*"
Click here to minimize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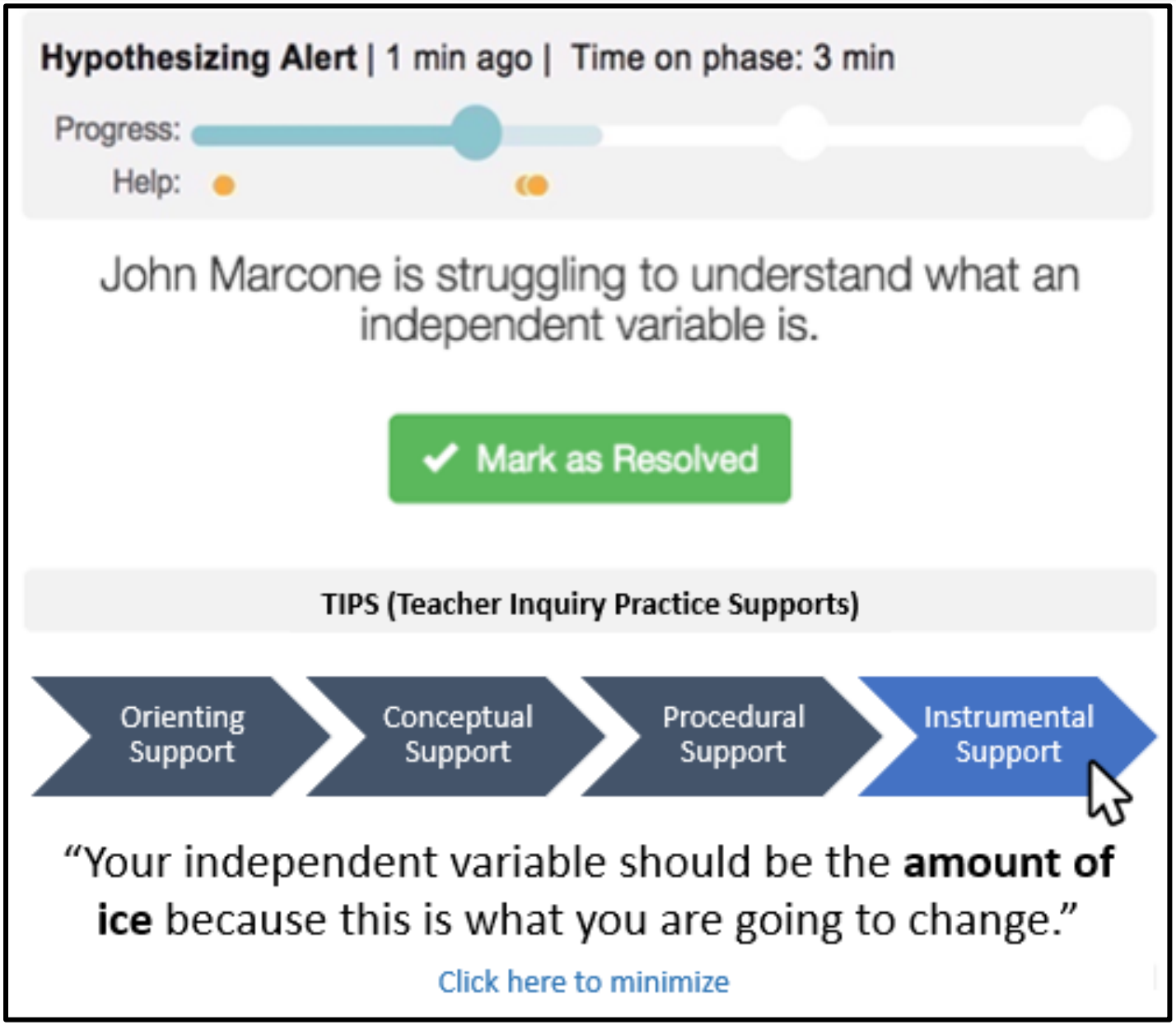
Progress:
Help:
John Marcone is struggling to understand what an independent variable is.
Mark as Resolved
TIPS (Teacher Inquiry Practice Supports)
Orienting Support
Conceptual Support
Procedural Support
Instrumental Support
"Look at the goal and think about which variable you are going to change in your investigation."
Click here to minimize


Hypothesizing Alert | 1 min ago | Time on phase: 3 min
Progress:
Help:
John Marcone is struggling to understand what an independent variable is.
Mark as Resolved
TIPS (Teacher Inquiry Practice Supports)
Orienting Support
Conceptual Support
Procedural Support
Instrumental Support
"Your independent variable should be the amount of ice because this is what you are going to change."
Click here to minimize

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Study 2: Inq-Blotter with TIPS

RQ1) How do TIPS impact the ways in which teachers support students?

Methods

- Participants:
  - 4 teachers from different schools
    - 2 Remote (Fully Online, Synchronous)
    - 1 In-Person/Traditional
    - 1 Hybrid

- Procedure:
  - Teachers used **Inq-Blotter with TIPS** as students completed Inq-ITS labs
  - Teachers were interviewed about their experiences

Measures

- Inq-Blotter with TIPS Log Data
  - Clickstream data of the types of alerts and supports that teacher selected and timestamps
- Audio-Recordings
- Teacher Interviews

Analyses

RQ1) How do TIPS impact the ways in which teachers support students?

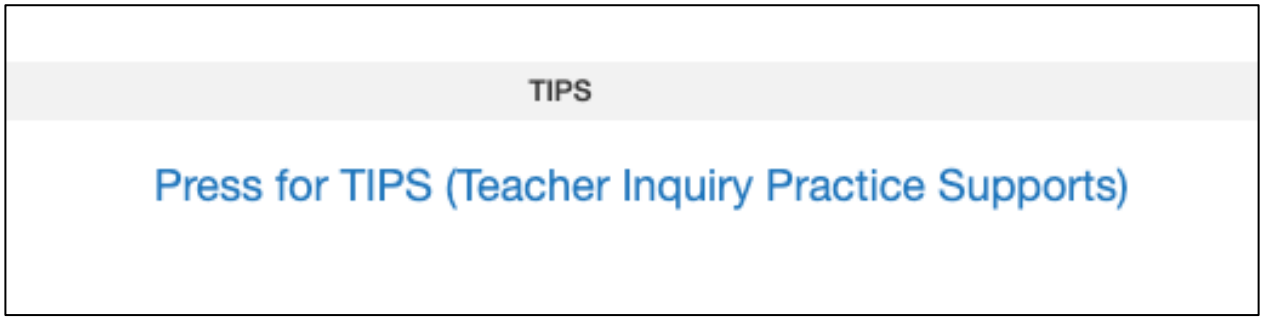
- Researchers examined data for initial themes that emerged from the data

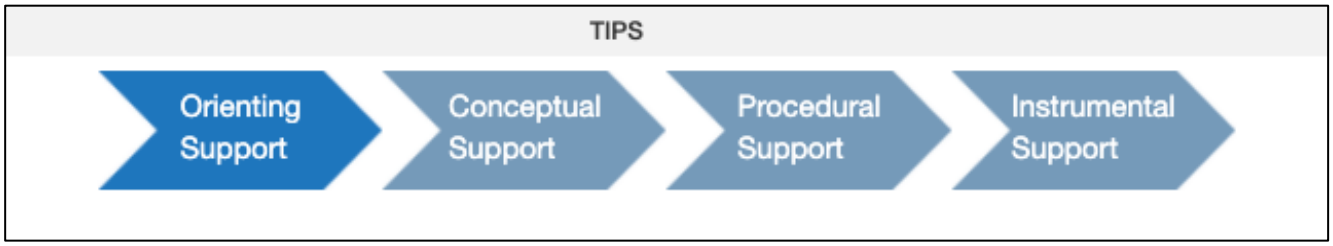
Preliminary Results

- Three initial themes were identified from the data:
  - Design recommendations for improved usability
  - TIPS helped teachers differentiate levels of support
  - TIPS helped teachers with timeliness

Preliminary Results – Theme 1

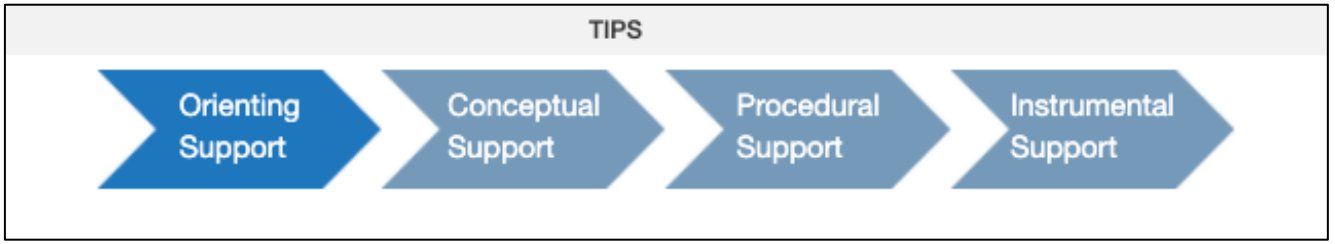
- Design recommendations for improved usability
  - Remove need to "Press for TIPS"
  - Simplify language of TIPS terminology
  - Update graphics (i.e., arrows)





Preliminary Results – Theme 2

- TIPS helped teachers differentiate levels of support
  - "In general, it was **helpful to remind me to not jump straight to giving kids the answer**. I had a few kids surprise me. They figured things out on their own using the TIPS more often than I thought they would."
  - "I talk to my kids all the time, but it made it easier to identify like a **laser what I needed to talk to them about**."



Preliminary Results – Theme 3

- TIPS helped teachers with timeliness
  - "The **TIPS saved me time** to clarify what is going on...I was able to make my way around the room to more students. When you add [that] up...it really saves me time."
  - "[TIPS] helped me with **starting that communication with the students**. How much did that decrease the amount of time? Probably 1-2 minutes. I get those TIPS, and that's what I would send the kids online."

Discussion

- The preliminary results of this study provide insights that can inform future design iterations of Inq-Blotter with TIPS
- Our early findings also suggest alerts that include helpful suggestions, like TIPS, may be useful in promoting the support that teachers provide to their students on science inquiry practices
- On-going analyses will look at log data to determine how students' performances changed as a result of teachers using TIPS in their instruction

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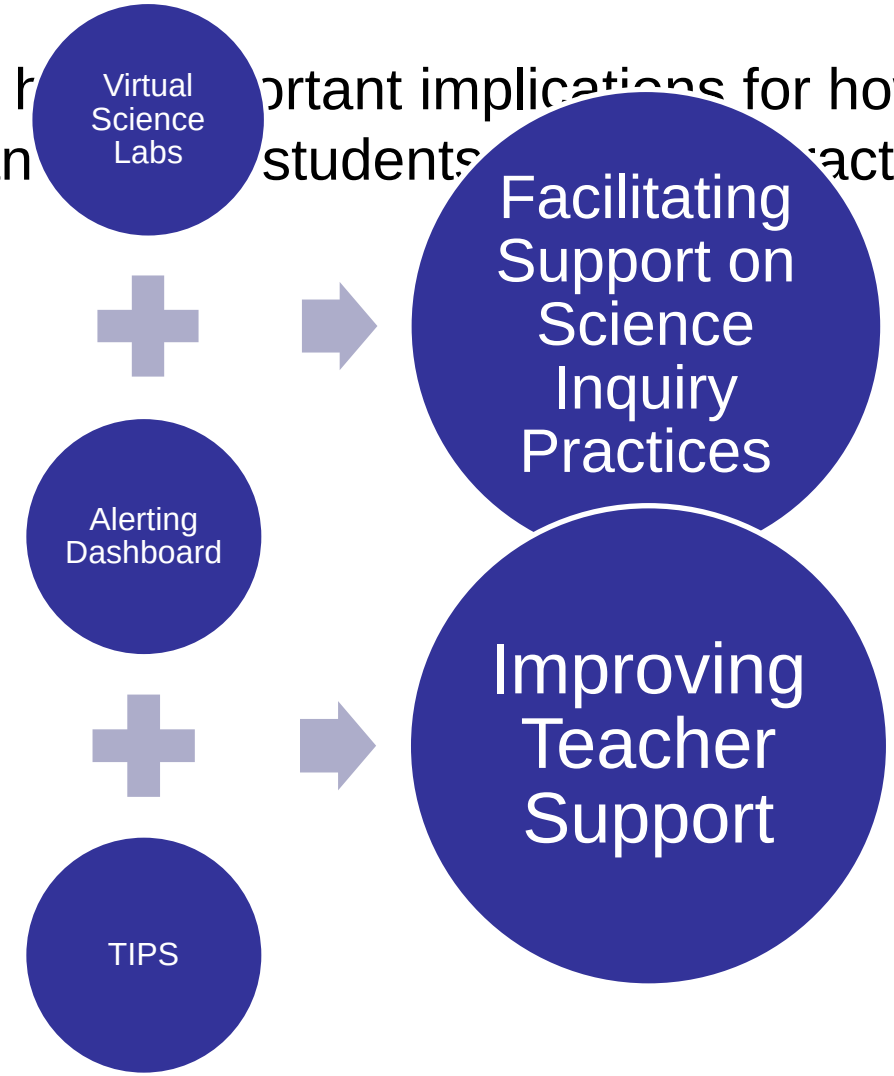
Discussion

- These findings h ortant implications for how alerting dashboards can students actices



Future Research

- Future work will examine:
  - Testing updated design elements
  - Examining discourse and running controlled comparisons to explore student performance in relation to design features
  - Expanding the systems to support Using Mathematics in Science at the high school level

Acknowledgements

- A huge thank you to the Rutgers Inq-ITS Team and Apprendis Team!

Thank you!

Rachel Dickler & Amy Adair

Rachel.Dickler@gse.rutgers.edu
Amy.Adair@gse.rutgers.edu

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Example Interview Questions

- How does **TIPS** facilitate the *timeliness* with which you can help your students with inquiry (compared to your usual method/Blotter)?

- How well does **TIPS** help you identify *which skills* individual students are having difficulties with (compared to your usual method/Blotter)? Please explain.

- How well does **TIPS** promote communication and collaboration with your students one-on-one (compared to your usual method/Blotter)? Please explain.

Results: RQ2 (continued)

- Example of teacher support when a student improved:
  - T: You're doing an experiment but you're not targeting your hypothesis **[Evaluative Comment]**, so what's your hypothesis? **[Orienting Scaffold]**...What is the only thing on here that you're going to change? **[Procedural Scaffold]**

- Example of teacher support when a student did not improve:
  - T: So that one should be loudness **[Instrumental Support].** Let's look **[Orienting Support]**... So your gonna change the speed of the wave and thats gonna effect the loudness **[Content Support; Instrumental Support]**

TIPS Development (continued)

1. Obtained 219 teacher-spoken segments from recorded conversations with the 2 middle school teachers from Study 1

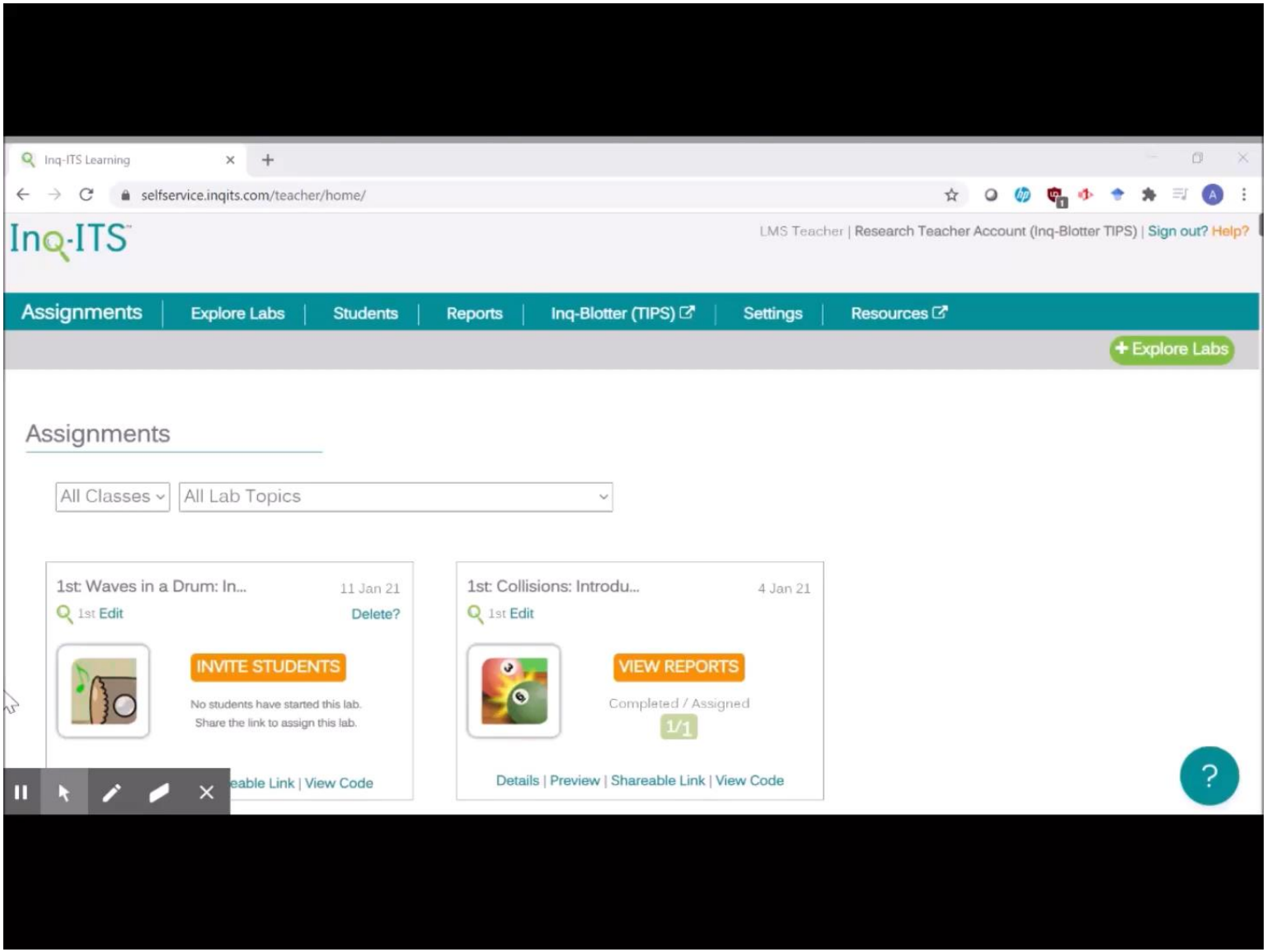
2. Coded segments for four categories of support (i.e., orienting, conceptual, instrumental, procedural)

3. Filtered segments for which students improved on the practice after receiving support from the teacher

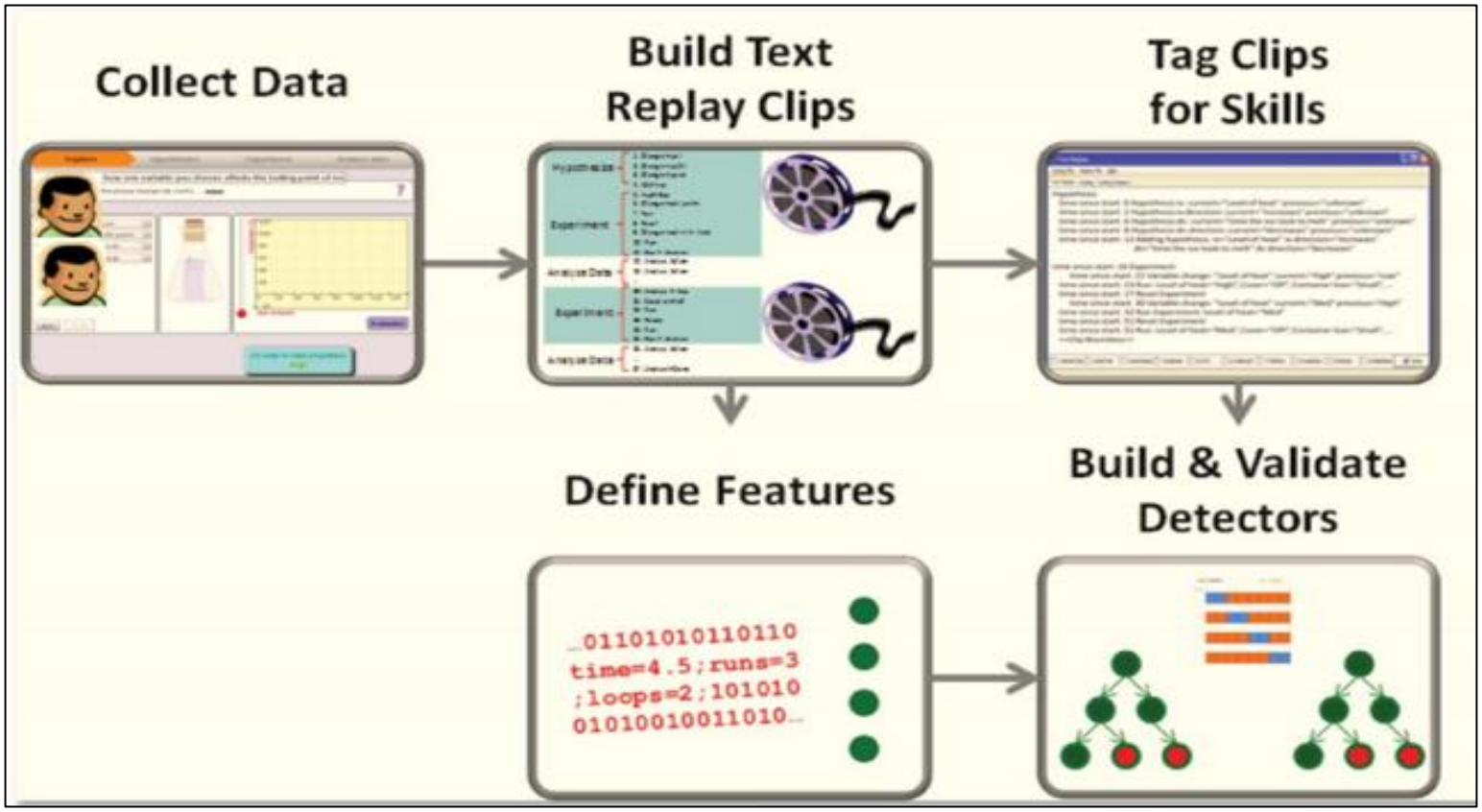
4. Constructed TIPS for each category of support based on filtered teacher segments

5. Embedded TIPS into the Inq-Blotter system

TIPS Walkthrough



Educational Data Mining – Text Replay Tagging



Gobert, Baker, & Sao Pedro, US Patent no. 9,373,082 (January 29, 2014)

Inquiry Practice Subcomponents

Inquiry Practice	Sub-Practice
Hypothesizing	Selecting target IV
	Selecting target DV
Collecting Data	Designing a controlled experiment
	Running a pair of controlled trials
	Testing the hypothesis
Interpreting Data	Identifying whether results support the initial hypothesis
	Examining the target IV
	Examining the target DV
	Interpreting the relationship between the IV and DV
Warranting Data	Selecting more than one trial
	Selecting controlled trials
	Selecting appropriate trials that show the relationship between the IV and DV
	Selecting trials that support the claim

Measures: Inq-Blotter Log Data

- Inq-ITS Log Data
  - Automated scoring of science practices (from 0-1 points)
- Inq-Blotter Log Data
  - Clickstream data of which students were helped, science practices helped, and timestamps
- Audio-Recordings
  - N = 35 recordings were captured and transcribed
  - Teacher turns coded by two raters for types of supports provided (i.e., science practices, content, evaluative, etc.)

(Gobert et al., 2013, 2018)

Teacher Discourse Codebook

Support Type	Definition	Example
Orienting Scaffold	Directing attention to a particular practice	"Let's look at analyzing your data… Let's look at your data"
Conceptual Scaffold	Definition/explanation of an inquiry practice	"The independent variable is what's manipulated. So what are you changing here?"
Procedural Scaffold	Information on the steps involved in an inquiry practice	"You always run a control[led trial] and you always run it more than one time. Why do you think you need to run it more than one time?"
Instrumental Scaffold	The exact actions to take to complete the inquiry practice	"It's saying to you that it didn't change…So you need to click 'no change'."
Content Comment	A statement regarding scientific domain-related content	"So that's saying, ya know, if you have a shorter string the wave speed will be faster, if you have a longer string it'll be faster."
Content Question	Asking the student about scientific domain-related content	"So you're gonna change the speed of the wave and that's gonna effect the loudness?"
Evaluative Comment	Statements regarding whether student work is correct or incorrect	"According to this you're struggling with your hypothesis."

(Dickler et al., 2018, 2019a, 2019b, in press)

Trends in dashboard use during remote learning, definitions, and examples.

	Trend	Definition	Example [Segment ID]
Effective Use of Dashboard Features	Identifying Student Difficulties (*N* = 18)	Teacher identifies and provides individual support to a student on an inquiry practice in response to a dashboard alert	T: I am seeing that you are probably having some trouble…graphing?...And you only have three data points…You must at the very minimum have 5 so you can actually see how the data points sort of line up…[52]
	Identifying Trends in Class Data (*N* = 12)	Teacher identifies a pattern across multiple students' inquiry performance based on dashboard	T: I see a whole bunch of them having troubl with the modeling because they don't hav enough data points to see the fit…Alright I'n gonna do some quick pops into the rooms jus to make that note to them… [28]
	Identifying Inactive Students (*N* = 7)	Teacher identifies students working on the wrong lab or not actively completing the lab based on dashboard	T: Flower growth?....Well I think one of my student groups is working on the flower lab instead of this [Ramp] one [18]
Limitations	Communication Limitations (*N* = 15)	Teacher identifies or experiences limitation related to modes of communication during dashboard use as result of being remote and lacking in-person contact	T: This would be so much easier if I could take a glance over their shoulder. It takes so much extra time to get them to share everything to take a look… [17]
	General Technical Challenges (*N* = 11)	Teacher identifies or experiences internet, computer, or meeting programs interfering with dashboard use	T: I don't understand, sometimes [the meeting] breakout room allows me to move them to main session and sometimes they don't… so I cannot help her…[67]

Results (RQ1)

- 80% (32/40) of students significantly improved on their next opportunity at the practice after receiving teacher help
  - Opportunity 1 (*M* = .50, *SD* = .21) improved to opportunity 2 (*M* = .82, *SD* = .27, *t*(39) = -5.119, *p* < .001)

Inquiry Practice	Number of Students who Improved
Hypothesizing/Forming Questions	15/17 (88%)
Collecting Data	3/6 (50%)
Analyzing Data	14/17 (82%)

- 80% (16/20) of students in both Mr. J's and Ms. F's class improved

Results (RQ1; Continued)

- Results of the repeated measures ANOVA revealed a significant main effect of the number of activities/opportunities, $F(2, 68) = 22.91$, $p < .001$, $\eta^2 = .40$.
  - This finding indicated that there were significant differences in student performance on inquiry practices between either the first, second, or third activities.
- Follow-up comparisons using paired-samples t-tests revealed that:
  - students significantly improved from their first opportunity ($M = .49$, $SD = .20$) to their second opportunity ($M = .83$, $SD = .24$), $t(34) = -5.56$, $p < .001$, $d = -.94$,
  - students also significantly improved from their first opportunity ($M = .49$, $SD = .20$) to their third opportunity ($M = .85$, $SD = .26$; $t(34) = -5.84$, $p < .001$, $d = -.99$)
  - there were no significant differences between students' performance on their second ($M = .83$, $SD = .24$) and third opportunities ($M = .85$, $SD = .26$; $t(34) = -.49$, $p = .63$, $d = -.08$

Results (RQ1; Continued)

- Results indicated that there was a marginally significant interaction between type of support students received and the number of activities completed, $F(2, 136) = 2.60$, $p = .078$, $\eta^2 = .04$ (with an alpha of .05).
  - Post hoc comparisons revealed that while student performance on activity 1 was the same across groups (as students were matched based on their performance on activity 1; $M = .49$, $SD = .20$), the students who were helped by a teacher in response to Inq-Blotter performed significantly higher on their second activity ($M = .83$, $SD = .24$) compared to students not helped ($M = .66$, $SD = .35$; $F(1, 68) = 5.60$, $p = .021$)
  - as well as marginally significantly higher on their third activity ($M = .85$, $SD = .26$) compared to students who were not helped ($M = .69$, $SD = .36$; $F(1, 68) = 4.70$, $p = .034$; with a corrected alpha of .025).
  - There was also a significant between subjects main effect of condition where students who received help ($M = .72$, $SD = .23$) performed significantly higher overall relative to students who did not receive help ($M = .62$, $SD = .29$; $F(1, 68) = 6.28$, $p = .015$, $\eta^2 = .09$).
  - A significant main effect was also found for task ($F(2, 136) = 26.89$, $p < .001$, $\eta^2 = .28$)

ENA for Activity 1 to Activity 3

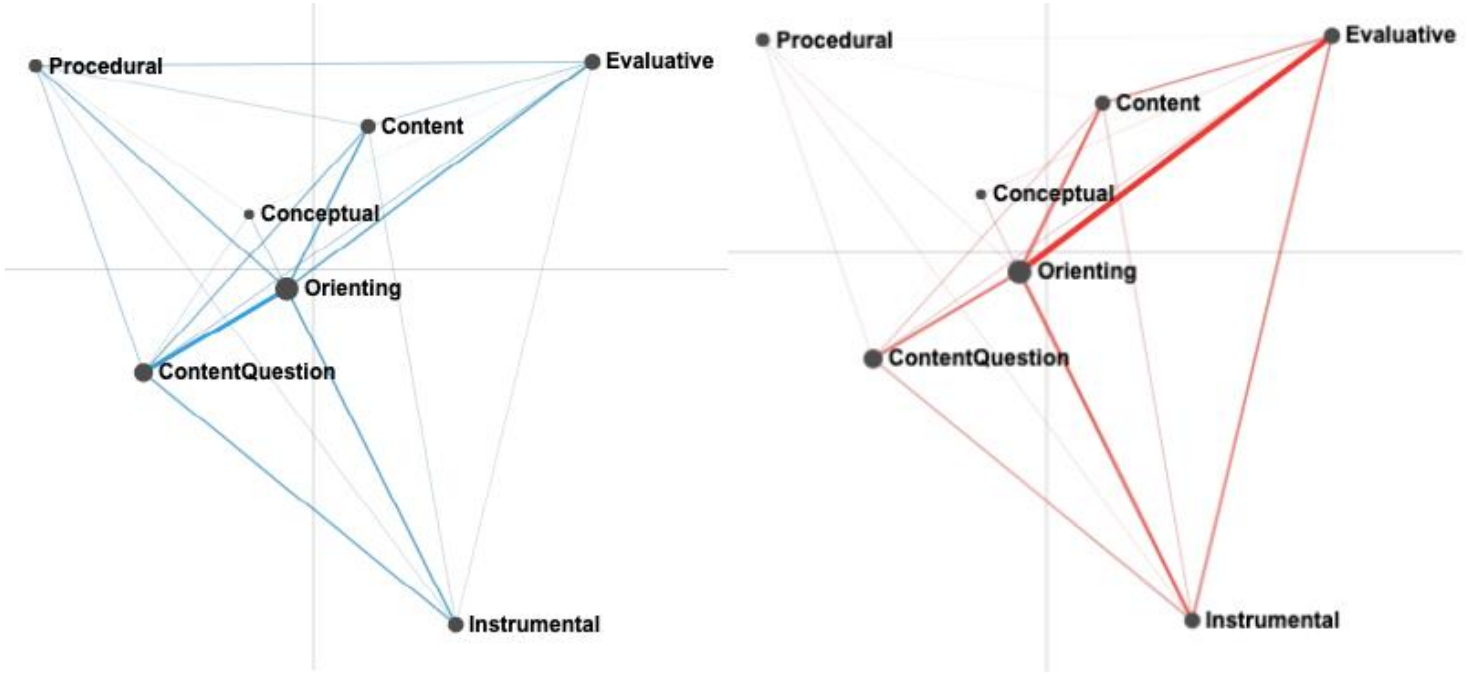


Figure 6. Networks for when students improved (blue; left) or did not improve (red; right) from the first to the third opportunity.

ENA for Activity 1 to Activity 3

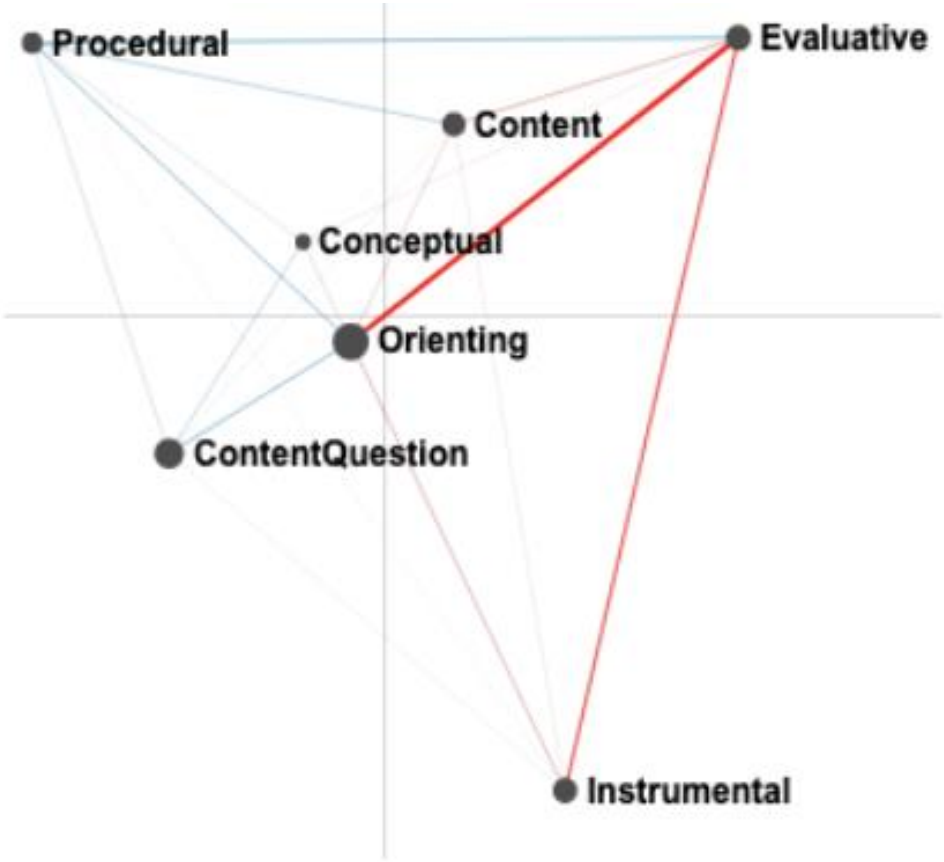
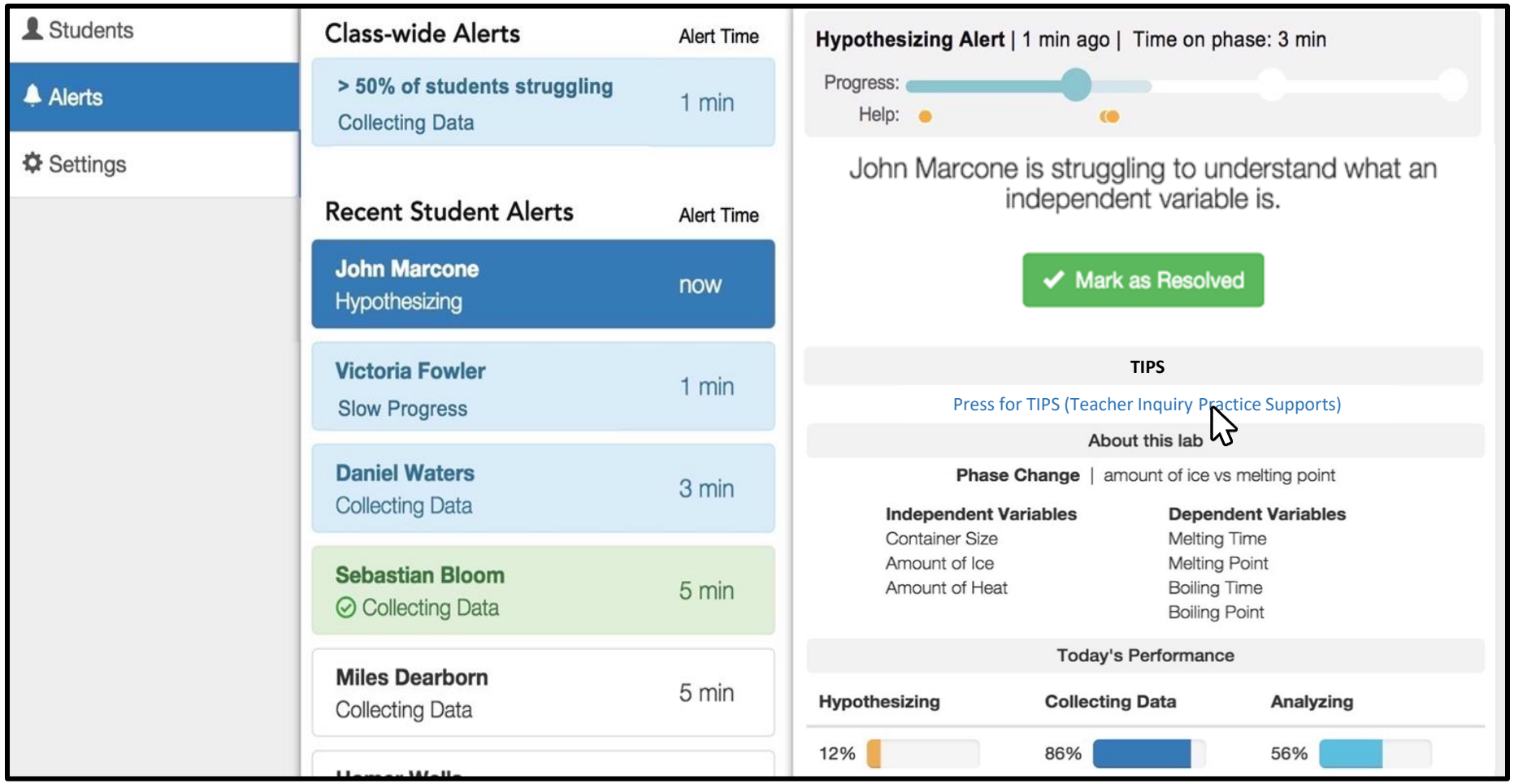


Figure 7. The subtracted network comparing when students improved (blue) or not (red) from the first to the third opportunity.

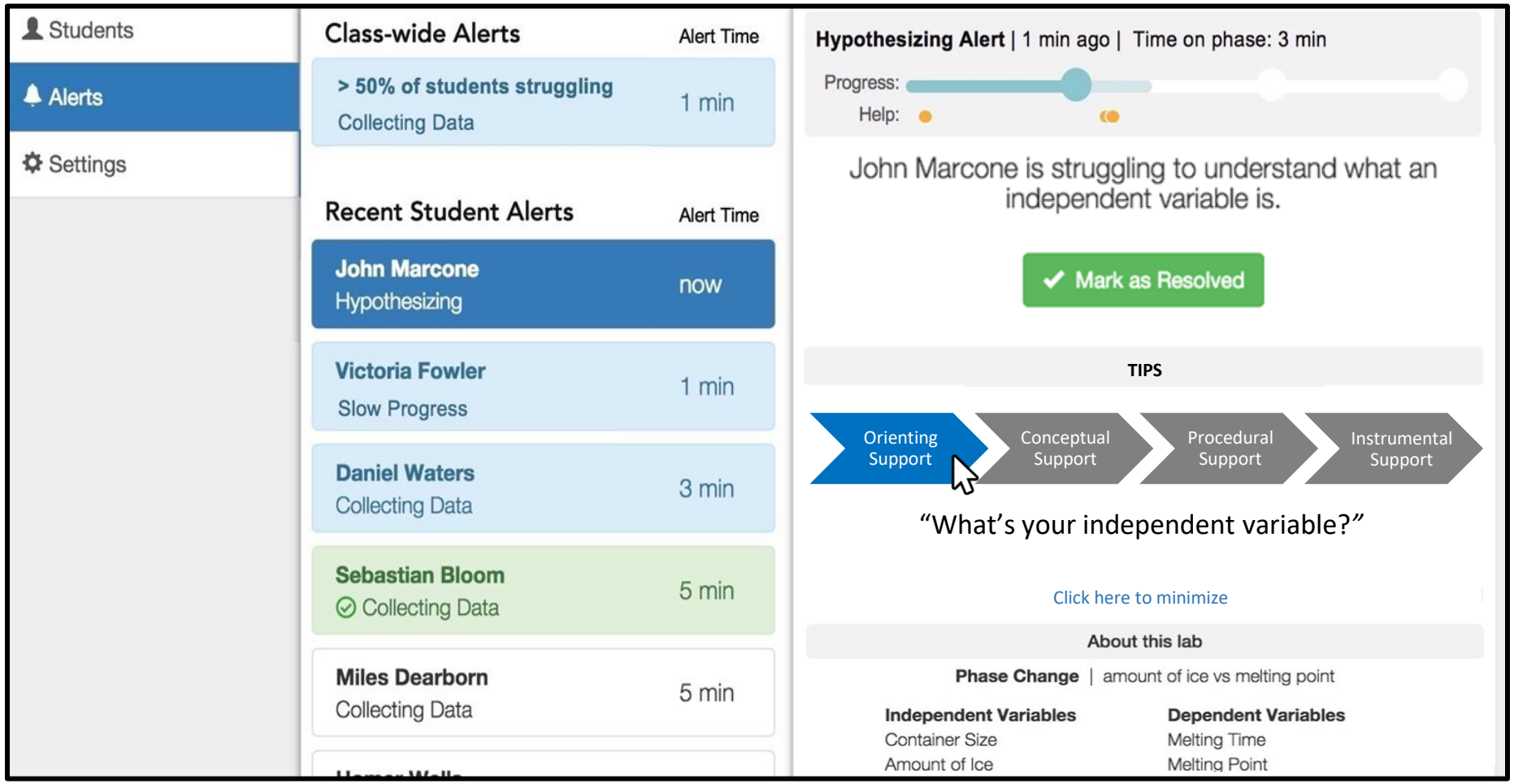
TIPS Walkthrough

The following slides include screenshots of the Inq-Blotter dashboard with the new TIPS:

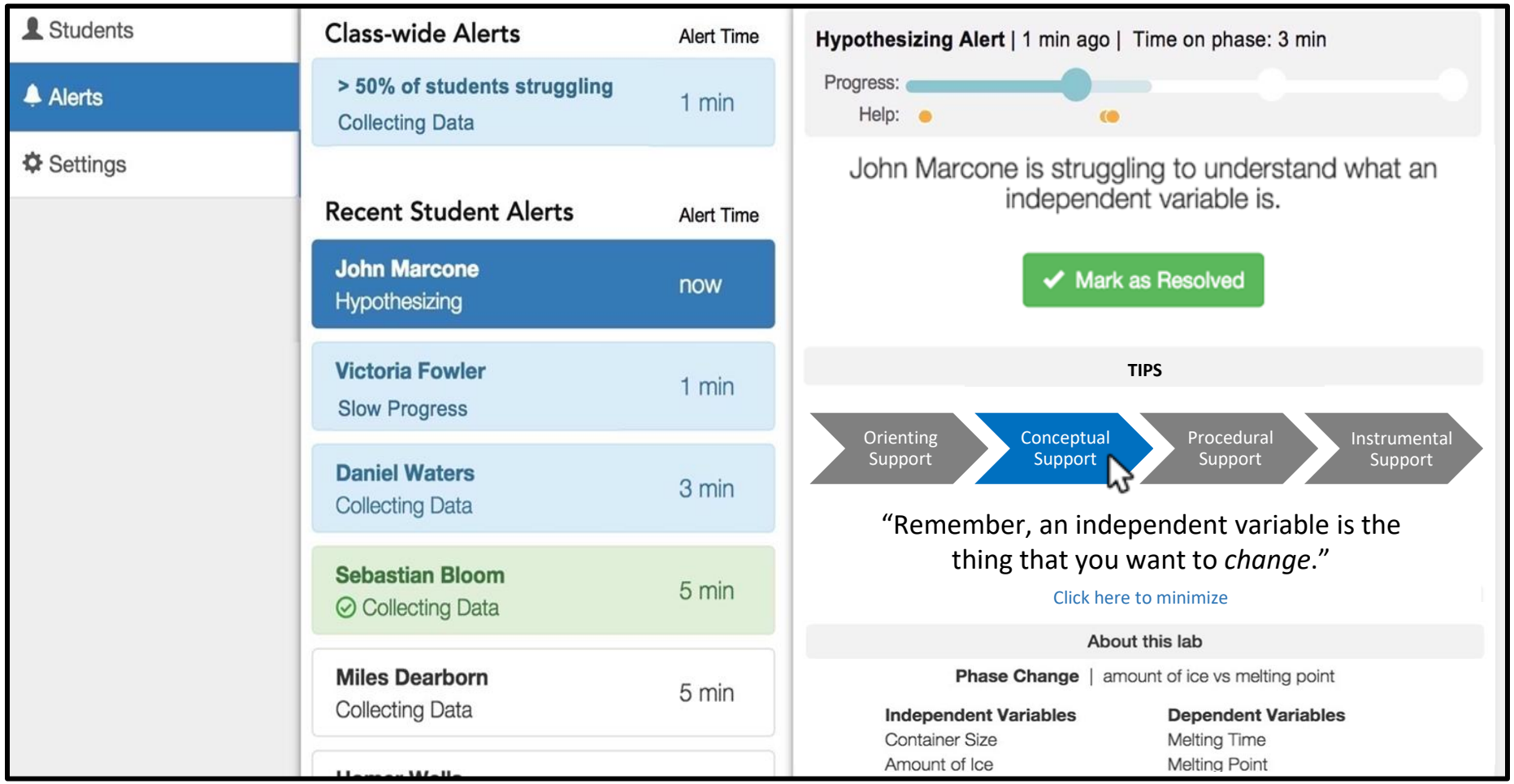
1. Teacher can select “Press for TIPS (Teacher Inquiry Practice Supports)” if she wants to access the prompts



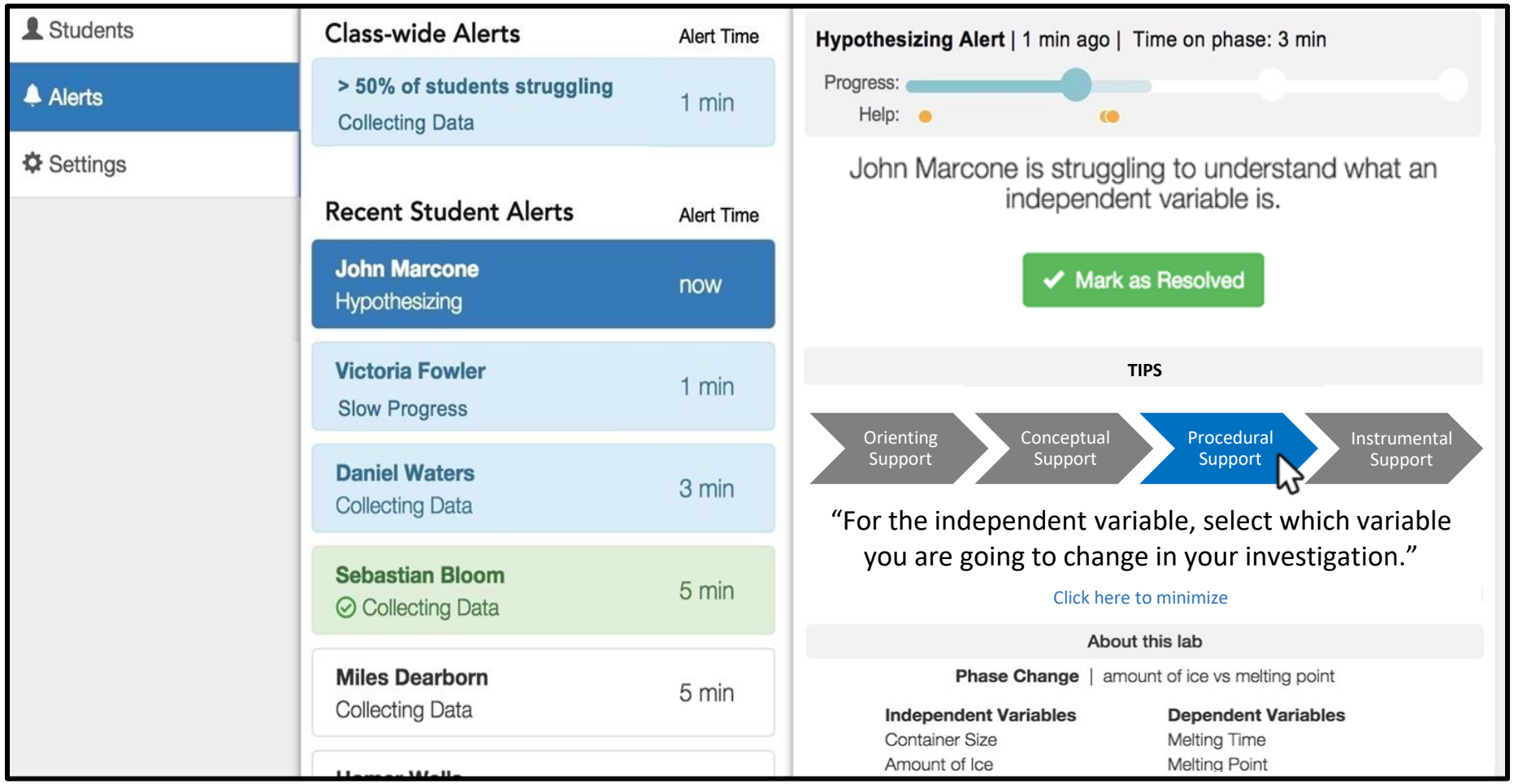
2. Teacher can look through questions and minimize when finished (or scroll to see other information below)



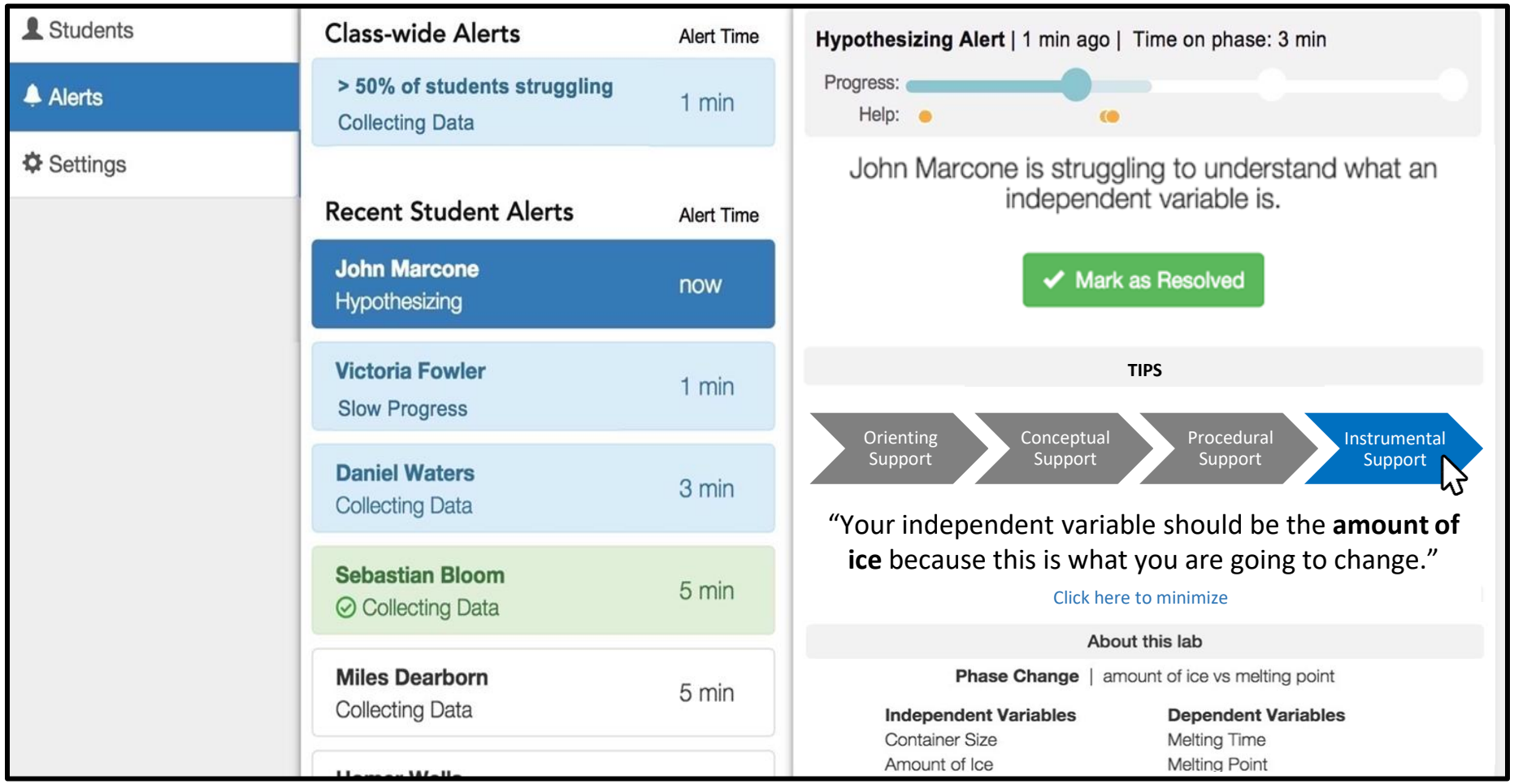
2. Teacher can look through questions and minimize when finished (or scroll to see other information below)



2. Teacher can look through questions and minimize when finished (or scroll to see other information below)



2. Teacher can look through questions and minimize when finished (or scroll to see other information below)



More Examples

- The next few slides have examples of TIPS for the different types of alerts that may appear

More Examples - Hypothesizing

Type of Alert	Alert Text
1. Untestable hypothesis	John has created a hypothesis that targets a dependent variable to be manipulated, and an independent variable to be measured. John may be struggling to understand the concept of a variable or what a hypothesis is.
2. IV false	John has created a hypothesis that targets a dependent variable to be manipulated, and may be struggling to understand what an independent variable is.
3. DV false	John has created a hypothesis that targets a independent variable to be measured, and may be struggling to understand what an dependent variable is.

More Examples - Hypothesizing (continued)

Type of Alert	Alert Text
4. Off Goal (IV & DV)	John has created a testable hypothesis, but the variables selected will not help them reach the goal of the assignment.
5. Off Goal (IV)	John has created a testable hypothesis, but the independent variable selected will not help them reach the Goal of the assignment.
6. Off Goal (DV)	John has created a testable hypothesis, but the dependent variable selected will not help them reach the Goal of the assignment.

More Examples - Collecting Data

Type of Alert	Alert Text
7. Single Trial	John has attempted to start analysis without enough data – either a single trial or no trials. John may be struggling to understand that analysis requires the comparison of multiple trials.
8. Confounded Trials	John is changing too many variables at once.
9. Not Targeting Hypothesis	John is conducting controlled experiments, but is not targeting their hypothesis. The independent variable John is manipulating is not the independent variable specified in the hypothesis.
10. Nominal or Not exploring the space	John ran a controlled experiment that targeted their hypothesis, but did not run controlled trials for all variables their hypothesis calls for.

More Examples - Analyzing Data

Type of Alert	Alert Text
11. IV & DV Incorrect	John has created a claim that has a dependent variable being manipulated, and an independent variable being measured. John may be struggling to understand the concept of a variable or what a claim is.
12. IV false	John claimed that an independent variable was being measured, and may be struggling to understand what an independent variable is
13. DV false	John claimed that a dependent variable was being manipulated, and may be struggling to understand what an dependent variable is.

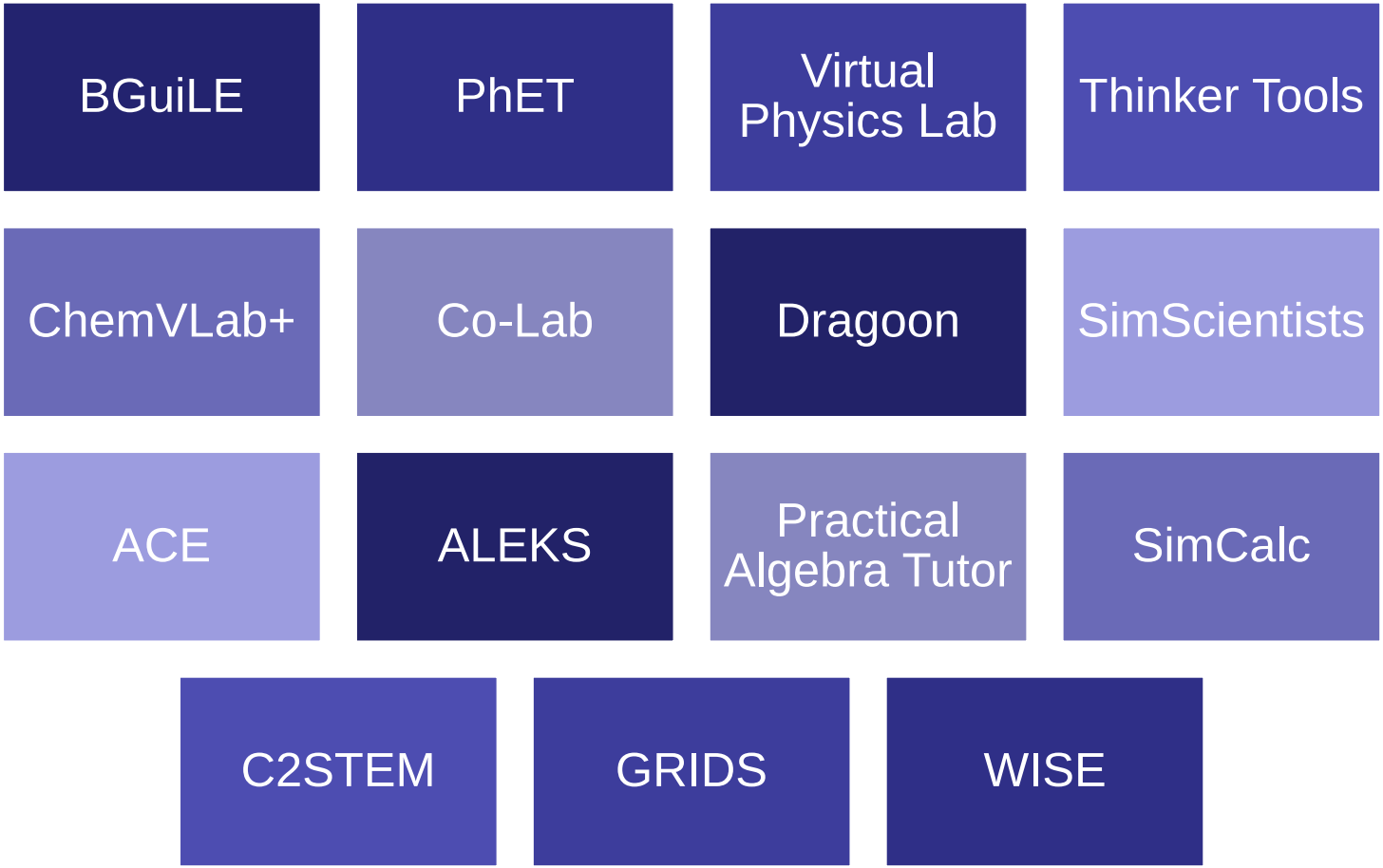
More Examples - Analyzing Data (continued)

Type of Alert	Alert Text
14. Based on the Claim IV, no valid claim can be made with the data collected	John has made a claim that cannot be warranted with the data collected. Either John has collected confounded data with respect to their claim, or has not varied the variable the claim targets.
15. Claim does not match trends in collected data	John has claimed a relationship between the independent variable and the dependent variable that is not shown in the data they collected.
16. Not enough trials selected as evidence	John has not selected enough trials to use as evidence of their claim. They may have selected only one trial, or not selected any trials.

More Examples - Analyzing Data (continued)

Type of Alert	Alert Text
17. Selected trials not control	John selected trials as evidence that are confounded. Students need to select controlled trials as evidence.
18. Wrong IV Controlled	The independent variable John has targeted when selecting evidence does not match the independent variable in the claim.
19. Selected trials do not support claim	The trials John has selected as evidence do not support their claim.
20. Student does not understand if their claim supports their hyp	When selecting if their claim supported their hypothesis, John did could not correctly identify if their claim supported their hypothesis or not.

STEM Student Technologies

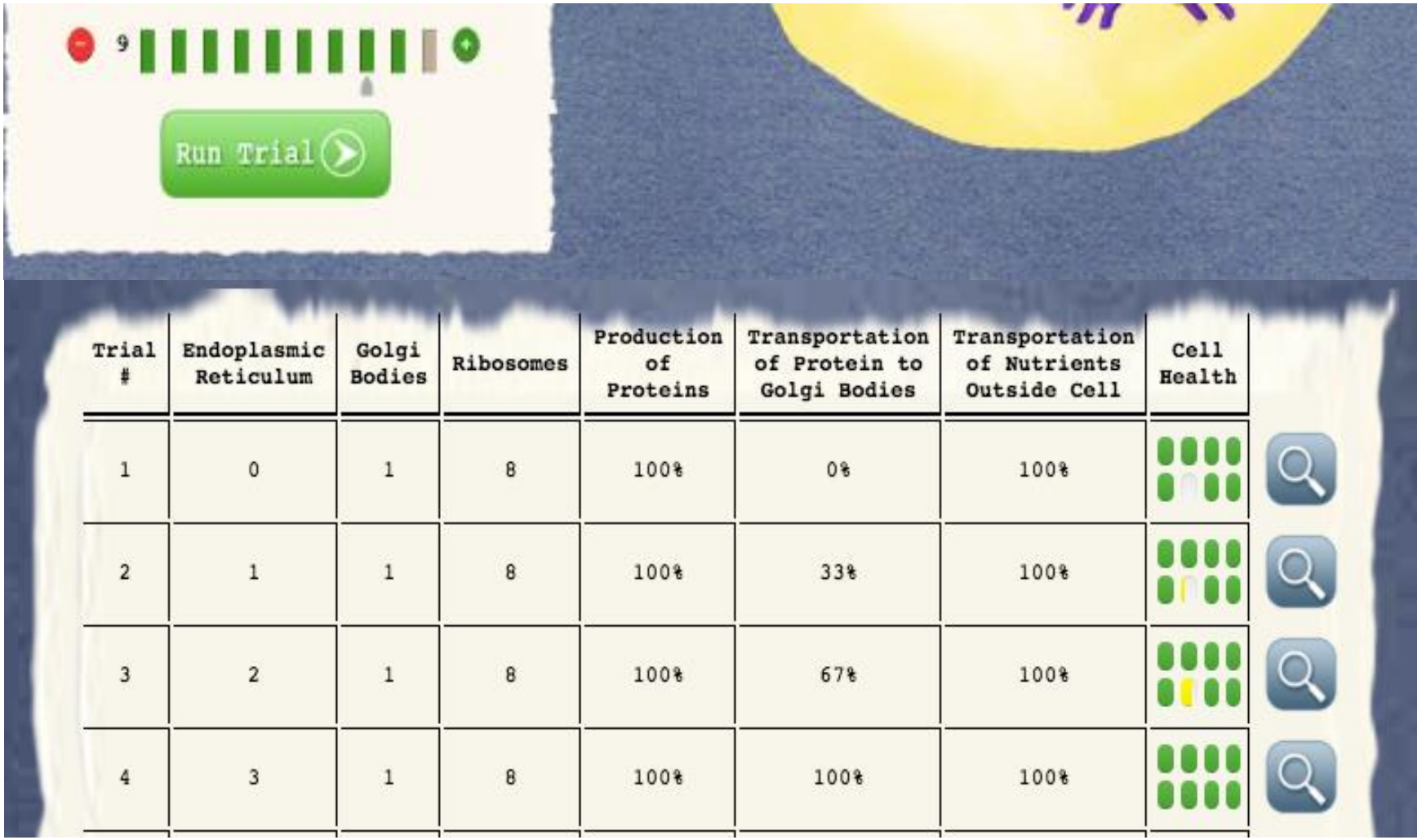


(Aleven et al., 2016; Conati et al., 2005; Corbett & Anderson, 1995; Craig et al., 2013; Davenport et al., 2018; de Jong et al., 2013; Darrah et al., 2014; Feng & Heffernan, 2007; Koedinger & Anderson, 1998; Koedinger et al., 1997; Lee et al., 2014; Lynch & Ghergulescu, 2017; Mokros & Tinker, 1987; Quellmalz et al., 2012; Tabak & Reiser, 2008; van Joolingen, 2005; VanLehn et al., 2016; Wieman et al., 2010; White & Frederiksen, 1998; Wilensky & Reisman, 2006)

Inq-ITS Animal Cell Virtual Lab

Asking Questions/Hypothesizing

Carrying out Investigations/Collecting Data



Trial #	Endoplasmic Reticulum	Golgi Bodies	Ribosomes	Production of Proteins	Transportation of Protein to Golgi Bodies	Transportation of Nutrients Outside Cell	Cell Health
1	0	1	8	100%	0%	100%	
2	1	1	8	100%	33%	100%	
3	2	1	8	100%	67%	100%	
4	3	1	8	100%	100%	100%	

Help from Rex

Analyzing and Interpreting Data

Evidence

These trials are evidence of my claim: 4, 5, 6,

Select	Trial #	Endoplasmic Reticulum	Golgi Bodies	Ribosomes	Production of Proteins	Transportation of Protein to Golgi Bodies	Transportation of Nutrients Outside Cell	Cell Health
☐	1	4	4	8	100%	133%	400%	
☐	2	4	1	5	63%	133%	100%	
☐	3	8	9	9	113%	267%	900%	
☑	4	8	9	9	113%	267%	900%	
☑	5	5	9	9	113%	167%	900%	
☑	6	2	9	9	113%	67%	900%	

Explaining Findings in Writing