

Let's talk posters: a novel role-playing activity to prepare undergraduate researchers for poster presentations

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ABSTRACT Calls to increase undergraduate involvement in research have led to a significant increase in student participation via course-based undergraduate research experiences (CUREs). These CUREs provide students an authentic research experience, which often involves dissemination of research by public speaking. For instance, the First-year Research Immersion (FRI) program at Binghamton University is a three-semester CURE sequence that prepares students for scientific research and effective communication of their findings. After one semester of research, students from the FRI program are tasked with presenting their research to hundreds of faculty members, staff, friends, and family at the annual FRI poster session. However, our students, and undergraduates in general, report high anxiety and fear around public speaking such as this. To better prepare our students for public speaking at a research poster session, we developed a workshop that includes a novel role-play activity to mimic a fast-paced poster session or conference in order to address students' fears and increase confidence levels. The role-play activity gives students iterative practice such that they are prepared for the realities of a poster session including variation of poster attendees. During the activity, students switch roles between presenter and audience member. In the role of an audience member, students are given Pokémon-like role-playing cards that explain the traits and abilities of various types of poster-goers that students might come across (faculty in and out of discipline, staff, family, friends, etc.). Students improvise and enact their card-assigned role as they engage with their classmates who are practicing their poster presentations. To assess student outcomes, students were given three surveys: pre-activity, post-activity, and post-poster presentation. Immediately following the activity, 64% of students reported the highest level of confidence, and following the poster session, 93% of students reported extreme confidence in their poster presentation abilities. These data show that this role-play activity can help address student confidence and better prepare students to communicate their research.

KEYWORDS research poster presentation, public speaking, confidence, course-based undergraduate research experience (CURE), undergraduate research, science communication

The First-year Research Immersion (FRI) program at Binghamton University is a three-semester course-based undergraduate research experience (CURE) sequence that engages students in authentic, high-impact Science, Technology, Engineering, and Mathematics (STEM) research. Students work in teams to design cutting-edge research projects across 11 "streams," including Microbial Biofilms in Human Health, Ecological Genetics, and Clean Energy. Guided by a research educator (1), student teams work to identify a gap in knowledge, propose a novel project to address this gap, collect necessary data from the laboratory, field, or online sources, and compile their results.

The FRI program also requires students to present a research poster during their first and third semesters at the annual FRI poster session. Poster presentations develop

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both oral and written communication skills, encourage collaboration among students, and can serve as an assessment tool for instructors (2). As such, it is no surprise that CUREs and other undergraduate research experiences (UREs) across the country similarly require their students to create and present research posters, with some even attending larger regional or national conferences (3–7). Having students prepare and deliver visual presentations is shown to benefit students' scientific literacy and ability to understand difficult scientific concepts (8–10). However, undergraduate students often struggle to effectively present their ideas and explain their rationale. At the most basic level, this is because over half of college students (64%) report fears around public speaking (11). Public speaking fear comes from a variety of factors including fear of being judged and uncertainty about the topic (10, 12). On top of public speaking fears, students may struggle due to lack of instruction, feedback, and revision in the classroom (13–15).

Furthermore, poster presentations pose unique challenges that can be difficult for students to anticipate and navigate in addition to the stresses of public speaking and difficulties in communicating complex scientific concepts. First, the student must attempt to assess their audience. Is the listener a professor with knowledge of their field? A peer from a different discipline? A faculty member from another department? The student then faces the challenge of adjusting their talk to engage and communicate with this attendee, such as by using relevant examples, appropriate jargon, etc. Additionally, they may feel unprepared for the scope of questions they are asked. While a family member may ask a student to simply define a term or concept, an expert from their department may ask why they used certain methods over others, something they may not have considered. Moreover, posters are often close together, and the room quickly becomes loud, requiring the student to jockey for space and project their voice. Attendees move swiftly, often joining in the middle of student presentations, forcing them to address this new attendee while in the midst of communicating with another. Listeners may unexpectedly interject, which can throw students off their "flow," and make it difficult to pick up where they left off or to adapt their presentation accordingly.

Considering these challenges, our team wondered if the ways in which we prepared our students for these presentations could be improved. The students in FRI are "early career" with the majority being first-year college students. Over 80% of FRI students have never presented a research poster before, and may likely be in the majority (64%) of college students that have fears around public speaking. Thus, we asked how we could create more realistic poster presentation practice opportunities for students, and how could we use these opportunities to build student confidence and address fears of public speaking?

To improve the alignment of existing training with these desired outcomes, we developed a workshop within the classroom that exposes our students to the realities of research poster presentations. The workshop engages students in a role-playing activity in which half of the class acts as different poster session attendees or audience members (assigned using laminated Pokémon-style character cards), while the other half practices presenting their poster to these audience members. In this way, students are challenged to view poster presentations as a more flexible "poster conversation" that requires them to adapt their talk to the listener and immerses students in the dynamic, fast-paced environment of a poster session. Additionally, in simulating the poster session environment, students are better prepared to tackle challenges they may encounter and build confidence in their presentation and public speaking abilities. Here, we describe this poster presentation workshop, including corresponding lectures, the role-playing activity, associated materials, rubrics, and assessment tools.

Intended audience, learning time, and prerequisite student knowledge

This workshop was developed for an introductory-level CURE for first-year STEM majors, though it can be easily modified to fit the needs of any CURE or URE. The workshop was designed to fit within the constraints of a single, 2-hour class period (Table 1), which included time for students to set up their posters and take a pre-activity survey

TABLE 1 Timeline for assessments, workshop, and poster session activities

Pre-activity lecture/discussion	Improvisation activity	Post-activity lecture/discussion	Post-poster presentation
Duration: 35 minutes	Duration: 60 minutes	Duration: 15 minutes	Duration: 5 minutes
Topics and activities - Students will think about the realities of the poster session and the associated challenges. - Students will receive an understanding of how to participate in the activity. - Students will receive advice for providing effective feedback.	Topics and activities - Students will interact with one another in a mock poster session. - Students will be able to practice their presentation and engage as an audience member. - Students will receive feedback highlighting any need for additional practice.	Topics and activities Students will personally reflect then discuss with the class their lessons learned from this activity.	Topics and activities - Students will be assessed for a poster presentation grade. - Students will personally reflect.
Learning objectives - LO 1 - LO 2	Learning objectives - LO 1 - LO 2 - LO 3 - LO 4	Learning objectives - LO 3 - LO 4	Learning objectives - LO 1 - LO 2
Assessment Pre-activity survey (Appendix 5).	Assessment Student, peer mentor, and instructor feedback using rubric.	Assessment Post-activity survey (Appendix 5).	Assessment - Instructor feedback using rubric. - Post-poster session survey (Appendix 5).

(~15 minutes), a pre-lecture (~20 minutes), the role-playing activity (~60 minutes), and a post-activity survey and whole-class debrief (~15 minutes). In the pre-lecture, students were provided with instructions as to how the activity would work (Appendix 1), and they were provided with guidelines and a rubric (Appendix 4) for providing feedback to their peers.

Prior to this workshop, students had been taught and workshopped poster making, poster design, and poster presentation as part of the scientific process. Also, throughout this course, students were taught and practiced oral presentations such as PowerPoint progress reports and elevator talks to prepare them for speaking about their research.

Learning objectives

At the end of this activity, students will be able to:

1. Effectively communicate their scientific message to audiences of varied backgrounds using a poster presentation.
2. Critique and provide feedback on peers' poster presentations.
3. Incorporate feedback to improve their poster presentations.
4. Build confidence in their ability to convey their scientific message through a poster presentation.

Data presented in this manuscript were determined to be exempt (STUDY00003634) and collected in accordance with Binghamton University's Institutional Review Board rules and guidelines.

PROCEDURE

Materials

An outline for the workshop (as intended) is provided in Table 1. This timeline can be modified to suit varying classroom constraints. In the workshop presented here, students were able to make use of the FRI Learning Lab which has 10 poster-sized Clear

Touch panels on which each of the 10 teams could display their posters for practice. In previous iterations of this workshop, posters were already in hand and were hung on the classroom walls for practice when projectors or Clear Touch panels were not available or feasible for the scale. The role-play cards were printed and laminated (Appendix 2) for 50% of the students in the class; half presenting and half improvising as audience members. Poster presentation rubrics (Appendix 4) were also provided in print so that students improvising as audience members could use the rubric to provide constructive and guided feedback to their peers.

Student instructions

1. Complete the pre-activity survey (Appendix 5).
2. Bring a copy of your finalized research poster to the workshop.
3. Listen and participate in the pre-lecture (Appendix 1).
4. Read through your assigned personality card (Appendix 2).
 - a. Focus on your assigned background, behaviors, levels of scientific and discipline-specific mastery, as well as toughness. Prepare yourself to assume this role when it is your turn to engage as an audience member in the activity.
 - b. Ask any clarifying questions about your role so you can fully engage in the character.
5. Select the team members who will be presenting for the first half of the activity and those who will be engaging as audience members.
6. Have fun and challenge your peers so that they are better prepared for the difficulties they may face during the poster session. Remember to also be respectful, professional, and mature during the activity.
7. Assume your presenter or audience role. In the audience role, be sure to rotate to other posters around the room.
8. Halfway through the activity, switch roles.
 - a. Team members who were presenting for the first half will now be audience members and the role-playing students will move to present.
9. Listen and participate in the post-lecture debrief and reflection through the post-activity survey (Appendix 5). This will include making plans to continue practicing and addressing any issues identified during the activity.

Faculty instructions

Prior to the workshop, instructors should dedicate lecture time to familiarize students with research posters and poster presentations. Advise students to practice prior to the activity so that they are prepared to be a presenter and an audience member. Reserve a space or classroom where students can share the posters, mimicking the actual poster session. In the case of this study, 10 Clear Touch panels were available for students to display their posters. Students are encouraged to have a finalized copy of the poster in order to be prepared to present. Provide class time for the students to complete the pre-activity survey before beginning the pre-lecture.

In the pre-lecture portion of the workshop, develop a classroom contract with students on the board or Google Jam Board in order to ensure that students have a mutual understanding for respecting one another to foster a supportive, helpful environment for practicing. Build a discussion regarding the background of research with an emphasis on why the audience should care. Prepare students to think about who their audience will be and the challenges they might face. Offer your students personal anecdotes and advice about how to handle changing audiences. Facilitate students' decisions on which students will be presenting and those that will be role-playing as an audience member.

During the activity, instructors should encourage students to explore the various posters to ensure that all presenters gain experience in delivering their presentations to various "audience members." Ensure students are acting within professional boundaries

and continue to provide constructive feedback. Instructors should assume the role of a tough audience member who is capable of asking more complex questions. Undergraduate peer mentors (UGPMs) should be available to help guide students by offering insight from their own experiences. UGPMs can share their experiences from their character types and previous poster sessions.

Following the activity, the instructor should encourage students to take the post-activity survey as a means of reflection (Appendix 5). The instructor should then lead a discussion encouraging students to share their experiences and how they will continue to prepare for the poster session.

To follow up with students' actual performance at the poster session, the instructor should both evaluate students using the rubric (Appendix 4) and encourage them to fill out the 5-minute post-poster session survey (Appendix 5). We embedded these questions into our end of program assessment survey.

Suggestions for determining student learning

In an attempt to assess student gains, questions on attitudes and abilities surrounding the poster presentation were included in a three-survey sequence. The first survey was provided prior to the activity, the second immediately following the activity, and the third following the students' public poster session (Appendix 5). Survey questions with open-ended prompts were analyzed using an inductive open-coding process between the six study team members to identify common themes and come to consensus. Students were also assessed by their instructors using the poster presentation rubric (Appendix 4).

Safety issues

For this activity, physical safety concerns are minimal. However, keep in mind that this workshop involves role-play, feedback, and high levels of student interaction. Students' mental health should be taken into consideration. A proper classroom climate with an expectation of respect and professionalism should be upheld so that students feel safe to engage in this activity.

DISCUSSION

Field testing

The activity presented here was piloted with a small group of summer student researchers in 2022 ($n = 15$). These summer researchers were also early-career students with little to no prior research experience participating in an Research Experiences for Undergraduates (REU) or FRI's Summer Research Immersion program. After the summer pilot, the workshop was then implemented into the first-semester course of the FRI program in fall 2023 with 298 enrolled students. Data were collected via a series of three anonymous Qualtrics surveys which were administered prior to the workshop, immediately following the workshop, and following the public poster session. Due to the anonymous, exempt nature of this study, the data could not be matched across time, and represent a within-subjects design in which all students received exposure to the workshop training.

Evidence of student learning

Although visual and oral presentations are effective methods for learning (8–10) and common practice across scientific disciplines, students struggle to effectively communicate due to structures or lack thereof in the classroom and fears surrounding public speaking (11, 12). The goals for this workshop were to both improve students' abilities to effectively communicate their research at a poster session and to build their confidence, and thus reduce fears. To assess this workshop, we used a series of three surveys administered via Qualtrics, one prior to the pre-lecture and role-play activity, one immediately after the activity, and the third following their public poster session. From these surveys, we gathered both Likert scale responses to their level of confidence

as well as open-ended qualitative responses discussing what they were confident and nervous about, and what they found most impactful about the workshop. Although we did not have a control group to compare against, the average score for the students' graded poster conversations was 94.3% (median: 96.7, standard deviation: 6.9, $n = 298$) showing that students were able to build this skill as assessed using a standardized rubric (Appendix 4).

Student learning outcomes, as a result of this workshop, indicated that there was a perceived benefit for student preparation, confidence, and execution of their poster presentations. Because these data are nonparametric, Kendall's tau-b correlation was chosen to measure the strength and direction of association between exposure to the workshop and students' perceived confidence in poster presentation abilities. A significant positive correlation was found between exposure to the activity and confidence (<0.001 , 0.396 medium effect size). Before the role-play activity, the median response of surveyed students reported that they had "average confidence" (3 of 5 on Likert scale) in their presentation abilities (Fig. 1). From qualitative open-coding analysis of student responses, we saw that students were most confident about their poster design and their content knowledge while being most nervous about conveying their

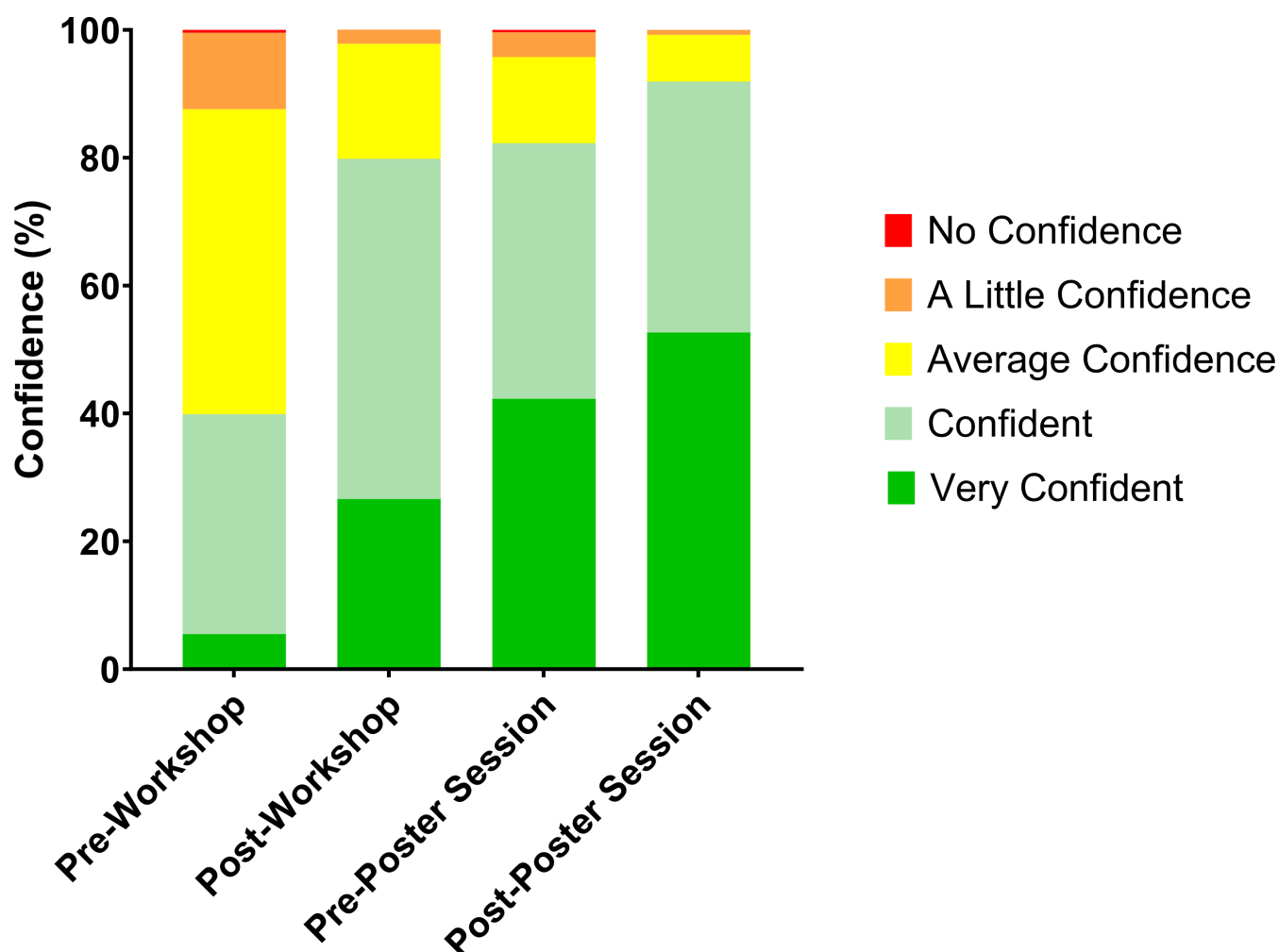


FIG 1 Students' self-reported confidence in poster presentation abilities. Data show students' self-reported confidence in delivering their poster presentation at the public, final poster session at various points in time from left to right: before the activity ($n = 218$), immediately after the activity ($n = 139$), after the activity but before the public poster presentation ($n = 260$), and after the public poster presentation ($n = 260$). Students were asked to rate their confidence on a 5-point Likert scale (Appendix 5). A significant positive correlation (Kendall's tau-b) was found between exposure to the activity and confidence (<0.001 , 0.396 medium effect size).

content knowledge, their talk structure, and Q&A (Table 2). These data suggest that students felt well prepared on the research content and their poster but they were less sure about how to explain their research to others and how to answer questions. These conclusions are supported by student quotes on what they were most nervous about. For instance, one student said they were nervous about, “explaining the project itself, making it seem important to people.”

Immediately following the workshop, students were surveyed again asking the same questions. This time, the median student response was “confident” (4 of 5 on Likert scale) (Fig. 1). This represents a positive shift from “average confidence” (3 of 5) to “confident” (4 of 5). While student responses now mentioned increased confidence in conveying their content knowledge, new themes emerged showing nervousness about doing so for a changing audience (Table 2). The absence of “varied audience” as a nervous theme before the workshop could suggest that students may not have been aware of the realities of poster sessions and were now nervous about their abilities in the unique, changing environment of a poster session. For instance, one student shared the following about the workshop: “This workshop helped to prepare me for the public by creating different scenarios that very well might happen during the actual presentation. It was a good way to practice changing my talk on the fly, as well as getting feedback on what should be emphasized more in my poster or talked about less.” We did not view the emergence of this nervous theme as a negative outcome. Rather, we felt it showed an awareness of the realities of the poster session with enough time to practice and prepare for it.

Following the workshop, we also asked a few additional questions about the workshop itself. We asked students how they felt the activity helped prepare them for the public poster session. The most common emergent themes were addressing variable audience (53%), value of practice (33%), and value of feedback (27%) (Table 2). One student quote captured these ideas by stating, “The workshop has given me more experience in public speaking. I really liked the improvisation because it made me cognizant of how diverse the audience will be.” We also asked them what their most important takeaway message was from the workshop and we identified emergent themes of engagement of audience (27%), addressing the variable audience (20%), and concision (20%).

Students were surveyed one last time following their poster presentation at the end of semester FRI public poster session. In this survey, students were asked how they felt going into the poster session and how they felt after the session. They were also asked to reflect on what they did well and what they felt they could still work on. Results showed that the median student response was still “confident” going into the poster session (4 of 5 Likert scale) but increased to “very confident” (5 of 5 Likert scale) following their poster presentation (Fig. 1). The standout themes for student confidence continued to

TABLE 2 Thematic analysis of open-ended prompts on elements of poster presentation students were nervous and confident about^a

What aspects of the poster presentation; are you feeling nervous about/did you struggle with?		
Pre-activity→	Post-activity→	Post-poster session
Conveying content knowledge (20%)	Addressing variable audience (40%)	Engagement (20%)
Presentation structure (27%)	Question and answer (20%)	No code (20%)
Question and answer (20%)		
What aspects of the poster presentation; are you feeling confident about/did you do well with?		
Pre-activity→	Post-activity→	Post-poster session
Content knowledge (53%)	Conveying content knowledge (33%)	Conveying content knowledge (40%)
Poster design (13%)	Content knowledge (20%)	Engagement (40%)
		Addressing variable audience (27%)

^an = 15.

include conveying content knowledge, and now included themes of engagement and addressing variable audiences (Table 2). This could demonstrate that with additional practice (Fig. 2) and awareness around presenting their material to a variable audience, students felt more prepared. The only theme that emerged when students were asked what they were nervous about was engagement (20%). However, this was contrasted by a higher percentage of students (40%) who reported confidence around their engagement abilities (Table 2).

Although we did not have a matched non-participant group to compare against, the significant, positive correlation between perceived confidence from beginning to end following exposure to the workshop suggests that the activity could be an important part of this skill building. One student quote regarding the main takeaway captures student outcomes and adds context for the impact of this activity, “Learning how to communicate professionally and enthusiastically in a multitude of ways on the spot. This was the most impactful takeaway because it helped me feel more confident going into the poster session and knowing I have practiced communicating my poster in different ways and scenarios prior to the session.”

Possible modifications

This activity could be easily adapted to suit one's needs. For instance, if there is no access to a smart technology classroom, instructors could use the printed posters, use projectors, or use student devices to display posters. Furthermore, the improvisation card deck (Appendix 2) includes a card template (Appendix 3) and modifiable cards which can be tailored to the type of audience that would be encountered for a particular poster session. The audience at an internal, institutional poster session might be more general and varied like our card deck, or the audience at a national meeting's poster session might be more specific to the discipline. We also suggest an adaptation to this activity in which instructors provide questions for each of their students' posters that can

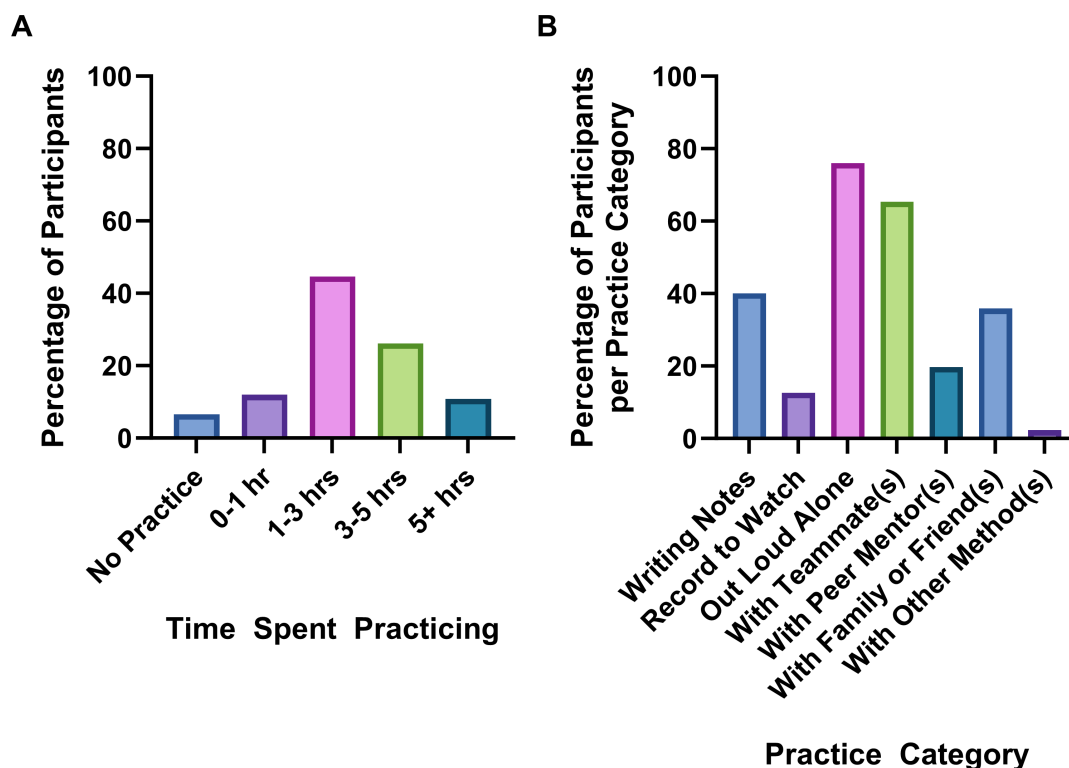


FIG 2 Time spent practicing by various methods. To be able to assess whether or not the activity impacted how much students ($n = 260$) practiced and their method of practicing for the public poster presentation, students were surveyed on (A) the number of hours spent practicing and (B) the ways in which they practiced. Students were able to list more than one way in which they practiced; thus, data show percentage of total students for each category.

be used by the improvising students if they are struggling to ask tough questions and engage critically with their peers. Furthermore, although this activity was designed and implemented in an undergraduate research program, this workshop could be beneficial for early-career graduate researchers as well. No modification would be required other than adapting the audience cards to the type of audience the graduate student group may encounter.

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ADDITIONAL FILES

The following material is available [online](#).

Supplemental Material

Appendixes 1, 2, 4, 5, and 6 (jmbe00178-23-S0001.pdf). Workshop lecture slides, PDF of card deck, poster presentation rubric, survey questions, and code book.

Appendix 3 (jmbe00178-23-S0002.ppt). Modifiable card template.

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