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TRAINING BIOMEDICAL SCIENCE GRADUATE STUDENT TEACHING ASSISTANTS IN TEACHING, LEARNING, AND PROFESSOR SUPPORT

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Teaching skills are widely applicable and particularly useful for many graduate students in science, technology, engineering, and mathematics (STEM) disciplines who intend to become academic faculty. However, these students often receive little to no pedagogical training during their graduate education. This article describes the process of designing an in-depth, teaching-focused workshop that increased the self-efficacy of graduate students while accommodating their busy irregular schedules. The hybrid workshop includes both synchronous and asynchronous activities focusing on teaching and learning theory (e.g., learner-centered teaching, goal setting, lecturing, feedback, metacognition) and professor support (e.g., Canvas and Zoom management, classroom technologies). Participating students completed pre- and post-questionnaires that included a knowledge quiz and captured their perceptions of the workshop. The workshop designers then used the student responses and feedback to improve the design of future workshop iterations to better accommodate the needs of the graduate students. A total of 34 students attended the workshop. Students found the workshop to be helpful overall. They engaged in meaningful discussions about teaching and learning, learned new information about teaching and learning, and would strongly recommend this training to other graduate students. Many stated that they would likely implement what they learned into their own teaching and mentoring. As such, the designers believe that this teaching-focused workshop has the potential to provide our graduate students with a much-needed foundation in teaching and learning without significantly detracting from their other responsibilities.

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INTRODUCTION AND CONTEXT

Many biomedical graduate students receive little to no formal training in pedagogy, as their education often prioritizes research productivity over teaching development. (Vergara et al., 2014). To avoid this deficiency, a foundation in pedagogical theory and practice should be provided to graduate students during their education, when they have a degree of protected time for academic and professional development. Implementation of such teaching training programs increases research self-efficacy, improves communication of their scientific research at various levels, and enhances time management in both research and teaching responsibilities (Gormally et al., 2011; Shortlidge & Eddy, 2018;). Although this problem in graduate education originates at the institutional level, these teaching-focused programs can mitigate the consequences, motivating the authors to create such a program that supports graduate students in their specific institutional context.

The Indiana Biomedical Gateway Program at Indiana University School of Medicine

In 2007, Indiana University School of Medicine (IUSM) created the Indiana BioMedical Gateway (IBMG) Program to provide a common first-year curriculum for students pursuing a PhD in any of the basic science departments at IUSM. This rigorous and time-intensive first-year curriculum includes multiple foundational courses on molecular and cellular biology, pharmacology, immunology, toxicology, physiology, genetics, neuroscience, and research methodologies. During this period, students also rotate through multiple faculty laboratories to explore research areas and help them identify a specific research mentor with whom they will complete their doctoral thesis. Once students complete their first year, their academic schedules become less standardized but remain incredibly busy. In the remainder of their doctoral education, students must complete additional coursework specific to their research area, a 12-unit doctoral minor, a qualifying exam, a dissertation proposal and defense, research grant applications, and laboratory research and writing of their doctoral theses. Besides these requirements, students often engage in extracurricular activities such as presenting at scientific conferences and seminars, supporting science advocacy and public outreach, and various research side projects.

Although doctoral students develop a strong foundation in biomedical sciences and research methodologies through the IBMG program, they have few opportunities to improve their knowledge and skills related to teaching. The core IBMG curriculum does not include coursework related to pedagogical theory or practice, nor does it require students to serve as teaching assistants to earn their stipend. This curriculum design allows students to prioritize their laboratory experiments and maintain adequate progress on their theses. However, if a student has an interest in developing their teaching skills or gaining teaching experience, they must independently seek out teaching assistantships or one-off opportunities to provide lectures, lab instruction, or office hours, of which there are few. Even if students succeed in identifying teaching opportunities, they may not receive the necessary guidance and support to succeed in those roles. Moreover, these activities are often in addition to the already heavy workload of the students. As a result, many IBMG students refrain from taking on these teaching opportunities, thereby limiting their development of these valuable skills.

PROJECT MOTIVATION

This project stemmed from the lead author's personal experience in the IBMG program and interest in teaching. The lead author wanted to serve in a teaching assistant position to gain teaching experience but found few opportunities available. As an IBMG first-year student, the lead author went to a TA's office hours and asked the TA how to study for the course. When the TA responded with "That's a great question, I'm not sure", the lead author saw an unmet need for training teaching assistants within the IBMG program in skills related to teaching and learning and professor support. The lead author's prior experience as an undergraduate teaching assistant and supplemental instructor sparked a passion for improving the quality of teaching and learning in higher education. Upon joining the Anatomy, Cell Biology, & Physiology department in the second year of the IBMG PhD program, the lead author made valuable connections with mentors and other students within the Education Track program to help design this training.

As doctoral students in the Education Track of the IUSM Anatomy, Cell Biology, & Physiology PhD Program, the second and third authors also had a vested interest in improving the quality of education offered for and by graduate students at IUSM. Collectively, the authors shared a passion for teaching and considered it to be an essential skill for graduate students. Therefore, the authors designed and piloted a teaching training program to support the pedagogical development of graduate students at their institution.

DESIGN PROCESS

Needs Assessment

To understand current student feelings regarding teaching assistant positions and teaching training, the authors administered a brief survey on teaching assistant experiences to biomedical science graduate students at IUSM who served as teaching assistants. Three students indicated that they knew of teaching training available through the Indiana University Indianapolis (IUI) Center for Teaching and Learning. However, two of the three students did not take advantage of this training. The results of this survey showed

that the students valued their teaching experiences but wanted more training. One of the TAs said, "Honestly, the TA experience itself wasn't all that helpful. It was the way to open doors, both in making connections as well as giving me 'experience' on my CV so others would be willing to have me help." This indicated that the TA-ship helped as a CV-building experience, and some students found the experience helpful for making connections to find more teaching opportunities. However, the TA-ships offered did not help with gaining experience in informal teaching or learning teaching techniques and strategies. Based on this survey and from informal interviews with various graduate students, the authors decided that implementing biomedical science PhD student-specific teaching training would greatly benefit graduate student teaching assistants, their learners, and professors who have teaching assistants in their classrooms.

SELECTING GOALS AND TOPICS

Designing a workshop to train graduate student teaching assistants, the lead author (E.S.) began with a list of important topics based on her own experience as an IUSM teaching assistant. In collaboration with a curriculum design expert and the Director of Trainee Services, the lead author (E.S.) discussed how to design a workshop aligned with the goals of both students and professors at IUSM. Due to disagreements between professors on the role of a teaching assistant in their classroom, the lead author began by discussing various roles of a teaching assistant with the curriculum expert and the Director of Trainee Services. These conversations resulted in the previously mentioned survey given to current and past graduate teaching assistants at IUSM. The reported roles of a teaching assistant included administrative assistant, student support, peer tutor, technology support, and guest lecturer. Based on the survey, most teaching assistants described their roles as "administrative assistants" and defined this as helping professors primarily with the learning management system (LMS) Canvas, recording lectures, and grading. In the student support category, most teaching assistants reported hosting office hours and helping with homework. Teaching assistants reported that the roles of administrative assistant, student support, and technology support were the most important for helping professors, whereas student support and peer tutor were their most important roles for helping students. The teaching assistants shared what they learned from being teaching assistants. One teaching assistant said, "Most students don't want a TA or don't trust one. Most students don't ask questions or seek advice, and they end up making totally preventable mistakes on exams and homework." Another teaching assistant mentioned, "Honestly, the TA experience itself wasn't all that helpful. It was the way to open doors, both in making connections as well as giving me 'experience' on my CV so others would be willing to have me help." These responses suggest that teaching assistants viewed their experiences as beneficial, but potentially frustrating.

The authors also administered a survey to current biomedical graduate students at IUSM to gather information on how students view the role of the teaching assistant in their classroom, how often they attend office hours, and whether getting help from the teaching assistant affected their performance in the course. According to the survey, many students view the role of the teaching assistants as an "administrative assistant" and as "student support". However, few students reported attending the office hours offered by the teaching assistant. This indicated that the current role of the teaching assistant did not help either students serving as teaching assistants or those being taught by teaching assistants.

Based on the results of the survey, all five of the described roles for a teaching assistant were included in the training. The lead author began by developing a training program proposal based on previous experience from a supplemental instruction program at The University of Alabama in Huntsville. The program focused on training teaching assistants for a hybrid role between supporting the professor through activities like grading, proctoring, and helping with technology and teaching and learning strategies that a supplemental instructor would use (Doubleday & Townsend, 2018).

Based on feedback from the proposal, the lead author designed the workshop to implement topics from two categories: "professor support" and "teaching and learning". The goals and objectives in each of these categories followed Bloom's taxonomy (Krathwohl, 2002) and are outlined in the list below:

- *Goals: Professor Support*
    - Be able to use Speedgrader, modules, and assignments to help set up a Canvas page.
    - Be able to effectively set up a Zoom meeting, create breakout rooms, and troubleshoot.
    - Describe three different technology tools that facilitate learning and embed them in Canvas.
    - Explain how to effectively facilitate in-person and online discussions.

- *Goals: Teaching and Learning*
    - Describe how to set goals for an office hour or lecture.
    - Provide examples of effective questioning techniques.
    - Explain active learning and what techniques to use to encourage it.
    - Explain the importance of independent learning.
    - Describe various study strategies.

Based on these goals, the lead author and the curriculum expert, and the Director of Trainee Services decided to include other collaborators to design and help with the

development activities. For the development of the activities, E.S. and A.C. worked together with the help of the Director of the Anatomy, Cell Biology, & Physiology Education Track PhD program, the Vice Chair for Professional Development, and the curriculum expert and Director of Trainee Services. The authors designed activities to be both asynchronous and synchronous. E.S. and A.C. decided on a flipped classroom model to deliver lecture content regarding the various learning objectives asynchronously and then to have students demonstrate their knowledge and practice new skills synchronously. Due to the COVID-19 pandemic, Zoom served as the primary platform for the training. Activities leveraged the entirely virtual environment, using the various features of Canvas, Zoom, and a variety of other technology tools. All activities modeled each of the previously described learning objectives.

Asynchronous Activities

To provide the biomedical graduate students with a degree of flexibility in completing the training, the authors developed several online, asynchronous activities. These activities consisted of lecture-type videos with active learning components and student engagement activities. Students completed pre-work activities to introduce themselves to each other, learn material prior to meeting as a group, and to assess themselves prior to learning any of the material. Each asynchronous activity introduced students to a new topic. Students also had the opportunity to use VoiceThread, a useful tool for a classroom setting, to meet other students participating in the workshop. Thus, activities provided students with information, allowed them to demonstrate what they learned, and gave them the opportunity to practice using the tools.

Before creating a VoiceThread, students completed a pre-quiz on Canvas that assessed what they already knew about teaching, learning, and professor support. The quiz consisted of ten free-response questions that reflected the learning objectives for the course. Following the synchronous portion of the workshop, participants completed a similar post-quiz to assess what they had learned and whether their understanding of the described topics had improved.

Following the completion of the pre-quiz, students watched five videos covering the following topics: learner-centered teaching, learning strategies, effective teaching structure, using Canvas, and using Zoom. E.S., A.C., Vice Chair for Professional Development, and Director of the Anatomy, Cell Biology, & Physiology Education Track PhD program, developed a series of videos for the workshop. Each video lasted 15 minutes or less in length and included two to three self-quiz questions that allowed students to test their understanding following the video.

Next, students participated in two Canvas discussion boards. The two discussion boards covered the topics of wait time and comfortable learning environments. This activity taught students information about teaching and learning, and also taught students how to use a Canvas discussion board. This activity also encouraged students to interact with one another prior to meeting as a whole group, promoting student engagement and discussion prior to synchronous work.

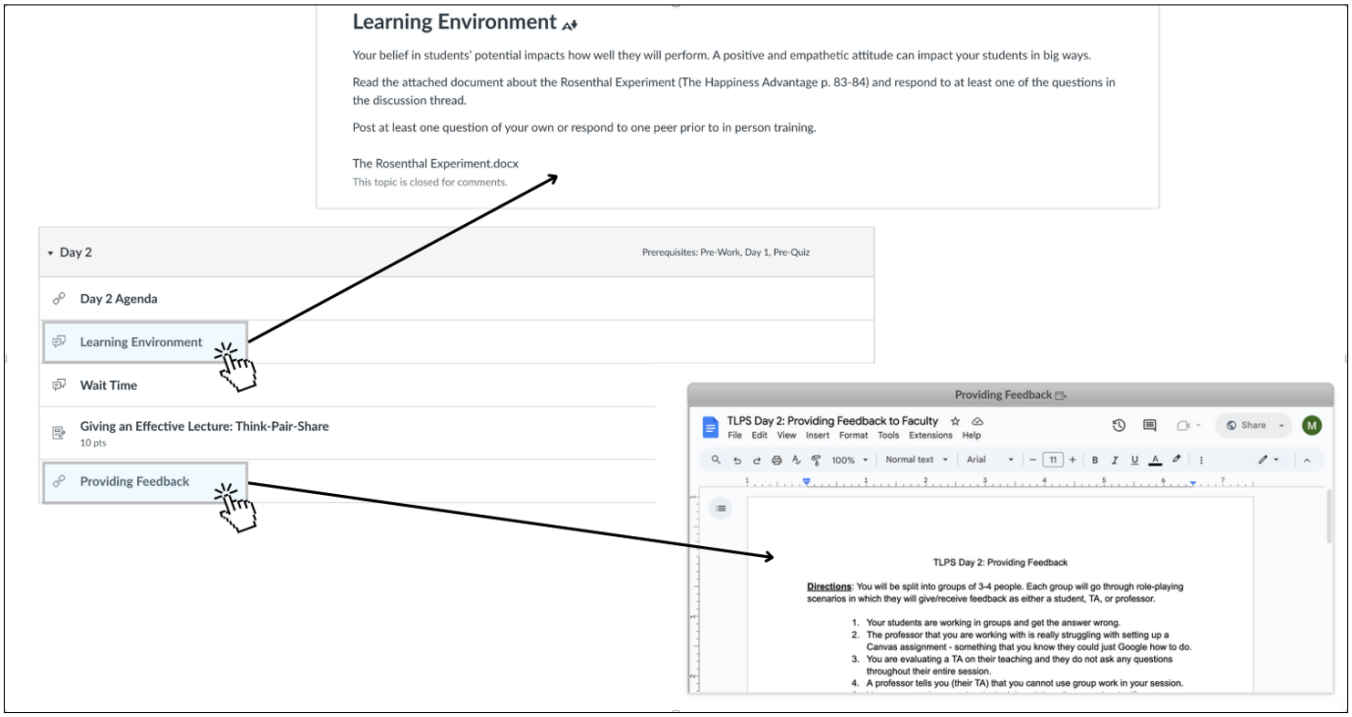

FIGURE 1. Snapshot from the Teaching, Learning, and Professor Support Canvas page.

Synchronous Activities

In addition to the asynchronous activities, the training also included several synchronous activities that allowed participants to reinforce their skills and learn from the experiences of the group. Synchronous activities spanned two days, with instruction and discussion for four hours each day. The first day consisted of discussions and activities demonstrating what students had learned from the prework. Initially, the facilitators (E.S. and A.C.) primarily led the activities. A snapshot of how the Canvas page for the course materials is set up can be seen in Figure 1. The second day consisted mainly of student-led activities, including doing a teaching demonstration. This progression allowed students to gain more independence and demonstrate their skills as the workshop went on. In addition to a primary activity where students learned and practiced information regarding teaching and learning, students would also help with Zoom or Canvas for each activity. For example, if an activity required breakout rooms in Zoom, a facilitator would delegate this task to a student and ask them to make the breakout rooms. Each activity involved the practice of both teaching and learning skills and professor support skills.

Many of the synchronous activities were adapted from the Peer Assisted Study Sessions (PASS) training from the University of Alabama in Huntsville Student Success Center. This is a supplemental instruction training program that E.S. participated in as an undergraduate PASS leader and also developed as a mentor for the program as a senior PASS leader and mentor. Activities were adapted from an in-person format to suit a virtual learning environment. To make the activities suitable for a graduate teaching assistant course, the activities modeled the structure taught in the asynchronous pre-work - to have a beginning, middle, and end. This design models how to design a lecture, an office hour, or a discussion - all of which are settings that a graduate student teaching assistant could be expected to teach in. Each activity also had learning objectives, encouraged student participation and active learning, and checked for student understanding. The first synchronous activity served as an introduction to the workshop; facilitators introduced themselves and the objectives for the program. They also described the logistics for the day so students knew the amount of expected participation, even with the online format.

Learner Centered Teaching

The first session involved learner-centered teaching and began with a discussion on what learner- centered teaching is. Students then used Zoom reactions to respond to whether they could define learner centered teaching, and then the facilitator for this session led a large group discussion regarding whether we see learner centered teaching in our classrooms. Then, students participated in an activity called "Count the Vowels". The facilitators provided students with a list of words to study with no context and asked them to count the vowels. Following this, the facilitators hid the list and asked students to write down as many words as they could remember from the list. Afterwards, the students looked at the list again and searched for the underlying organizing principle for the words. The facilitators then hid the list again and asked the students to write down all the words that they could remember. This activity allows students to see the difference between being aware of the goal before doing an activity and connecting information rather than simply memorizing it. This activity served as an introduction to multiple different aspects of learner- centered teaching and connected with many of the different objectives for the workshop. Students touched on goal setting, encouraging independent learning, and the importance of being specific about student expectations when it comes to teaching. This activity transitioned well into the next activity regarding goal setting.

Goal Setting

The opening for this session gave students one minute to write down three goals for the subject they are a teaching assistant for or one that they would like to be a teaching assistant for. Then, students shared their goals, and the whole group evaluated whether the goals were "strong" or "weak". Afterwards, the facilitator discussed Bloom's taxonomy, which was addressed in the asynchronous pre-work. The facilitator gave a brief introduction on what makes a strong goal and why goals and learning objectives are important for teaching. Then the main activity involved students working in groups of 3-4 to categorize written learning objectives/ goals into strong and weak groups. To close the activity, students re-evaluated the goals they wrote at the beginning of the activity and revised them to make them stronger.

Learning Strategies

The opening for this session involved a discussion of essential skills for session strategies. The facilitator for this session asked students which of the following topics they could remember from the asynchronous work: questioning, checking for understanding, and scaffolding. Then the facilitator gave a short summary presentation of these skills. They asked students to use Padlet and the Zoom chat to answer various questions regarding these topics. The use of Padlet introduced another technology tool for students to use in their own teaching. These methods of encouraging student discussion also kept students engaged while the facilitator presented information. The main activity for this session involved the categorization of various learning strategies. Learning strategy cards from the University of Alabama in Huntsville Student Success Center. These strategies were all various activities that can be used in study sessions, office hours, or during lectures, such as "Think-Pair-Share", "One Minute Paper", and "First Line Only". Students sorted

the strategies into the following categories: collaborative learning techniques, study techniques, quizzing/recall, organizational/visual, problem-solving strategies, and helpful tips. Students worked in Zoom breakout rooms in groups of 3-4 and wrote their categorizations on Google Jamboard. Each group discussed with one another and then with the whole group. This allowed students to be exposed to many different learning strategies and had them think about and discuss when to use these learning strategies. Following this activity, students would also work in their groups to discuss four different strategies, explain how and when they would use that strategy, and then they would act out their strategies to explain them to the whole group. To conclude the session, each student wrote down three strategies they wanted to try in their own teaching and explained why during a whole-group discussion.

Collaboration/Facilitation

This activity opened with a discussion of the best practices for facilitation and collaborative learning. The facilitator for this session intentionally used ineffective practices for facilitating a discussion, including a lack of wait time, a lack of follow-up questions, and did not provide any time for students to think or discuss independently prior to the whole group discussion. Students then discussed why the first discussion failed and what strategies they could use to facilitate discussions effectively. The facilitator then used a short presentation to remind students of a few more effective strategies for encouraging participation during class. For the main activity, students revisited the discussion boards they completed as a part of their asynchronous pre-work. In groups, students lead effective discussions using the pre-work discussion boards and the strategies they had just learned. Then, students created a new discussion board and facilitated a new discussion. This activity allowed students to practice facilitation and collaboration on multiple different levels. Students practiced using pre-existing discussion boards, created a discussion board and facilitated a discussion this way, and also got the chance to lead a discussion in a small group and a whole group setting. As a closing activity, students created a new discussion board about takeaways from today and responded to the discussion board, which modeled a good closing activity to use in their own classrooms and taught them how to create and use a discussion board on Canvas.

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Planning Teaching Sessions

Initially, a Zoom poll asked students to consider what they viewed as the most important part of a teaching session. This opinion question linked back to the effective lecture structure video from the asynchronous pre-work. Then, students had a whole group discussion on the importance of each part of a teaching session. Following this, students were assigned to Zoom breakout rooms and had to work on creating a structured session plan for either an office hour, a lecture, or another type of teaching session. Students created their plans using the beginning, middle, and end format discussed in the asynchronous pre-work and the introduction to this activity. Students used Google Docs and left comments on each other's plans to provide feedback. This allowed students to learn how to use Google Docs for their own teaching sessions and helped students give each other feedback on their plans. To close this session, the facilitator asked students to re-evaluate the parts of a teaching session they considered important. The facilitator also led a discussion regarding the most challenging parts of a session and how to plan for different types of sessions.

To close the first day of the workshop, facilitators asked students to do a one-minute paper and describe what they had learned during the first day. Then, we had students use Mentimeter (another online tool they could use in their own future teaching sessions) to ask any questions about what they learned. Afterwards, the facilitators debriefed with the students about what they had learned and answered any remaining questions.

As the first day of synchronous activities progressed, the students became more independent from the facilitators. This design of the synchronous activities allowed students to demonstrate their understanding of the content presented. In addition, the students had an opportunity to practice the skills that they learned. The second day followed this trend and continued to have students primarily lead the activities.

Practice Teaching Sessions

The second day of the workshop opened with practice teaching sessions. Students were grouped into breakout rooms with 3-4 students per group. Each student gave a five-minute teaching presentation that had objectives and followed the beginning, middle, and end format. Following the presentation, the other students in the group gave feedback to each student, listing one thing they did well and one thing they could improve on. When all students finished presenting, the whole group discussed the challenges

and benefits of the practice teaching sessions. Students discussed how they would use what they learned to develop teaching sessions in the future.

Difficult Scenarios

For this session, students first answered a Zoom poll about whether they had ever encountered an uncomfortable situation in a classroom as a teaching assistant or a student, or whether they had had a challenging student before. Following a debrief of this poll and a short discussion where students shared their experiences, students were placed into breakout rooms in Zoom with 3-4 people. They then reviewed a list of challenging scenarios that could happen in a classroom and discussed how they would address each situation. Facilitators visited breakout rooms to answer questions and ask follow-up questions. For a closing activity, students had a whole-group discussion about scenarios that they considered particularly challenging.

Providing Feedback

For this session, students first shared their past experiences with giving and receiving feedback. Students were then placed in breakout rooms of three and went through role-playing scenarios, in which they gave/received feedback as either a TA, student, or professor. The scenarios are listed below:

- *Roleplaying Scenarios*
  - Your students are working in groups and get the answer wrong.
  - The professor that you are working with is really struggling with setting up a Canvas assignment - something that you know they could just Google how to do.
  - You are evaluating a TA on their teaching, and they do not ask any questions throughout their entire session.
  - A professor tells you (their TA) that you cannot use group work in your session.

Following the role-playing activity, students led a discussion as a whole group about the challenges of giving feedback and what methods they would like to use in the future.

Giving an Effective Lecture

This activity served as a summary of everything that students had learned throughout the workshop. First, students completed a "Think-Pair-Share" and considered the question "What are important things to consider when structuring a lecture"? Next, students submitted their individual answers using Canvas assignments. Then, students explained how to grade these assignments using the Speedgrader function, while one student went through and graded the assignments while sharing their screen. For the main activity, students in groups of 3-4 each designed an interactive activity to teach others how to give an effective lecture. They posted their activity in a Canvas module with at least one assignment. Students could include discussion boards, quizzes, and link files to show that they had learned about giving effective lectures and to show that they could use Canvas effectively. Once this was concluded, students completed each other's modules and submitted assignments. Then, student groups graded the assignments in Speedgrader. This activity allowed students to demonstrate their knowledge of technology support and teaching and learning with regard to lecture structure. They also designed a teaching activity on their own, showing that they were able to design an effective teaching session.

To close the activities for the second day of the workshop, the facilitators used Mentimeter and asked students to describe what they learned in one word, demonstrating another function of Mentimeter for students to use in their own teaching sessions. Following this, students partook in a review quiz through Kahoot, which is another technology tool that students can use in their own teaching. To close the workshop, facilitators asked students to review what they learned and create an action plan for themselves. The action plan detailed what students should do following the workshop, which included things like deciding to apply for a teaching opportunity, incorporating teaching and learning skills into their mentoring in the laboratory, or using more Canvas or Zoom functions in their current role as teaching assistants. Overall, the synchronous activities helped students learn and demonstrate the skills necessary to be successful in all five of their roles as a teaching assistant. These activities helped students meet the objectives for the program and demonstrate their preparedness for effective professor support and teaching and learning. See Figure 2 for an outline of the agenda of the workshop.

DESIGN REFLECTION

Outcomes

The first workshop in August 2021 included 15 registrants: seven students who completed the pre-work quiz, 12 students who participated in the first day of the workshop, and four students who attended the second day and completed the post-work quiz. Overall, the design of the workshop was effective. Students who attended the first day met the learning objectives and demonstrated to the facilitators that they understood the information presented. However, with inconsistent participation, the facilitators could not collect pre-quiz and post-quiz results for all participants. As a result, not all students could receive formal evaluations or feedback on what they learned during the workshop. Also, since only a few students participated in the activities on the second day of the workshop, any students who did not attend did not get a chance to practice their teaching demonstrations and

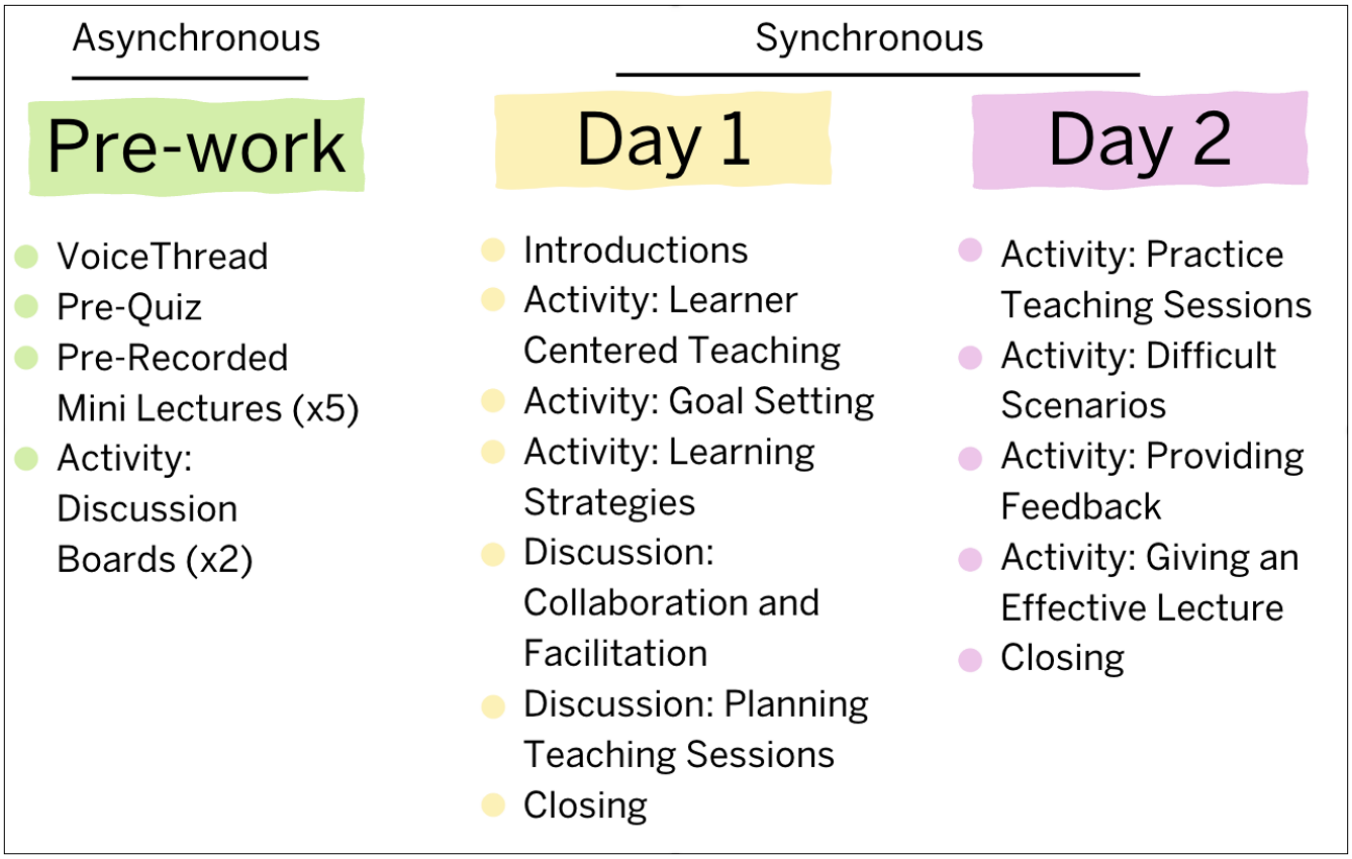

FIGURE 2. Agenda for the first iteration of the Teaching, Learning, and Professor Support workshop.

did not receive feedback. One suggestion for the design of this workshop that participants also suggested was shortening the time for activities in future iterations. This meant reducing the number of activities or moving more of the activities to asynchronous work. Another possibility involved extending the workshop to three days and shortening the meeting time from 4 hours down to 1-2 hours per day. This more flexible schedule would allow students to participate in more of the activities, as a shorter time commitment would leave time for them to attend to laboratory research and other responsibilities. Facilitators designed the activities to involve any number of students, though the design suggested 3-4 per group. The facilitators successfully adapted the activities on the second day to include only four students and still used the same activities with an opening, main activity, secondary technology activity, and a closing. Despite the low number of participants, students actively engaged in the sessions and had meaningful discussion. Some to other's suggested changes, including moving the providing feedback session to before the practice teaching sessions in order to teach participants about providing feedback before they give it to their peers. In addition, to address the multiple roles that a teaching assistant has at IUSM, one suggestion involved prioritizing responsibilities as a teaching assistant in the goal setting activity. Overall, the facilitators looked forward to continuing to improve the design of this teaching, learning, and professor support workshop for graduate student teaching assistants.

Surveys

Due to limited participation, very limited data were collected regarding participants. Students took pre- and post-quizzes to demonstrate what they had learned and show that they had met each of the learning objectives for the workshop. Not all students who attended completed the pre-quiz, and not all students who completed the pre-quiz took the post-quiz, so the evaluation proved challenging. In addition, students took a survey to evaluate the facilitators' performance and the workshop as a whole. Unfortunately, few students completed this survey. Also, facilitators would like to collect longitudinal data on participants who serve as teaching assistants. They would like to assess graduate student self-efficacy in teaching, and they would like professors to evaluate teaching assistant performance. With the improvements in timing for the workshop, as described above, participation in these surveys should increase. In addition, facilitators could make it a part of the workshop to participate in the post-quiz and evaluation survey. Facilitators could also incentivize students to participate in the surveys, which may be easier in person. For longitudinal data, it will be important to keep track of students who go on to become teaching assistants and to contact the professors whom they serve. Surveys and

interview questions can be developed for future iterations of the workshop.

Facilitator Reflection

Only one student out of the 12 that participated and the 4 that completed the post-quiz filled out the post-evaluation survey. Feedback from this student helped inform the facilitators on what to improve in the next iteration. This student stated that the most meaningful aspect of this training involved "sharing the different resources that could help us teach". The student stated that their future students would benefit from what they learned because "This training reminded me to be student-centered, so Students will benefit from my having learned to listen to them and provide an environment where they can trust that I believe in their ability." This emphasized to the facilitators the importance of focusing on learner-centered teaching. When asked what could be improved in the training, the student said, "Some of the activities could use clear direction, like some of the group activities that were also individual activities." This indicated to the facilitators that activities needed more explanation. Some of the activities required more resources and instruction. The facilitators decided to add more written descriptions to the activities and agreed that some activities required more direction - particularly for the collaboration/facilitation activity and the learning strategies activities, where students had individual and group work. For these activities, the facilitators added very clear PowerPoint slides with instructions to the presentation, indicating when students needed to write or create something individually. Figure 3 outlines examples of PowerPoint slides that describe how to perform group activities. Figure 3 also includes updates to the Canvas page for students, outlining and linking activities directly on the Canvas page so they have access to instructions and activity links on their own devices. Then, following a debrief of the individual work, a separate slide was added that clearly indicated group work expectations, with instructions for group tasks written out. By adding clearer visual instructions and physically separating the tasks by having group discussions following each task, the facilitators hoped the workshop would run more smoothly, and students would not experience confusion about activities.

With regards to the format, the student wrote, "Also, it was a little long. I think having all of the information in two days took a bit of time from schedules. Though the course was appreciated and well worth it, I think having shorter sessions over more days would allow us to balance our time better." Graduate students have challenging schedules to navigate, need to work long hours in the lab, and may feel fatigued by the end of the day. Having to sit through activities with few breaks and continuously participating in activities makes it difficult to focus. The facilitators noted this design flaw in the format. Changing from two longer days to three shorter days with more breaks included would solve this problem. In addition, the following year, facilitators planned an in-person portion of the workshop due to fewer

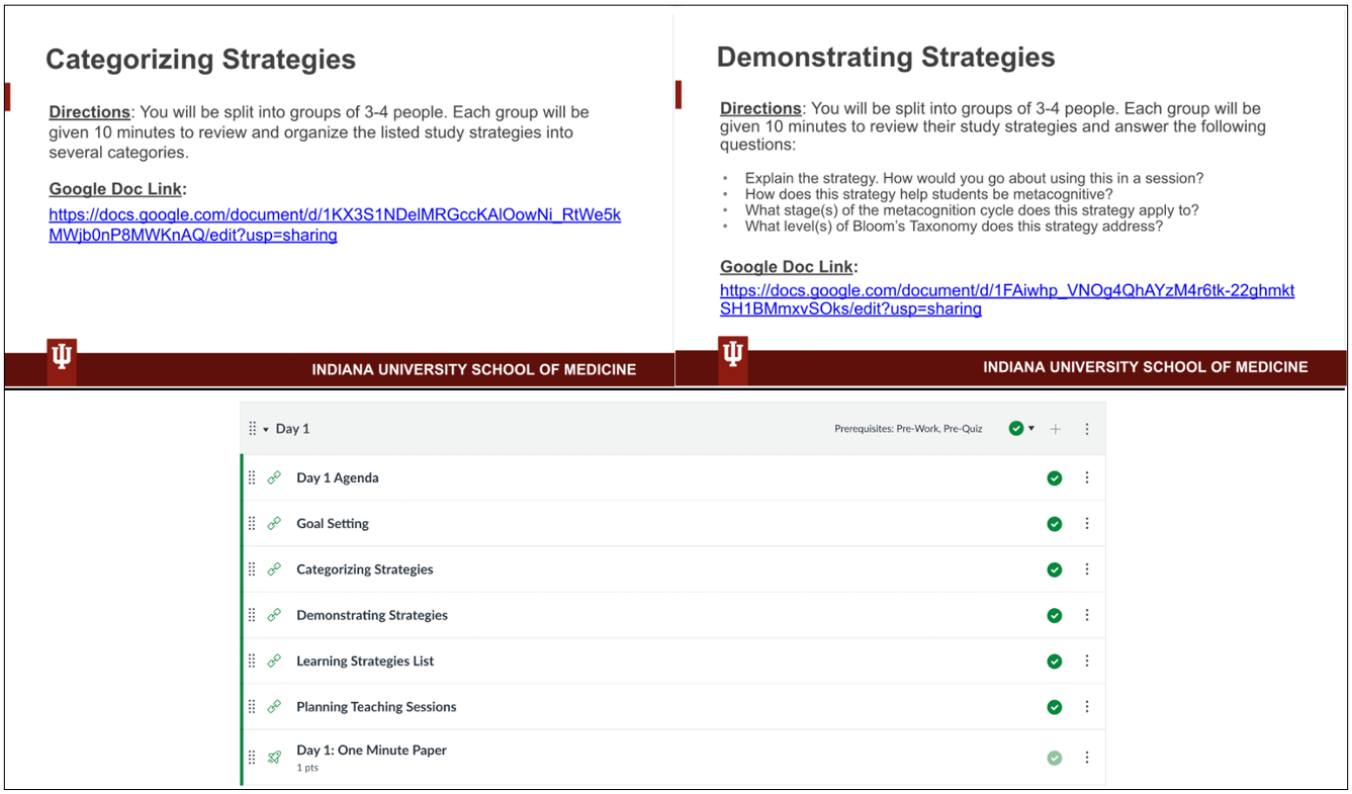

FIGURE 3. Example of PowerPoint slides and Canvas links to clarify instructions.

COVID-19 pandemic-related restrictions on in-person work. The facilitators believed that an in-person format would help with the concerns about clear directions that were expressed during the workshop and would allow for a more applicable understanding and evaluation of their students' teaching. Since the format for IUSM teaching assistants and most teaching at IUSM had returned to in-person at this point, the facilitators wanted to provide an in-person format to closely mimic the format that many students would be working and teaching in. Overall, changes were made to the design of the workshop based on student feedback, an evaluation of how students felt and performed during the workshop, and based on facilitator reflection on the workshop.

SECOND ITERATION

For the second iteration of TLPS in the summer of 2022, the facilitators focused on increasing attendance and transitioning to an in-person format. The facilitators added a third day to the workshop to better accommodate the busy schedules of the graduate students. This change decreases the daily time commitment that participants had to spend in the workshop and reduces the likelihood of fatigue from an all-day training. The workshop ran on Monday, Wednesday, and Friday - giving the participants time to complete the necessary pre-work and assignments on Tuesday and Thursday. The material remained the same as the previous year, with directions written out more clearly in the slideshow presentations. Material was distributed over three days from 3:00-5:30 pm. Facilitators also introduced the teaching sessions at the beginning of the workshop, and so students had the opportunity to prepare for the presentations on Friday. The in-person format included the Zoom and Canvas training by asking students to set up Zoom meeting components or use Canvas on the projector in the room during the session. These changes did encourage participation and promoted student engagement throughout the workshop. However, attendance decreased as the workshop progressed. Twelve participants completed the online pre-work, eight attended day one, seven attended day two, and six attended day three and completed teaching presentations. Only five participants completed the online post-work and evaluation of the workshop. We concluded that more changes needed to be made for the next iteration to encourage consistent attendance and participation.

Facilitator Reflection

The majority of participants strongly agreed that they planned to implement what they learned in their own teaching, wanted to continue to learn about teaching and learning, and would recommend this training to other students. When asked about the most meaningful aspect of the training, one student stated, "I loved the practicality of it. Getting examples of how to implement concepts was helpful." Two other students noted that they had meaningful group discussions in the follow-up survey. Multiple students also mentioned that they learned how to engage students in the classroom. Students also described what they would do differently because of what they learned in this training. Students mentioned the use of technology tools, one said, "I will incorporate more technology in my classroom." and another mentioned, "I learned different websites that I can use in teaching to make it more fun and different." Two of the students mentioned the use of wait time, one stating, "I will give more time to allow for responses. I'll also be mindful of the level of knowledge I expect my audience to have about the topic and adjust my discussion/lecture as such." Contrasting with the first iteration of the workshop, the facilitators specifically noted several "lightbulb" moments for students, especially by the end of day two. In an informal reflection regarding the 2022 workshop, one of the facilitators noted that students began to think differently about teaching and learning by day two and into day three in their teaching sessions. Based on the closing activities on day two, students' views on teaching essentials had changed. In the closing activity, students are asked what the most important part of a lecture is. Though there is technically no right answer, all the students in this session chose the answer "questioning" or "checking for understanding". This indicated to the facilitators that one of the main objectives of the workshop had been achieved, and all the students realized the importance of evaluating students' understanding of the material in multiple ways. This experience solidified the format of the workshop. Participants valued in-person group activities and discussions and thought they helped them learn and achieve the goals set for the workshop. Modeling good checking for understanding and demonstrating skills like wait time, efficient use of technological tools, and various learning strategies were very effective in this iteration of the workshop. The three-day format also gave students more time to prepare for their teaching demonstration and more time to process the information. This also could have contributed to the success of the students in this workshop and increased participation. Students also suggested some areas of improvement, specifically related to the timing of the workshop. One student stated, "I think the training is great as is. One thing I would try to do is to change the time. It is at the end of the day, and that is tricky, especially when you've been in the lab/classroom for most of the day. The information, however, is very great and very relevant." Another student suggested, "I would highly encourage a change in format! A 50-minute session-10min break-50 min session-10min break-50 min session would probably work best for all the days as, almost all days we went until 6pm. I think this workshop also deserves to have 3 hours each day allotted to it, so I would totally recommend an extended period of time with more breaks so there is less of a rush. And students should be allowed to attend the modules of their choosing to factor in time conflicts they might have." In addition to timing, students addressed the

content in this iteration, saying they would like to choose what modules to attend. Another student also noted, "I would put less assignments on Canvas because there were [so many assignments] that it discouraged me from doing it. I suggest to add [to] the activities or homework by the time it is requested to be done." This feedback indicated the importance of re-evaluating the format of the workshop. The facilitators discussed what would be best and considered the format suggested by one of the students with 10-minute breaks in between. Again, the design of the format in this iteration was flawed. To address both the time constraints on students and the concerns about the amount of online work that must be done prior to the workshop, the facilitators decided to change the days to Tuesday/Wednesday/Thursday. This avoided the possibility of students being out of town on a Monday or Friday and would allow participants to stay focused on the workshop with no days off in between sessions. This also gave the students an extra day (Monday) to continue to do the online work. Based on an informal debrief with students following the 2022 workshop, the students requested more information about teaching and mentoring in a laboratory setting. The facilitators decided to implement new activities to address these needs. Mentorship is an important part of the attendees' roles as graduate students; therefore, an activity to teach strong mentorship skills was an essential addition. The facilitators also saw an opportunity to add an activity to teach about metacognition, which is an important part of teaching and mentoring, especially in the context of working in a lab setting, and also related to the facilitators' research interests.

THIRD ITERATION

Based on feedback from the second iteration, we identified that our participants primarily included biomedical science PhD students with roles in the lab, so to meet the need of mentorship training in this environment, we decided to include an activity where participants learn and practice teaching in a mentoring role. We also included an activity to teach students more about metacognition and collected self-reflections from participants about their view of themselves as educators at the beginning and end of the workshop. Reflection is a critical component of dealing with uncertainty that commonly occurs in teaching and mentoring roles (Schön, 1983). The mentoring activity included a metacognitive component. Participants developed a tool to evaluate their own mentoring, which led to discussions about good mentoring practices and self-evaluation of mentoring skills.

From the second iteration, we concluded that we needed to use different strategies to increase attendance based on student feedback and instructor observations. To increase and maintain attendance, we kept the three-day in person format of the workshop and the time of day that we offered the workshop. We changed the days to Tuesday/Wednesday/Thursday. This increased consistent participation in the workshop, with 13 participants completing the online pre-work and 8 participants consistently attending the first and second day of the workshop. On the final day, one participant called in sick, resulting in 7 students completing teaching presentations. Another strategy we incorporated involved providing a digital badge to students who completed all the requirements including, attending each day of the workshop, completing all pre-work, post-work, and

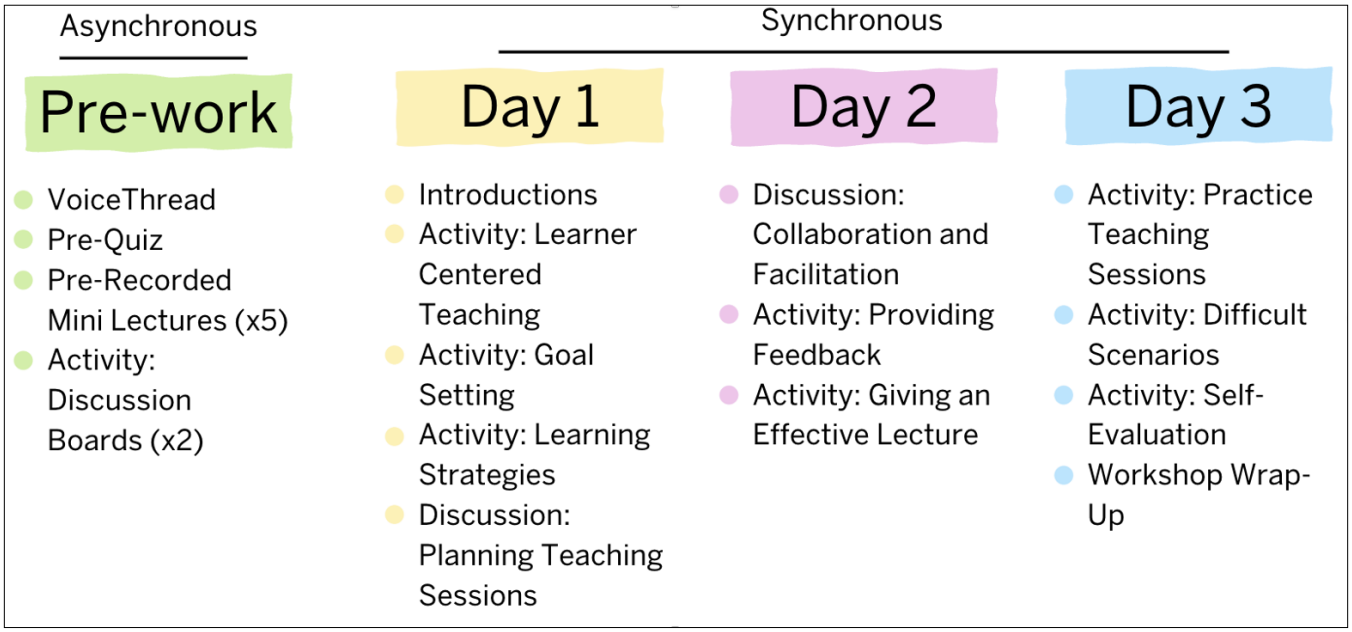

FIGURE 4. Agenda for third iteration of Teaching, Learning, and Professor Support workshop.

presenting a teaching session. We found that, unlike the previous iteration, many of the same participants attended each day of the workshop, participated, and 6 participants achieved the final badge for completing the required work. See Figure 4 for the agenda for this iteration. The workshop will continue to be held with this format for the fourth iteration in August of 2024.

Facilitator Reflection

The third iteration had similar feedback to previous iterations. The five students who filled out the follow-up survey strongly agreed that they planned to keep implementing teaching and learning strategies into their own teaching and that they would recommend the training to other graduate students. Multiple comments referenced the main tools introduced in the workshop, but also emphasized the other indirect skills taught during the workshop. For example, one student stated, "Learning different techniques to teach students will be invaluable, but [the training] also has helped educate me on the ways that I learn and how to use that to my advantage." Another student said, about what was the most meaningful aspect of the training, "Understanding that not everything will go as you planned, but being reassured you have different, new tools to deal with situations that arise". Similarly, another student also emphasized the value of learning about difficult scenarios in the classroom, stating "The tools introduced to us for active learning and dealing with different situations with students or professors was the most meaningful learning I got from this training." A third student mentioned the importance of the learning environment "...having the opportunity to apply what we learned in a comfortable and low-stakes practice session was invaluable, letting us experiment and try out the methods we had learned and see what worked and fit our teaching styles naturally." This cohort of students definitely found a lot of value in the modeling and demonstration of various teaching strategies and found it very useful to practice these skills on their own. Multiple students stated that they would also include learning objectives, goals throughout a teaching session, and wait time in their future teaching. When asked to suggest improvements for the training, one student suggested "Breaking it up to include an additional day or adding some more time to the sessions and then having a break halfway through. The sessions were long enough that at some point we would get tired from paying attention, and a break would help make sure that we can focus on all of the material, even at the end." Another student noted a concern about not understanding Bloom's taxonomy because they had missed the first day, where students practiced using Bloom's taxonomy with their own examples. The facilitators noted that for this iteration, participants really valued the content, the method of content delivery, and the ability to practice their skills. However, issues related to the timing of the sessions persisted, which previously contributed to the lack of attendance and overall fatigue. However, of all the iterations, attendance and participation remained most consistent in this one. One of the many challenges of a voluntary activity for graduate students is that many of them will not be able to attend full time due to their class and laboratory schedules. The badge for completing the workshop helped, but more strategies are needed to encourage attendance. Because attendance stayed relatively consistent throughout the three days of this workshop iteration and few complaints regarding the format, the facilitators decided to keep a similar format for the following iteration in 2024. Since the content was well received and participants met the goals of the workshop based on student feedback and instructor observations, the facilitators also decided to keep the content the same for the following year. The workshop will continue to be evaluated each year and adjusted based on the needs of the participants, the facilitators, and the students at IUSM.

CONCLUSION

Overall, this workshop provided a way for current biomedical science PhD students at IUSM to learn how to be effective teaching assistants. It provided a way for students who may not be able to serve as a teaching assistant due to limited availability - to gain some relevant teaching experience and practice the necessary skills for a future career as an academic faculty member. The facilitators have begun implementing changes to the workshop for the next iteration and are hoping to conduct the synchronous activities in person for this year's workshop and for future workshops. This workshop will be presented annually to provide a way to train IUSM graduate students to become successful biomedical science educators, advancing their skills and preparing them to effectively teach future undergraduate and graduate students before they begin their careers.

The authors learned a lot about graduate student teaching while designing and implementing this course. The biggest challenge in designing this workshop involved the retention of learners. Due to the demanding schedules of biomedical graduate students, getting learners to attend the workshop for all three days proved challenging. However, the students who did attend reported that they learned a lot and overall enjoyed the workshop. The authors hope that this workshop could eventually be implemented into the curriculum for the biomedical science education minor coursework or redesigned as a for-credit course to encourage more consistent participation.

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