Georgia Tech

PER @ GT

Defining Success in Science Multimedia Communication Courses

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Acknowledgements

Thank you to PER @ GT group members:

Dr. Emily Alicea-Muñoz
Dr. Michael Schatz
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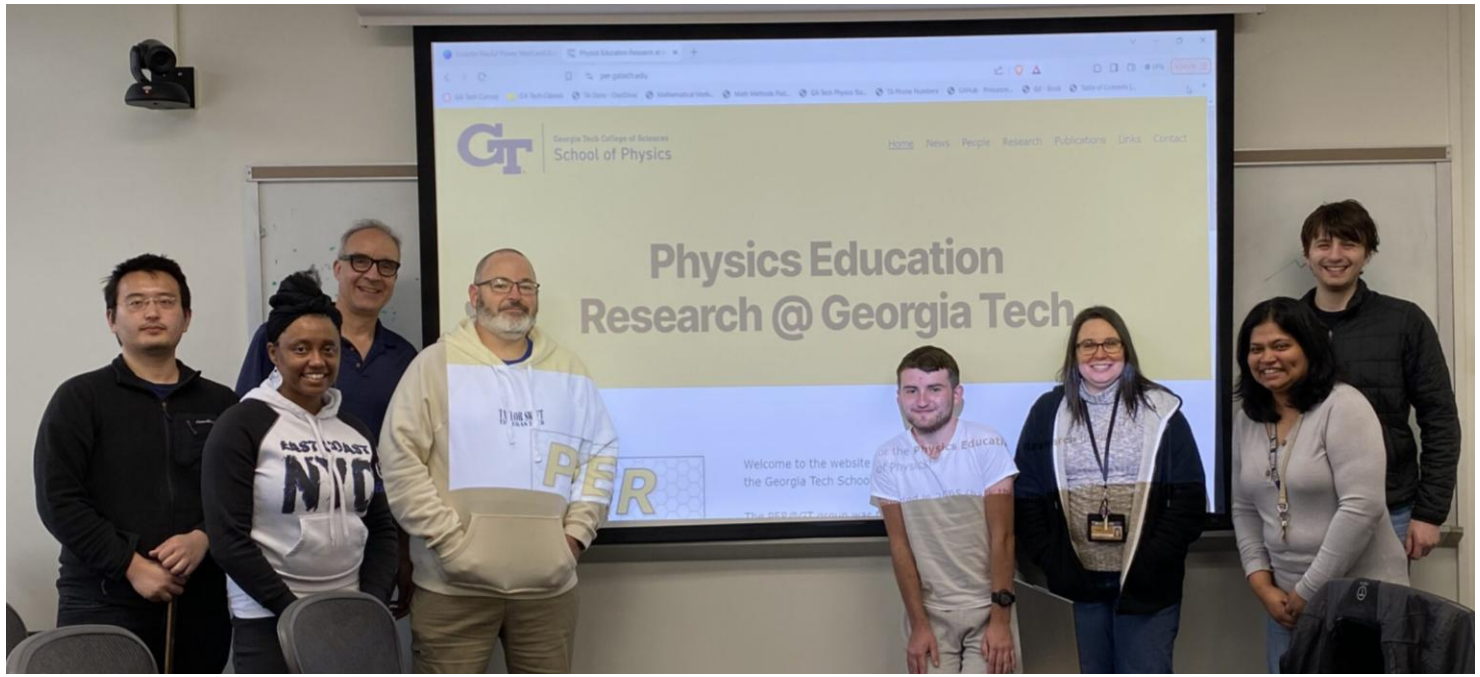


Thank you to collaborating instructors:

Dr. Colin Parker
Dr. Itamar Kimchi
Dr. Mary Peek
Dr. Sven Behrens

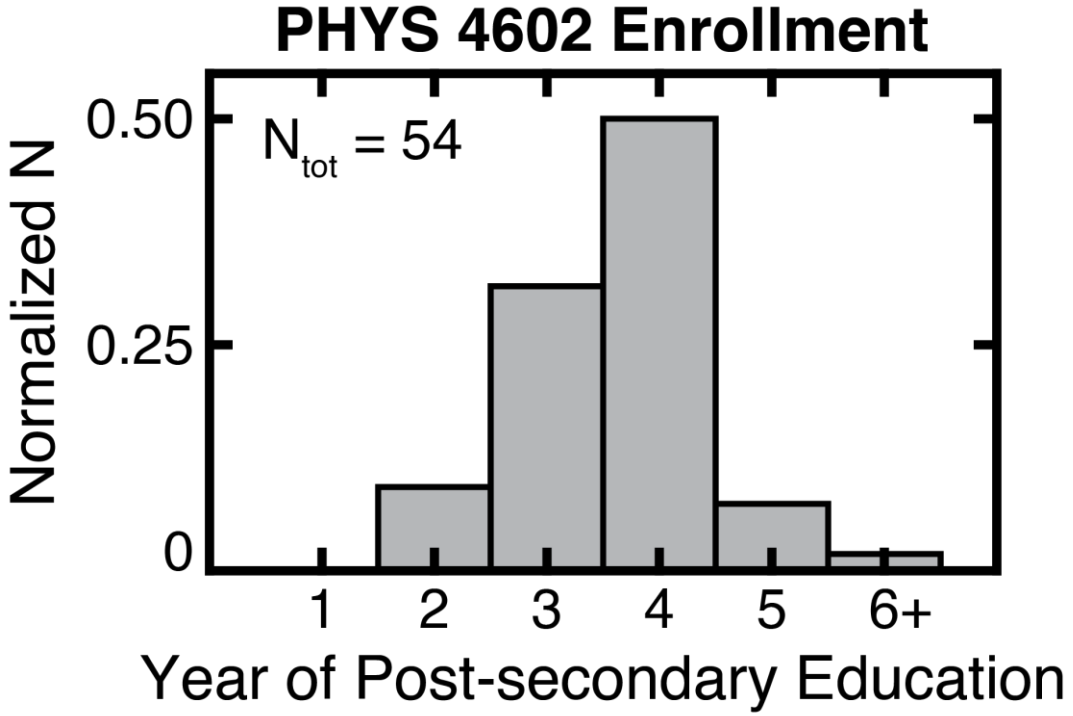
Implementation of relevant science communication resources has been slow and highly localized.

- National organizations **emphasize** the importance of developing **science communication skills** in students.
- Oral presentations help students develop effective **presentation, language, and research skills** [Aryadoust, 2015].
- Still, employer accounts suggest physics graduates are **deficient** in social and communicative skills [Sarkar et al., 2016].

Students deliver oral presentations in GT's required physics and biochemistry communication courses.

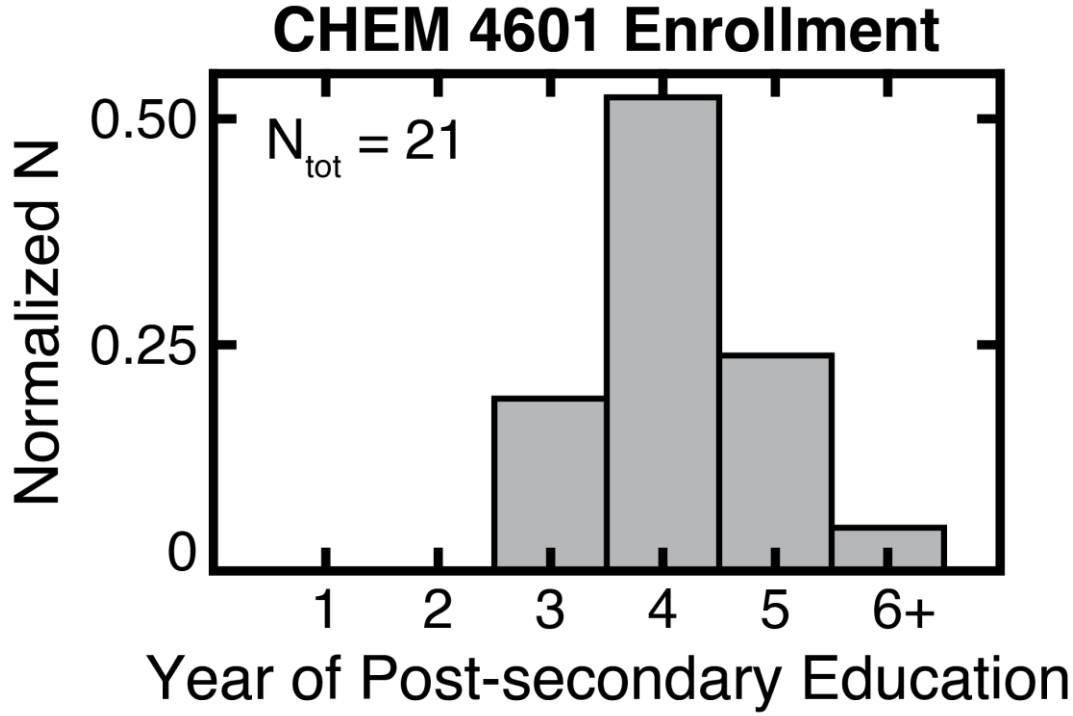
PHYS 4602 (1 CH, 107/135 consent)

- Typical semesterly enrollment: 20–50
  - One uncapped section
  - 50% 4th-years, 31% 3rd-years



CHEM 4601 (2 CH, 28/33 consent)

- Typical semesterly enrollment: 30–36
  - Two sections capped at 18 each
  - 52% 4th-years, 24% 5th-years



Demographic information obtained through optional survey.

Students deliver oral presentations in GT's required physics and biochemistry communication courses.

PHYS 4602 (1 CH, 107/135 consent)

- Typical semesterly enrollment: 20–50
  - One uncapped section
  - 50% 4th-years, 31% 3rd-years
  - Minimal external SciComm experience
  - Highly varied instruction each semester
- Students present **1x** per semester.
  - One 8-min presentation + 2-min Q/A
  - Topics: research at GT, summer internships, upper-division course topics
- Observed 3 semesters (F23, Sp24, F24)
- **Intervention in Sp25**

CHEM 4601 (2 CH, 28/33 consent)

- Typical semesterly enrollment: 30–36
  - Two sections capped at 18 each
  - 52% 4th-years, 24% 5th-years
  - Minimal external SciComm experience
  - 2 hours on slideshows, 1 hour on posters
- Students present **4x** per semester.
  - One 4-min presentation (No Q/A)
  - Two 20-min presentations + 5-min Q/As
  - One poster symposium + 1-min elevator pitch
  - Topics: journal articles within last 7 years
- Observed 2 semesters (Sp24, F24)

We analyze student presentations and semi-structured interviews to assess our instructional intervention.

1. Can research-based instruction improve student presentation quality without the opportunity for practice and feedback?
2. How does research-based instruction impact student attitudes toward both the course and science communication at GT?

i. Student presentations **privately evaluated in-person** with rubric based on Cognitive Theory of Multimedia Learning [Mayer, 2020]

ii. Consenting students solicited for optional, 20-minute **semi-structured interviews** (**39/107** in PHYS, **11/28** in CHEM)

Across semesters and departments, students value direct instruction on and practice with presentation skills.

- PHYS F23: W1 Syllabus review
  - *"It maybe **would be helpful** to have **one or two days of class** going over that. Learning how to pick out the key ideas from your slides, presenting them in one sentence, and just talking about why that's important…."*
- PHYS Sp24: W1 Intro to science presentations, W2–4 Presentation workshops
  - Students **valued guidance** on presentation structure and techniques.
  - **Workshops overstayed** their welcome and did not effectively simulate public speaking.
- PHYS F24: W1 Syllabus review, W2 Intro to science presentations
  - Interesting but **not enough time** for meaningful learning.
  - Not useful or engaging for people with **prior experience**.
- CHEM Sp24 & F24: W1 Science presentations, W4–5 Science posters
  - *"a good introduction into the course and the **expectations**", "very thorough", "a good primer", "very impactful", "good to **lead by example**", "good to see how the **structure of a talk** should be set up… and how to **keep the audience engaged**."*

The PHYS 4602 Sp25 curriculum integrated education and communications research with GT student values.

W1: Intro to Science Presentations
- Composed by faculty co-instructor
- Expectations, assignments, & learning outcomes
- Slide titles & composition basics [Doumont, 2012]
- Critiquing co-instructor's faculty interview slides

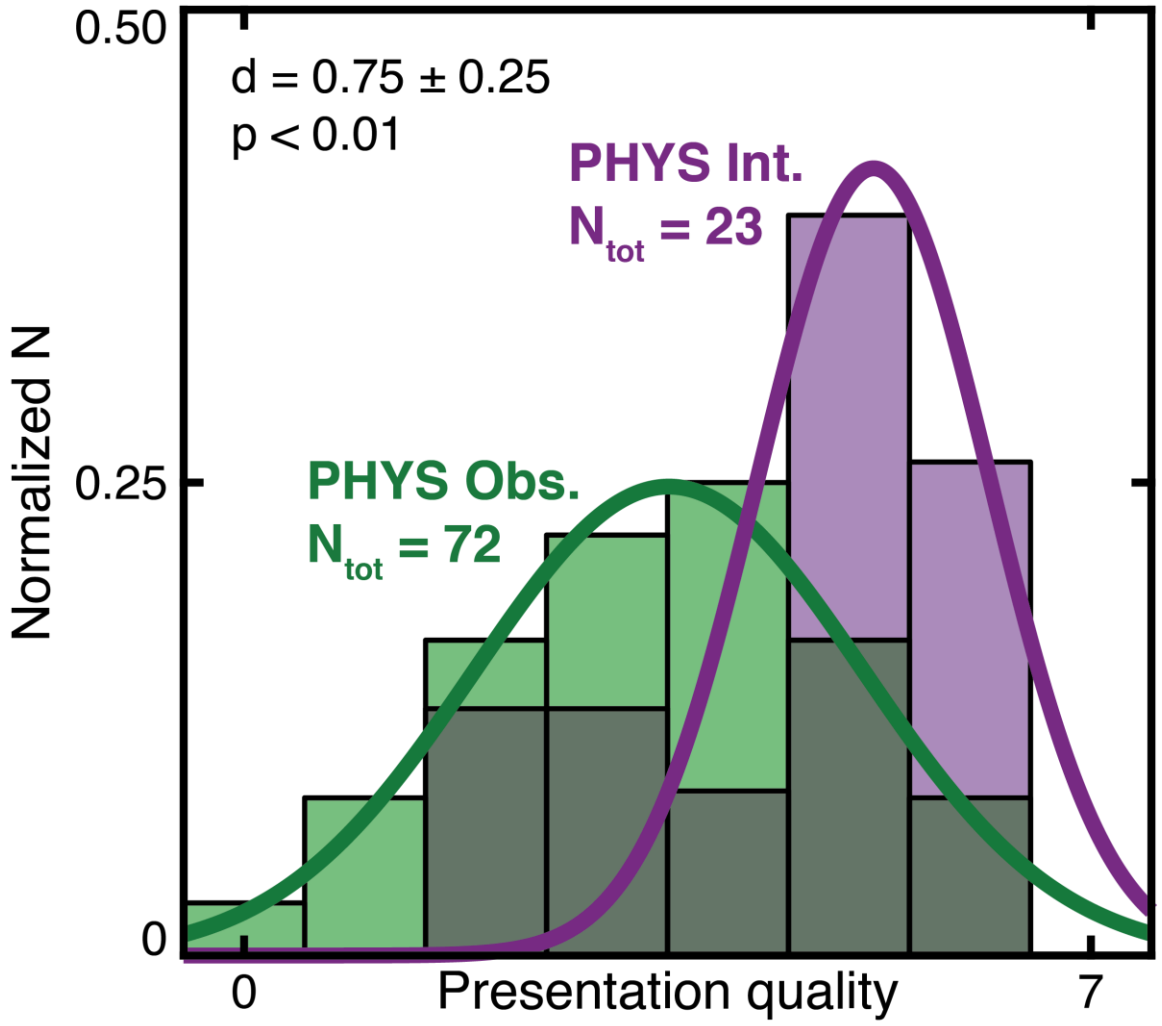
W2: Slide Design
- Applying the Backward Design process [Wiggins & McTighe, 2005] to short presentations
- Primer on multimedia learning [Mayer, 2020]
- Effects of medium on instructional graphic design
- 15-min activity: adapting premade graphics

W3: Presentation Workshop
- Flipped classroom day
- Iterate slides in groups
- Focus on two "key slides"
  - Step 1 of Backward Design
  - Includes main takeaway(s)

W4: Slide Critique
- Led by faculty co-instructor
- One "key slide" per student
- Brief public feedback
- Anonymized peer feedback
- Detailed instructor writeup

W5: Public Speaking
- Storytelling in science
- (Non)verbal communication
- Managing anxiety
- 1-min challenge: Staying conversational under pressure
- Reflection activity

Research-based instruction helped PHYS 4602 students in Sp25 significantly outperform earlier students.



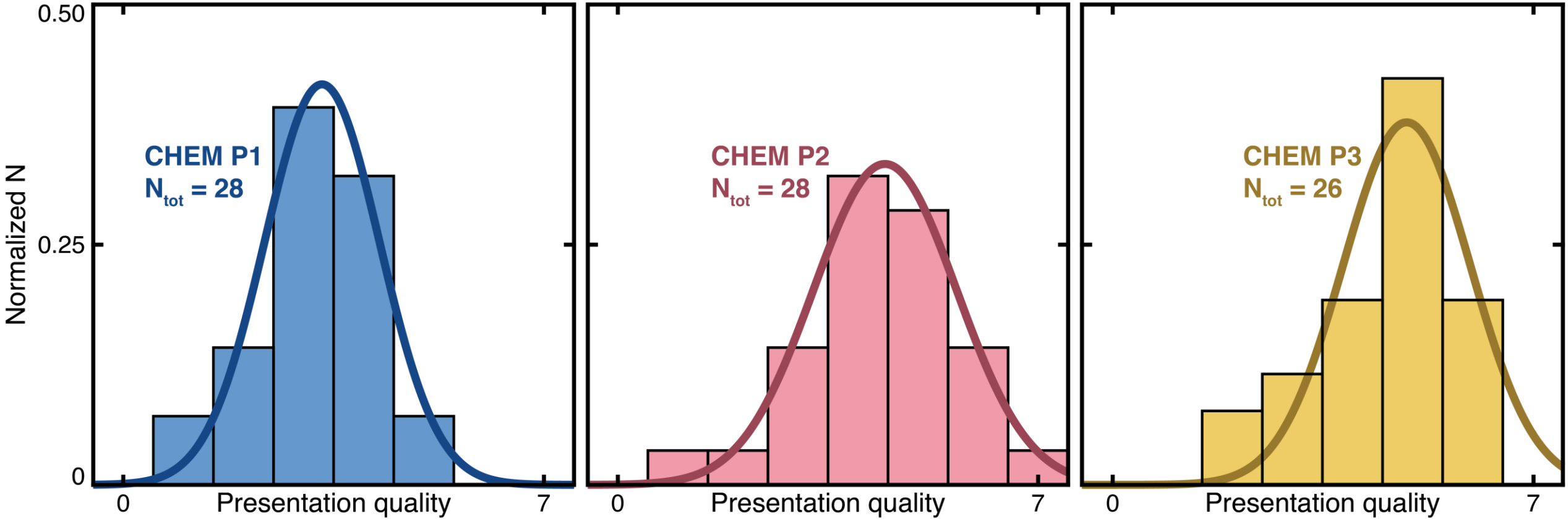
One-sided Mann-Whitney *U* test suggests improvement in quality ($p < 0.01, |z| = 3.02$).

Students praised many aspects of the new curriculum but still saw room for improvement.

- Students appreciated **learning** slide design **guidelines** (e.g., text and graphic usage, animations) and **practicing implementation**.
- Students found the workshop **useful for building** their slides and **getting feedback**, though some felt it was too soon to focus on slide specifics.
- Students were **frustrated** by critiquing one key slide because it led to **irrelevant feedback** built on **incorrect assumptions** about the presentation.
- Students embraced the speaking challenge as **initially scary but very helpful**. Some requested more feedback and exposure to build confidence.

In CHEM 4601, student presentation quality improved significantly after the first presentation.

One-sided paired Wilcoxon signed-rank tests suggest that students **improved between Presentations 1 and 2** ($p < 0.001, |z| = 3.74$) but **not between Presentations 2 and 3** ($p = 0.48, |z| = 0.06$).



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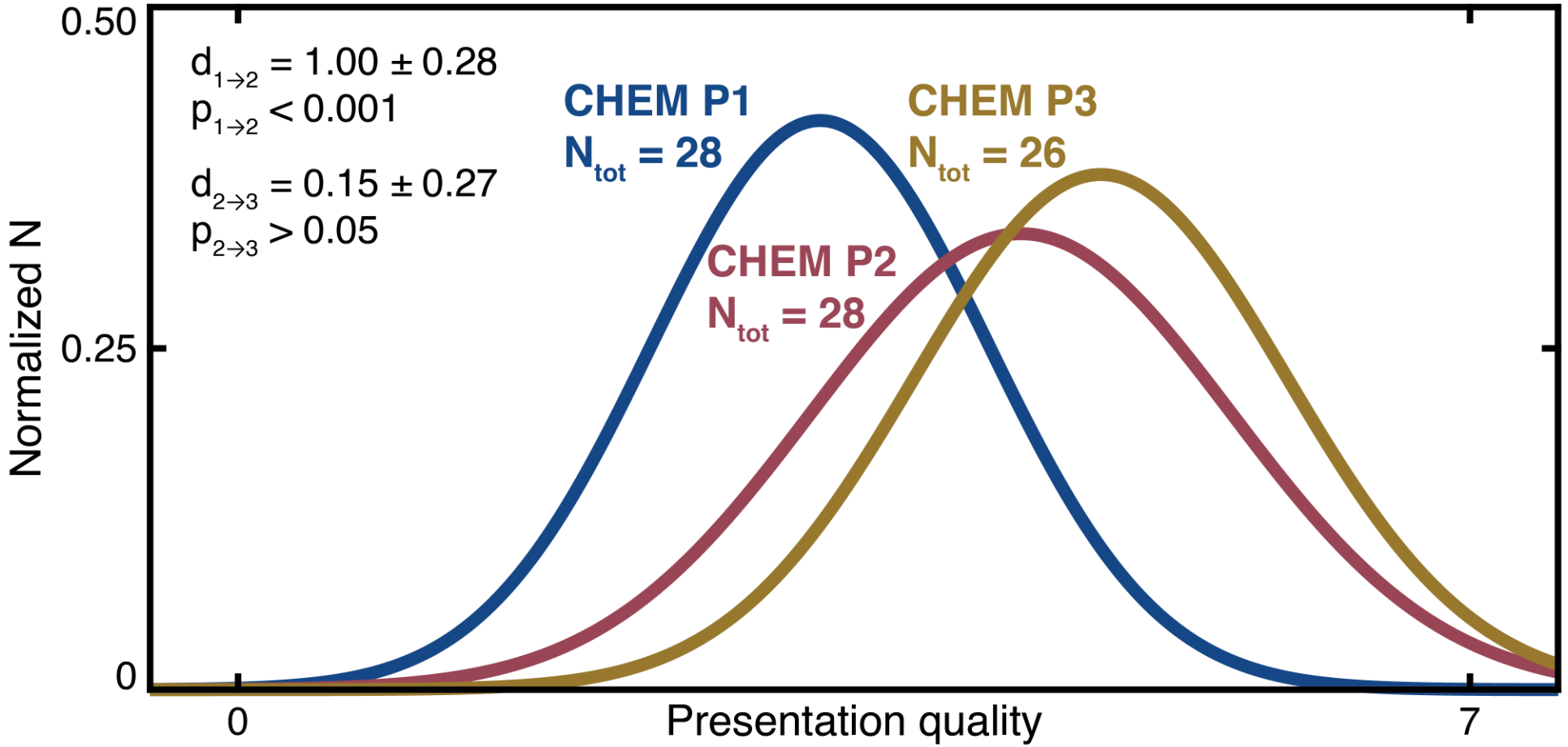
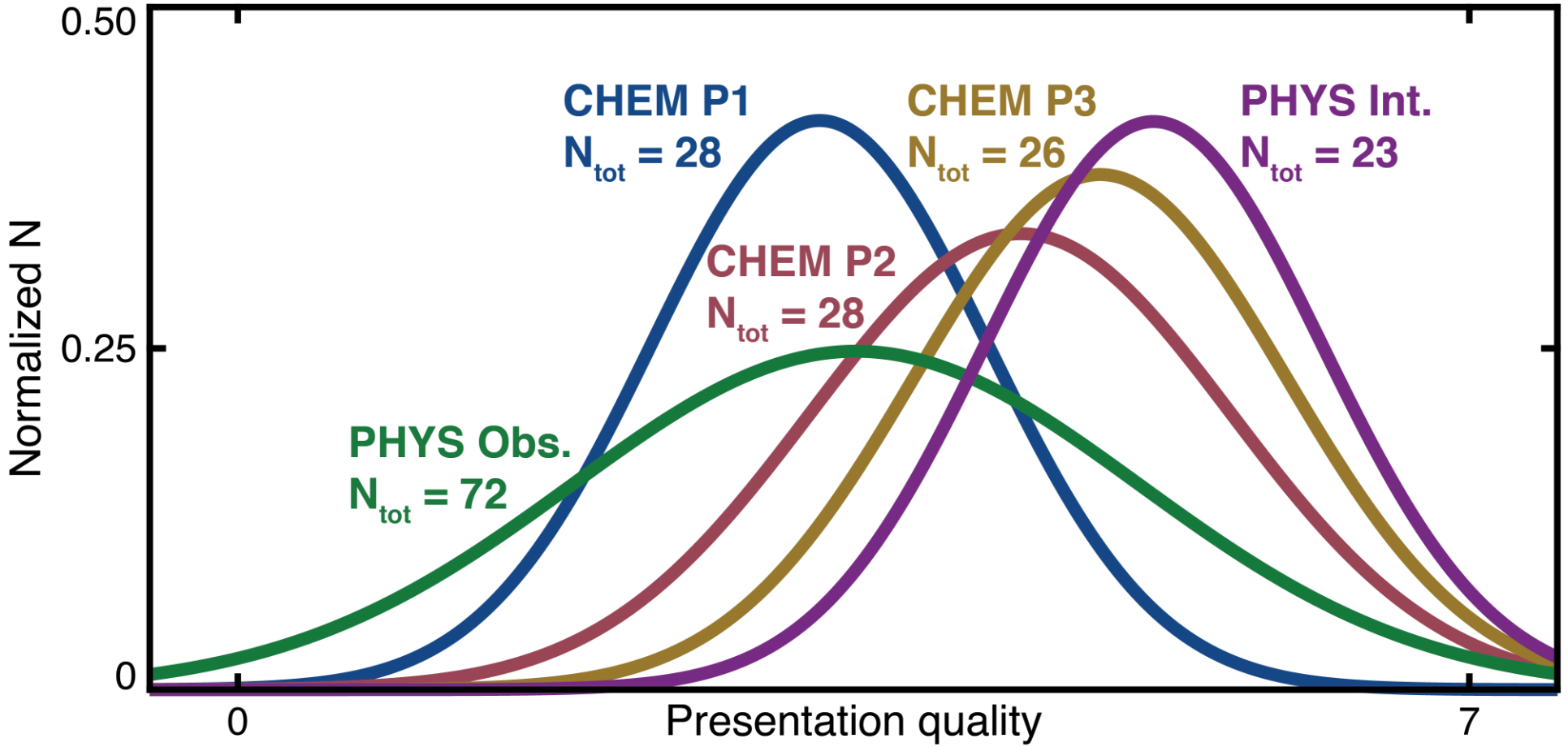
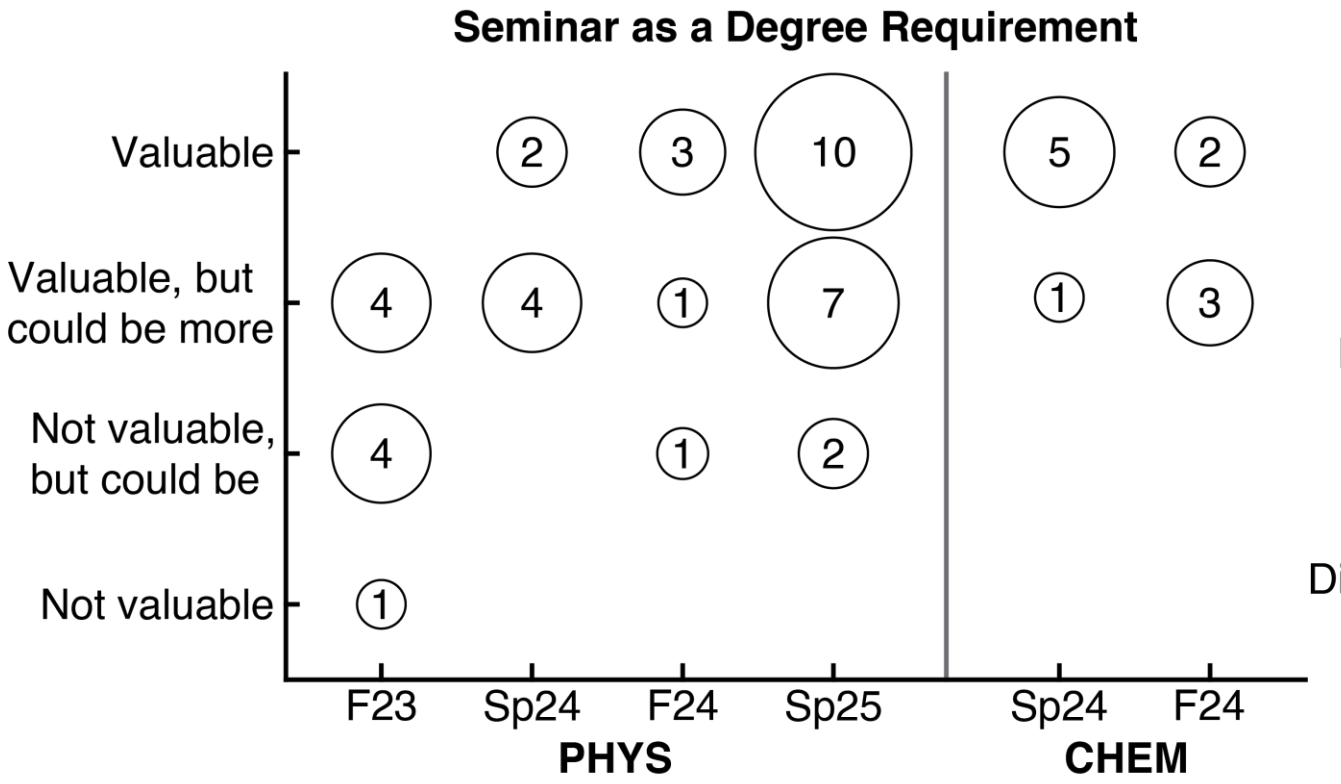


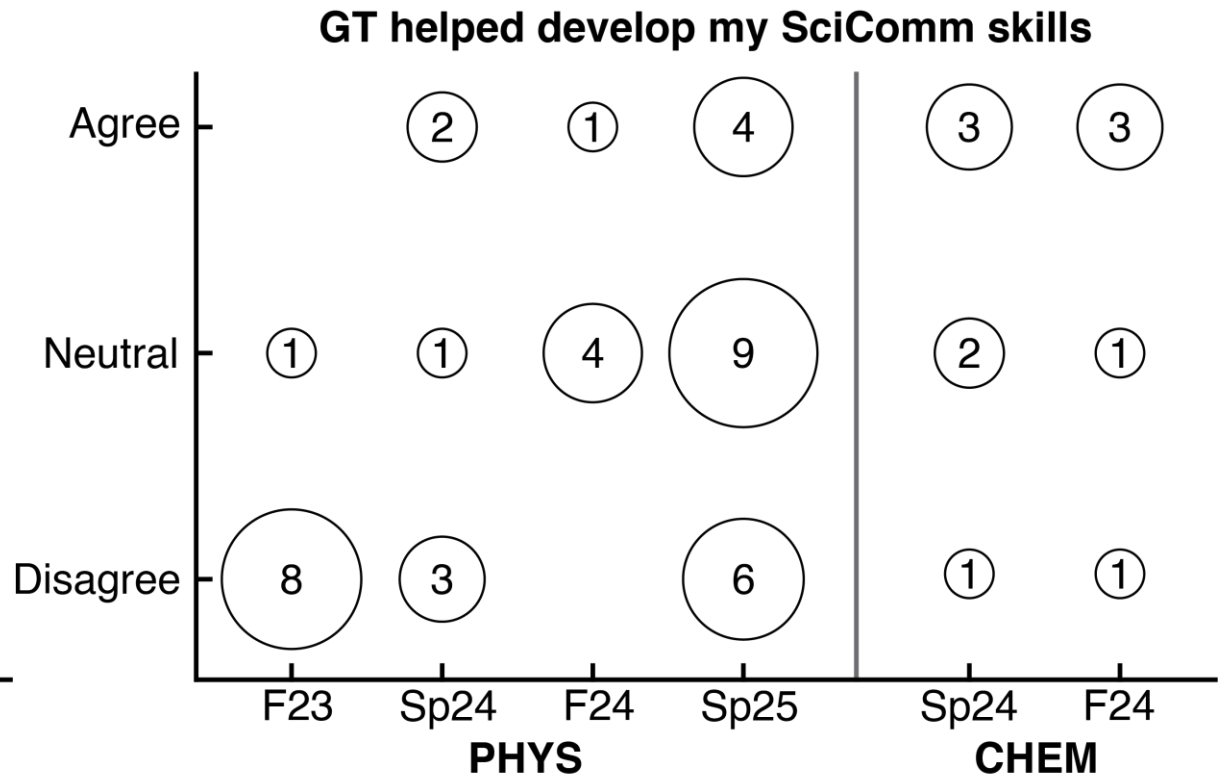
There are a variety of methods that teachers can use to help significantly improve student presentation skills.

Research-based instruction in PHYS 4602 helped students deliver presentations with **comparable quality** to those by students with **multiple opportunities for practice and feedback** in CHEM 4601.



Student attitudes toward learning science communication remain positive when any direct instruction is employed.





Pairwise exact permutation tests adjusted with Holm-Bonferroni correction (PHYS only):

F23 is worse than Sp24 ($p < 0.01$) and Sp25 ($p < 0.01$).

F23 is worse than Sp24 ($p < 0.05$), F24 ($p < 0.01$), and Sp25 ($p < 0.05$).

Ongoing changes to PHYS 4602 are improving student learning outcomes and beliefs.

- Student presentation quality improves with:
  - **Practice and feedback** (CHEM 4601, $p < 0.001$)
  - **Research-based instruction** (PHYS 4602, $p < 0.01$)

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- **Lack of direct instruction** on presentation skills **harms student attitudes** toward PHYS 4602 ($p < 0.01$) and learning science communication at GT ($p < 0.01$).

For group information,
visit https://per.gatech.edu/

Let's chat!
PERC Poster B-105
Wednesday, 8:20–9:00pm,
Independence West + BCDE

Other works, presented by **Abigail Creyts**:
PER: Student Reasoning: Part I
Monday, 2:24–2:36pm, Constitution DE
PERC Poster A-81, Wednesday, 7:30–8:10pm