Iteration of Virtual Modules to Enhance Graduate Pedagogy in a High School STEM Program

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Introduction: Graduate students in engineering have few opportunities to learn about curricular and pedagogical concepts as well as put them into practice. Such opportunities to develop teaching mentorship skills would be particularly meaningful for graduate students who are interested in pursuing a teaching-focused career post-graduation. *Discovery* is a volunteer-based STEM educational initiative in which graduate students create and facilitate open-ended, inquiry-focused BME projects for high school science classes to perform iteratively in a university environment. Graduate students are involved in all aspects of the experience and act as either instructor-mentors to secondary school classes or as discipline leads who develop program content and oversee instructor-student interactions. We have previously shown the positive impact of *Discovery* on graduate student skill development through program engagement and, more recently, through the creation of pedagogy learning modules for volunteers to formally learn pedagogical concepts for application during their interactions with secondary students. While feedback for the modules was generally positive (e.g., appropriate quality and quantity of content, confidence incorporating learning into future teaching), graduate learners identified areas of improvement, including flexibility in time commitment required, lack of specificity to the *Discovery* context, and an overemphasis on theory compared to practical applications. Our aim in this work was to improve previously created pedagogy learning modules and evaluate the effectiveness towards improving graduate skill development, especially pertaining to teaching and mentorship.

Materials and Methods: Virtual training modules created for the online Spring 2022 offering of *Discovery* were updated based on graduate participant feedback and made available for graduate learners during the in-person Spring 2023 offering, specifically during weeks without in-person activity. The Canvas learning management system was retained for module access. Each module consisted of an asynchronous pre-recorded webinar and two interaction items (e.g., discussion boards) for collaborative engagement with other *Discovery* volunteers. One interaction item concentrated on practical *Discovery*-focused teaching while the other asked for personal and professional reflection related to learners' own teaching. Modules were centered around relevant topics, such as pedagogy and curriculum development, with the new program adopting an inquiry-based learning approach to model the teaching style expected of graduate mentors. These improved learning resources will be evaluated by 2 discipline leads and 14 instructor-mentors. After the program's conclusion in June 2023, we will evaluate the training resources through group structured interviews to assess (i) perceived impact on graduate learner professional development and (ii) perceived utility in improving the educational outcomes of secondary students participating in *Discovery*. Audio transcripts will be recorded and de-identified for qualitative analysis using NVivo. Inductive thematic analysis will be performed to identify common themes among participant responses, and graduate learner perceptions will be compared to those from Spring 2022. Participants will also be identified as (i) an instructor-mentor or discipline lead and (ii) a new or returning volunteer to discern differences in perception between these groups.

Results, Discussions, and Conclusions: We hypothesize that the improved learning modules will be perceived as useful for graduate trainees learning about teaching practices, particularly through their in-person interactions with secondary students. However, we appreciate that due to the volunteer-based nature of *Discovery*, there may be varying degrees of module uptake among graduate learners, depending on self-interest and the perceived amount of time invested versus required. Additionally, we anticipate that discipline leads will perceive more value in module completion compared to instructor-mentors due to their direct application in curriculum development for *Discovery*. Finally, we hypothesize that returning instructor-mentors may perceive more utility in module completion, as they may have a better understanding of how to apply pedagogical concepts to their interactions with students compared to new instructor-mentors without prior experience. We aim to verify these hypotheses and uncover other relevant insights from *Discovery* volunteers through structured group interviews, which will be used to further improve our pedagogy learning modules for graduate skill development. More broadly, a similar approach to educator learning could be applied to contexts outside of *Discovery*, such as graduate student training for teaching assistantships, pre-service student-teacher practicums, or faculty positions.