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Board 360: Practicing Facilitating STEM Discussions: A Study on the Use of a Digital Simulation Tool for Teachers

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Marvez is a PhD student in the joint STEM Education and Cognitive Sciences program at Tufts University interested in games, language, and controversial discussions. In past research projects, they have worked on the development of virtual simulations for teachers to practice leading controversial discussions. They are interested in ways to prepare teachers to facilitate controversial debates with students in STEM classrooms, such as through simulations and games, on topics such as genetic modification, climate change, and public infrastructure. Marvez has also worked on the development of natural language processing models for assessment and personalized feedback in educational settings. At Tufts, Marvez works with McDonnell Family Assistant Professor Greses Pérez in the CEEO on the development of engineering board games for multilingual students in culturally relevant contexts.

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Camila Lee is an instructional designer and researcher at the Massachusetts Institute of Technology (MIT) Teaching Systems Lab (TSL). Her past research experiences with the Wellesley College Human-Computer Interaction Lab and the MIT Scheller Teacher Education Program have led her to design studies that seek to understand how to optimize learning with different model mediums such as immersive virtual reality. At the TSL, Camila works on projects that support teacher education through online learning experiences.

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Practicing Facilitating STEM Discussions: A study on the use of a digital simulation tool for teachers

Engineering requires complex, team-based problem-solving skills, and engineering education should reflect this needed expertise. However, teachers rarely get the opportunity to practice honing crucial skills such as facilitating and moderating discussions and may be fearful of bringing difficult or challenging debates into the classroom [1]. One way that pre-service STEM teachers can practice refining these skills is by engaging in digital teaching simulations [2]. Digital teaching simulations present realistic classroom scenarios to allow teachers to practice refining their skills in low-stakes settings [3]–[5].

Teacher Moments, a digital teaching simulation platform funded by two NSF grants in the Divisions of Research on Learning (# 2037983) and Computer and Information Science and Engineering (# 1917668), has been used to help teachers practice facilitating argument-based discussions and moderating design discussions. We present two research studies in which Teacher Moments has been used to help pre-service teachers practice facilitating argument-based discussions and provide an opportunity for teachers to practice facilitating a difficult discussion on the ethics of genetic engineering [6]. The Teacher Moments platform is accessible at https://teachermoments.mit.edu/.

First, Teacher Moments has been used to help pre-service math and science teachers practice facilitating argument-based discussions. In an on-going research study led by the Educational Testing Service (ETS), pre-service teachers are provided with an online practice suite of virtual reality, avatar-based, and Teacher Moments simulations. As pre-service teachers engage in realistic math and science classroom scenarios through Teacher Moments, they practice encouraging students to form arguments, discuss and critique their logic with peers, and communicate their reasoning. The platform also allows pre-service teachers to look back at their responses in context to reflect on their answers. Furthermore, the Teacher Moments simulation is being used to conduct 76 pre- and post-assessments to evaluate and measure the knowledge gained through the online practice suite of simulations.

In our second study, a branching simulation, much like a choose-your-own-adventure book, was designed in Teacher Moments in that participants took on the role of a high school science teacher facilitating a discussion about the ethics of genetic modification in humans [6]. In this simulation, called *Genetic Modification*, the participant interacts with students with strong opinions, who are violating established classroom norms on debate, who want to know the teacher's opinion on the topic, and students who are trying to bring misinformation into the discussion. The way that the participant chooses to respond to the students affects the flow of the conversation across these discussion issues. This style of simulation, in which participants' dialogue choices affect the flow of the narrative, is useful for modeling classrooms authentically and providing a high degree of participant choice. For instance, in the part of the discussion where the students demand to know the teacher's opinion, the participant can choose to deflect or share their opinion, both choices which have their own benefits and drawbacks when speaking with students on tense scientific issues [7], [8].

In *Genetic Modification*, we compared how participants (N = 42) across three experience level groups (no teaching experience, less than five years of teaching experience, and more than five years of teaching experience) changed in reported comfort with leading controversial discussions and how they interacted with the students during the discussion. In our pre- and post-comfort measure (1 - totally uncomfortable, 5 - totally comfortable), overall, participants' average self-reports of comfort increased from 2.95 to 3.95, and those with less than five years teaching experience reported the largest increase in comfort with facilitating difficult debates (pre-average = 2.5, SD = 1.07; post-average = 3.5, SD = .90). Expert teachers in the study reported high initial comfort values (average = 3.56) and slightly higher post-values (average = 3.67). This suggests that this style of simulation can be useful in helping novice teachers feel more comfortable in facilitating discussions and confident in their classroom debate skills through this kind of low-risk, high-conflict practice.

In regard to how participants facilitated the discussion, by analyzing participants' teacher-dialogue choices, we found that the participants with more years of teaching experience tended to use teacher-dialogue options that were more open-ended and more often gave control of the conversation over to students than those with fewer years of teaching experience. This suggests that this simulation was useful in detecting differences in discussion facilitation skills between participants with different levels of teaching experience, a distinction that could be useful for teacher educators and education professors who work with pre-service and novice teachers. Additionally, as this simulation is replayable, novice teachers can run through it many times to discover their new facilitation techniques. This simulation is available to play at https://teachermoments.mit.edu/run/fc5a028657/slide/0.

In these two studies, we show that the design in this teaching simulation platform can be used to train STEM teachers in the facilitation of classroom discussions and argument-based discussions between students. By immersing themselves in the Teacher Moments simulations, pre-service teachers were able to refine the skills needed to lead, facilitate, and moderate classroom discussions. Currently, Teacher Moments is used to teach discussion skills in several sites, including undergraduate teacher preparation lectures and community-based teacher preparation programs. As the next step in Teacher Moments, we are also developing natural language processing systems that allow participants to receive real time feedback based on their text or audio responses [9]–[11]. In our simulations on preparing teachers to facilitate argument based scientific reasoning, this type of system could be useful by providing personalized assistance to participants and for modeling more reactive and realistic types of student dialogue. In future work on these projects, we plan to continue to design increasingly authentic simulations of difficult moments of teaching to help pre-service and novice teachers prepare for the exciting challenges that await them in the classroom.

Sources

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