Georgia Tech

PER @ GT

Reflecting to Learn in a Physics Multimedia Communication Course

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SUMMER MEETING
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Acknowledgements

Thank you to PER @ GT group members:

Dr. Emily Alicea-Muñoz
Dr. Michael Schatz
Dr. Edwin Greco
Dr. Prabha Padukka
Andrew Wu
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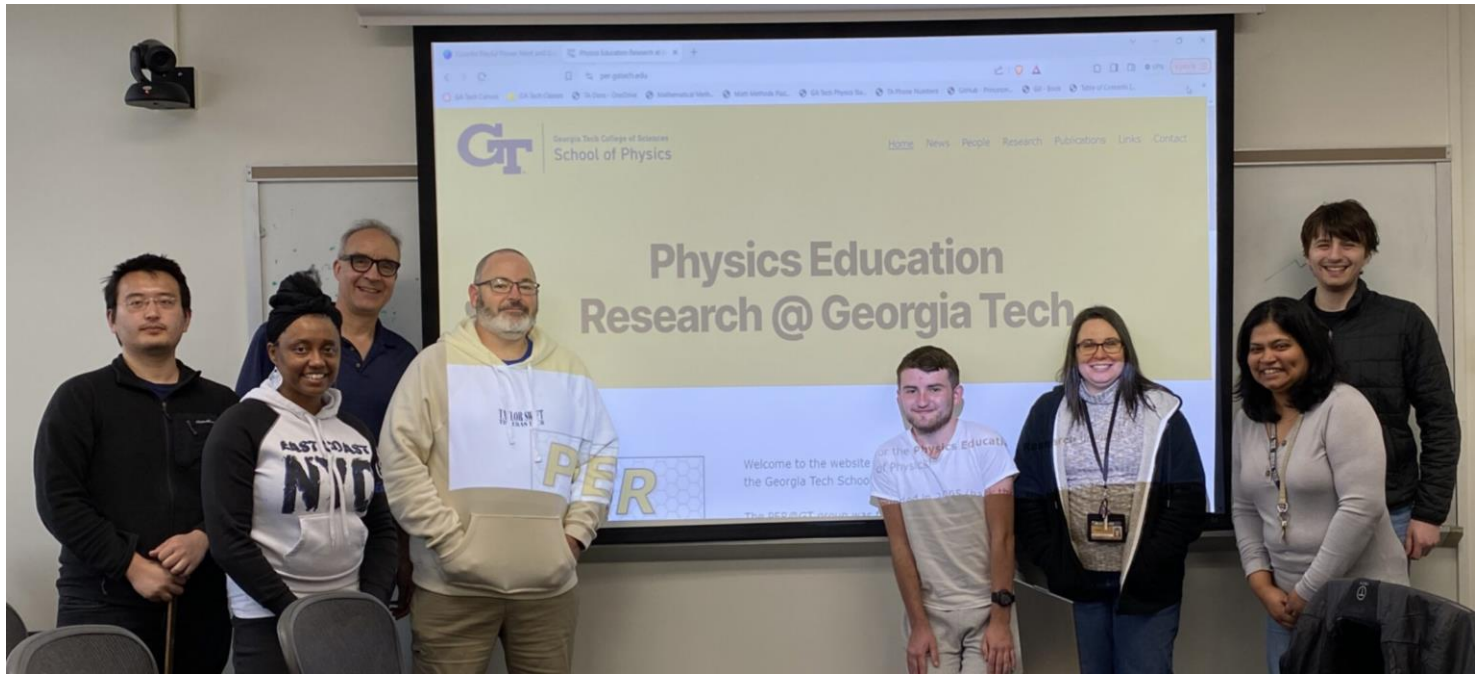


Thank you to collaborating instructors:

Dr. Colin Parker
Dr. Itamar Kimchi
Dr. Mary Peek
Dr. Martin Jarrio

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

- National organizations **emphasize** the importance of developing **science communication skills** in students.
- Still, employer accounts suggest physics graduates are **deficient** in social and communicative skills [Sarkar et al., 2016].
- High enrollment and limited class resources present **barriers** to providing students ample opportunities **to practice** presentation skills.

Adherence to CTML principles is a proxy for presentation quality.

- Cognitive Theory of Multimedia Learning **(CTML)** models visual & auditory processing [Mayer, 1997].
- Principles from CTML provide a framework for understanding **presentation quality**.
- Evaluate student presentations on **seven** principles.

Coherence:
Omit extraneous details.

Signaling:
Visually guide learners through content organization.

Students have dual roles in the physics communication course at GT.

Students as presenters

- Students have varied prior communication experience.
- Students present **once** per semester.
  - 8 min presentation + 2 min Q/A
  - Topics: research at GT, summer internship, upper-division course topic

Students as observers

- Randomly assigned peer evaluations per presentation
  - **Treatment:** reflection activity [Girard et al., 2011]
  - **Control:** assess engagement; distract from reflection
- End-of-class quiz on concepts from that day's presentations

	F23 (Instructor 1)	**Sp24 (Instructor 2)**
Consent rate	32/42	17/20
Presentation rate	4 per class	3 per class
Presentation date	Self-selected	Randomized
Instruction	None	First 4 weeks

How do the dual roles interact?

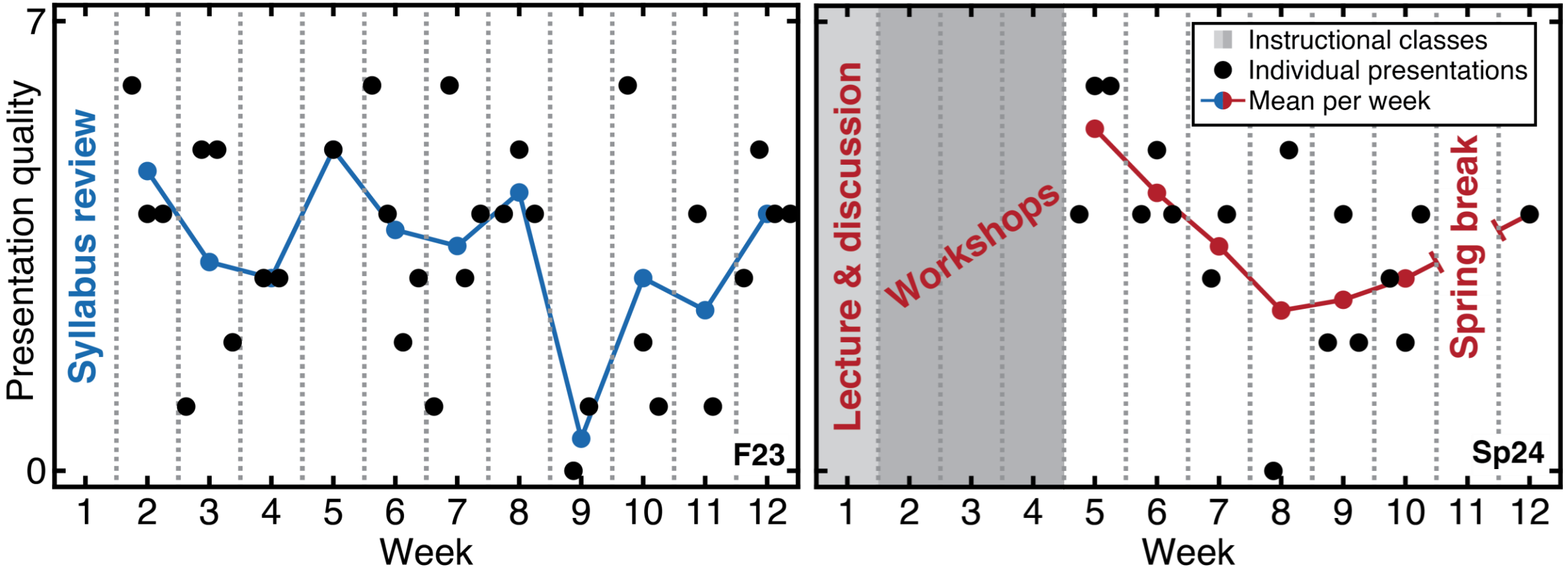
Students as presenters

- Is presentation quality affected by…
  - …reflection on peer presentations?
  - …instruction on presentation standards?

Students as observers

- Are learning outcomes from peer presentations affected by…
  - …reflection?
  - …presentation quality?

Presentation quality appears unaffected by observation, reflection, and instruction on presentations.

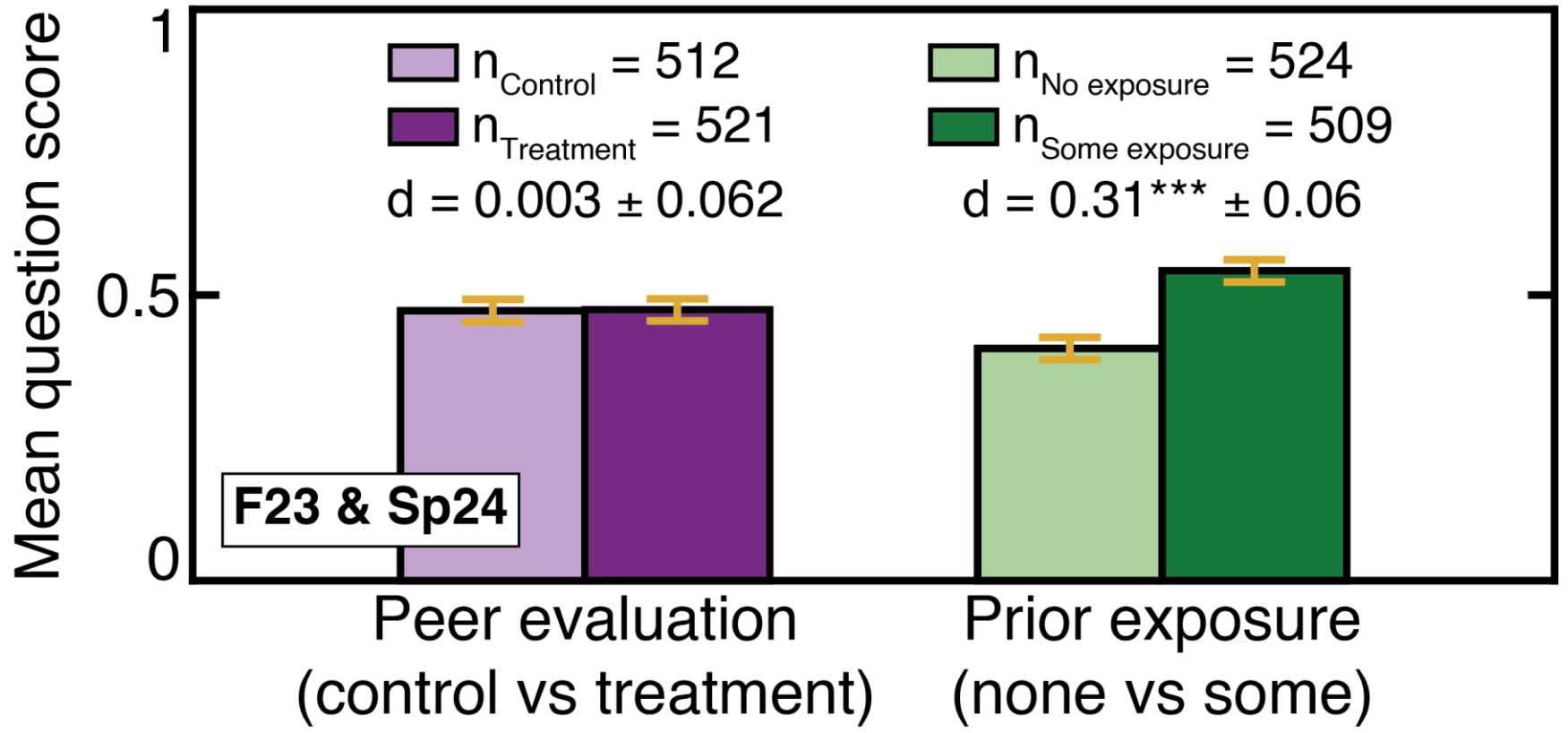


Presentation quality as measured by CTML remained **roughly constant** throughout F23.

One-sided Mann-Whitney *U* test **does not suggest a significant improvement** due to four weeks of instruction in Sp24 ($p = 0.38$).

Student quiz performance was linked more to prior exposure than in-class reflection.

Rubric: Full credit = 1 / Partial credit = 0.5 / No credit = 0



We observed no statistically significant differences between responses from students who filled either type of peer evaluation.

Lower and even reversed effect sizes corroborate common criticisms of CTML within PER.

Multimedia Design Principle	n_{defy}	n_{obey}	Measured effect size (Cohen's d)	Established effect size [Mayer, 2020] (Cohen's d)
Redundancy: Avoid text that is redundant with narration or images.	29	20	-0.25 ± 0.06; $p < 0.001$	0.72

- CTML studies rarely occurred in classroom.
  - Prerecorded, heavily scripted presentations
  - Presentations lasted under 2 min; 8-10 s per slide
  - Psychology Subject Pool at UCSB
- Large intrinsic cognitive load in this course may reverse Redundancy principle.
  - PER emphasizes multiple overlapping visual representations [Opfermann et al., 2017].

For details of other principles, see:
S. W. Tarr and E. Alicea-Muñoz,
2024 PERC Proceedings, **in review**.

Reflection and instruction were insufficient for developing undergraduate physics presentation skills.

- Widespread support for the development of science communication skills is **incongruous** with our current academic environment.
- Within our study, student presentations seem **unaffected by** observation, reflection, and instruction on **peer presentations**.
- Audience retention and transfer were primarily **affected by prior exposure** to presentation content.
- CTML principles may require **amendments** specific to the physics classroom.

Let's chat!
PERC Poster B68
Poster Session 2.2
Wednesday, 8:50–9:30pm, Galleria

For more details, see:
S. W. Tarr and E. Alicea-Muñoz,
2024 PERC Proceedings, **in review**.

Presenter: Steven W. Tarr
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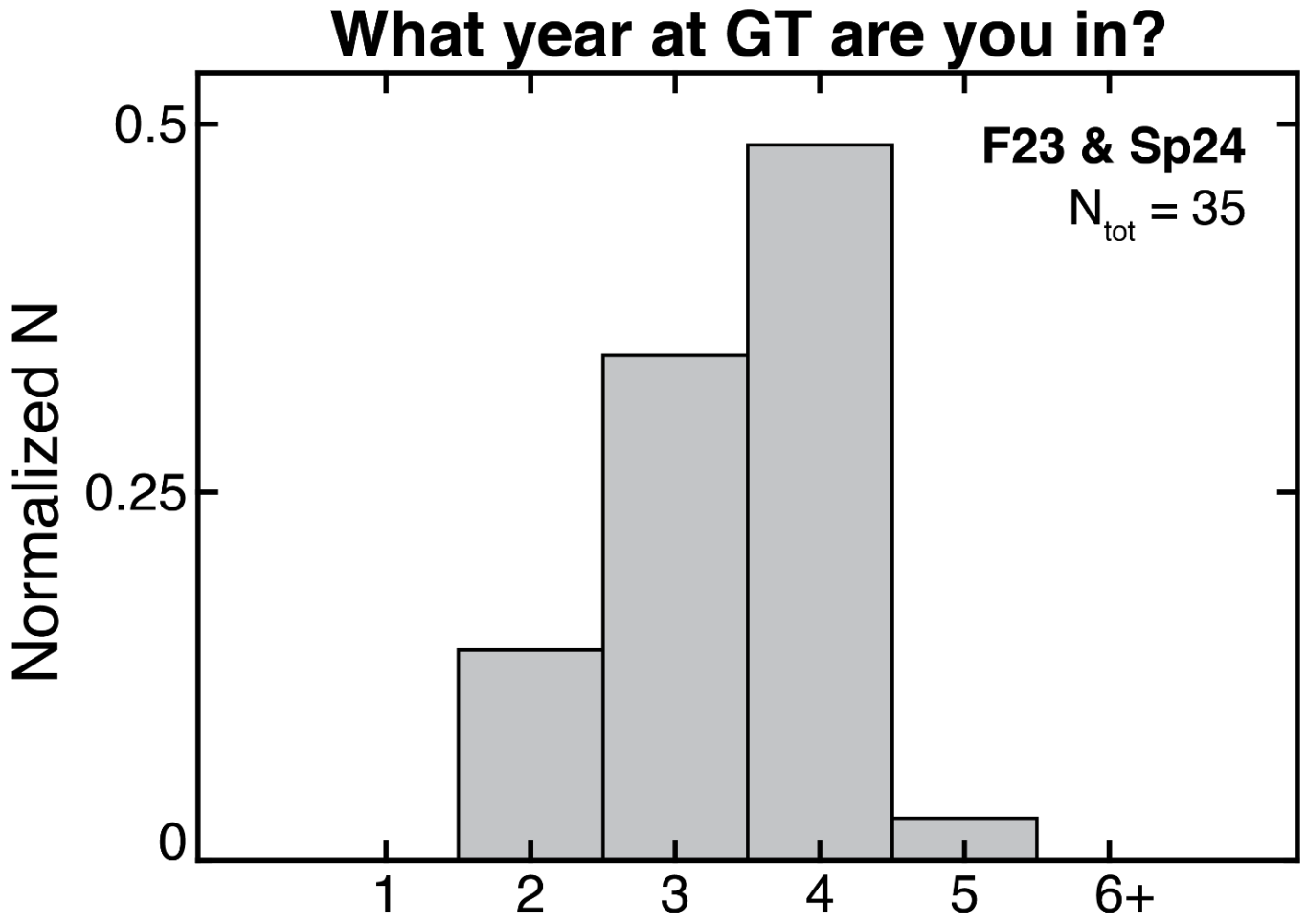
For group information,
visit https://per.gatech.edu/

Seniors constitute the largest subset Senior Seminar students, but they do **not** constitute a majority.



Peer evaluations

Treatment form

	Needs improvement	Just okay	Good	Excellent
Presentation content	☐	☐	☐	☐
Presentation quality	☐	☐	☐	☐

Have you encountered the presentation topic in any of the following? Check all that apply.

- ☐ College course other than Senior Seminar II
- ☐ Research at Georgia Tech (not in class)
- ☐ Internship/REU
- ☐ Reading/Watching for my own interest(s)
- ☐ Other (please specify): _____

Please list two content items you learned or felt were presented well:

1. _____

2. _____

Please list two techniques the presenter used that contributed to the presentation quality:

1. _____

2. _____

Control form

	Needs improvement	Just okay	Good	Excellent
Voice was clear, audible, and well-modulated.	☐	☐	☐	☐
Graphics and on-screen text are legible.	☐	☐	☐	☐

Have you encountered the presentation topic in any of the following? Check all that apply.

- ☐ College course other than Senior Seminar II
- ☐ Research at Georgia Tech (not in class)
- ☐ Internship/REU
- ☐ Reading/Watching for my own interest(s)
- ☐ Other (please specify): _____

What has your experience with the presentation topic been like in the past? Please briefly describe other presentations (classroom or otherwise) you have seen on similar topics:

_____

_____

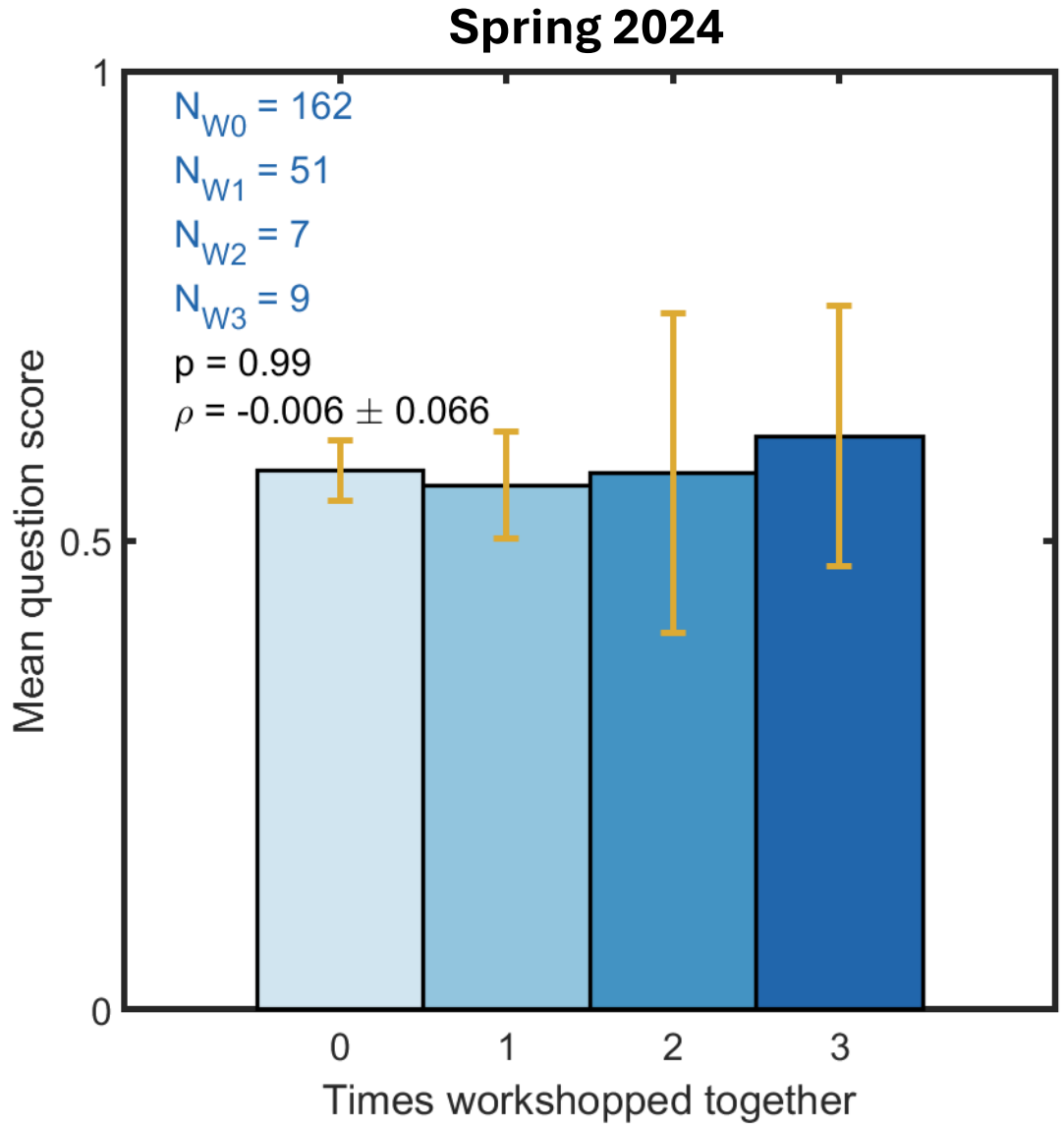
Please describe your level of engagement throughout the presentation and how it compared with the experience(s) described above:

_____

_____

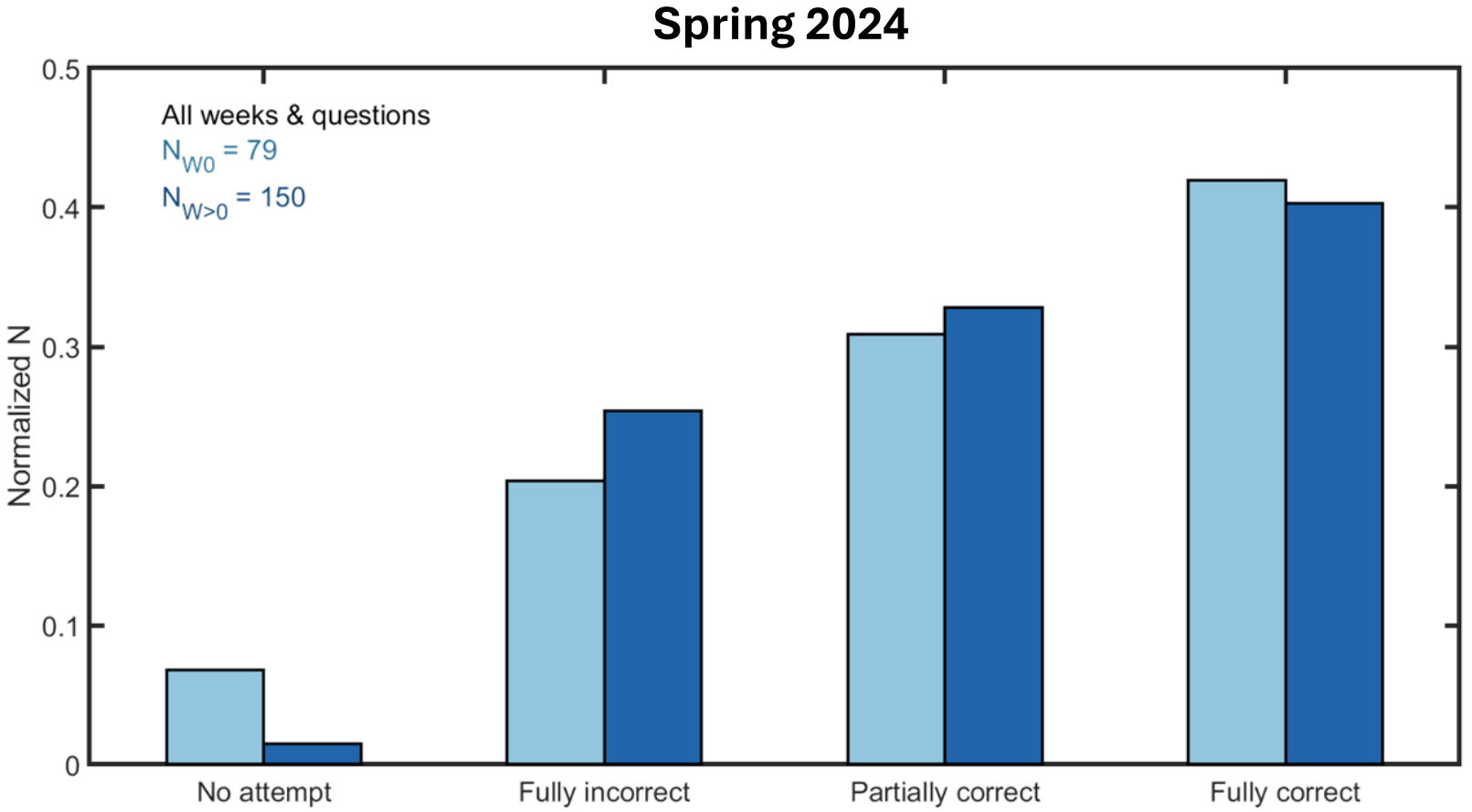
Kruskal-Wallis and Spearman's ρ tests do not show significant correlation between quiz performance and workshop group.

Despite workshops largely focusing on quiz question choice and developing matching presentations, students who workshopped together did **not** significantly outperform others on their quizzes.

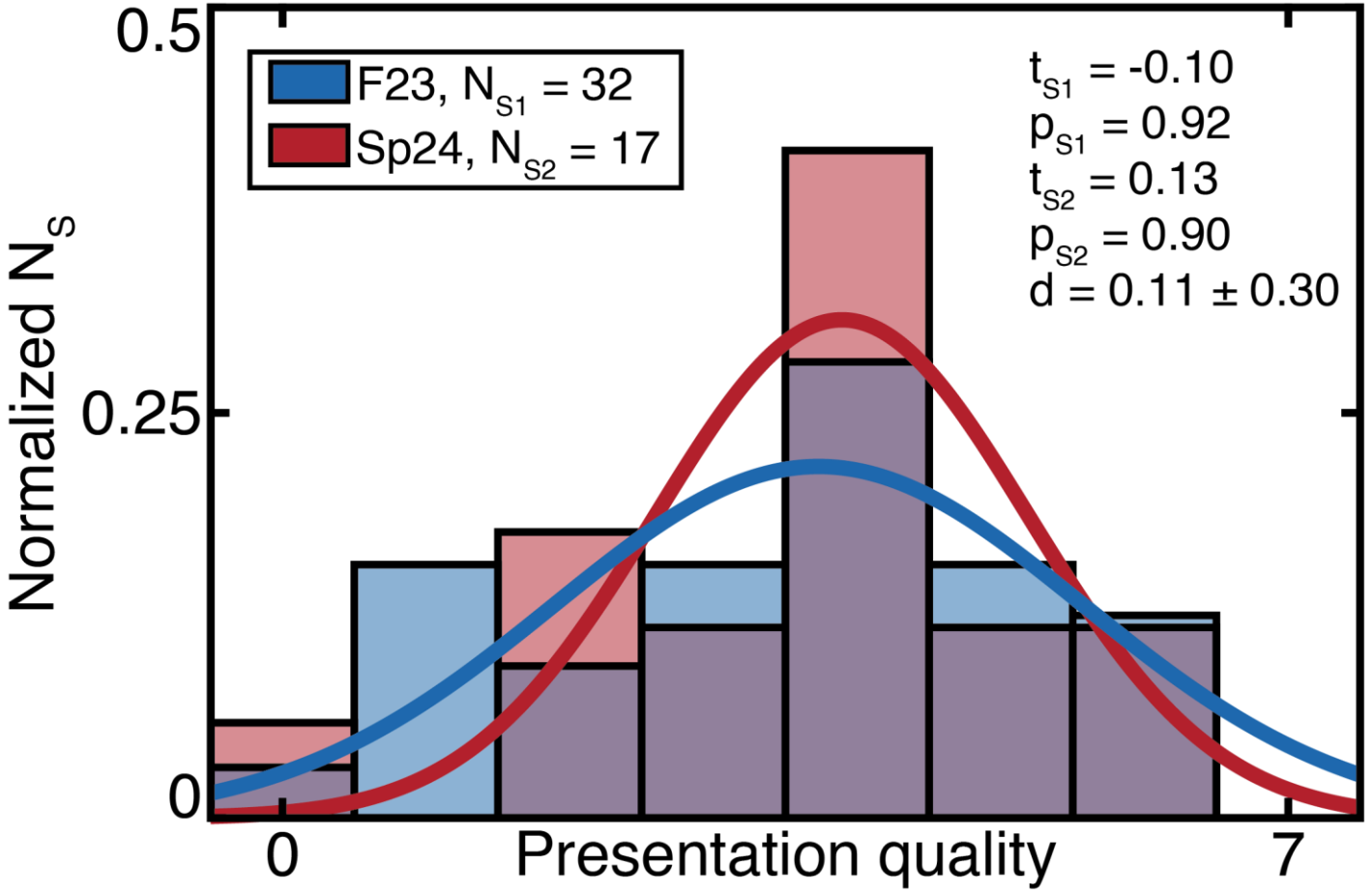


Kruskal-Wallis and Spearman's ρ tests do not show significant correlation between quiz performance and workshop group.

Students who workshopped together at least once were **more likely to attempt** an answer. However, these answers were **more often fully incorrect**.

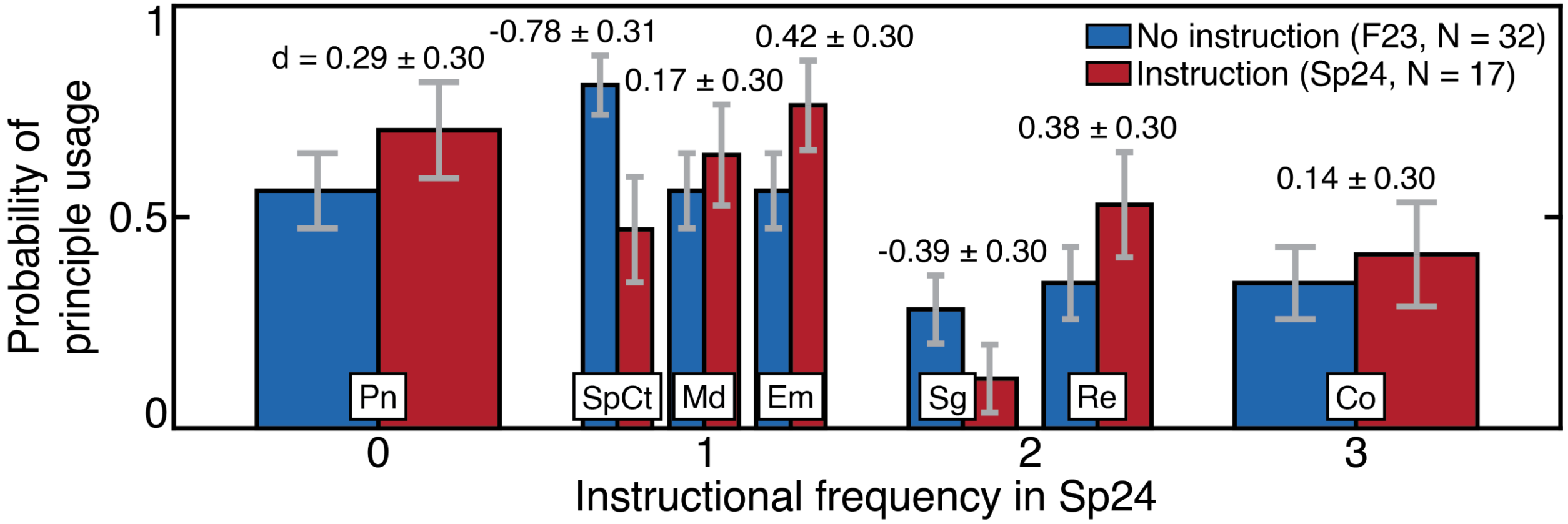


Instruction had an inconclusively small effect size on student presentation quality.



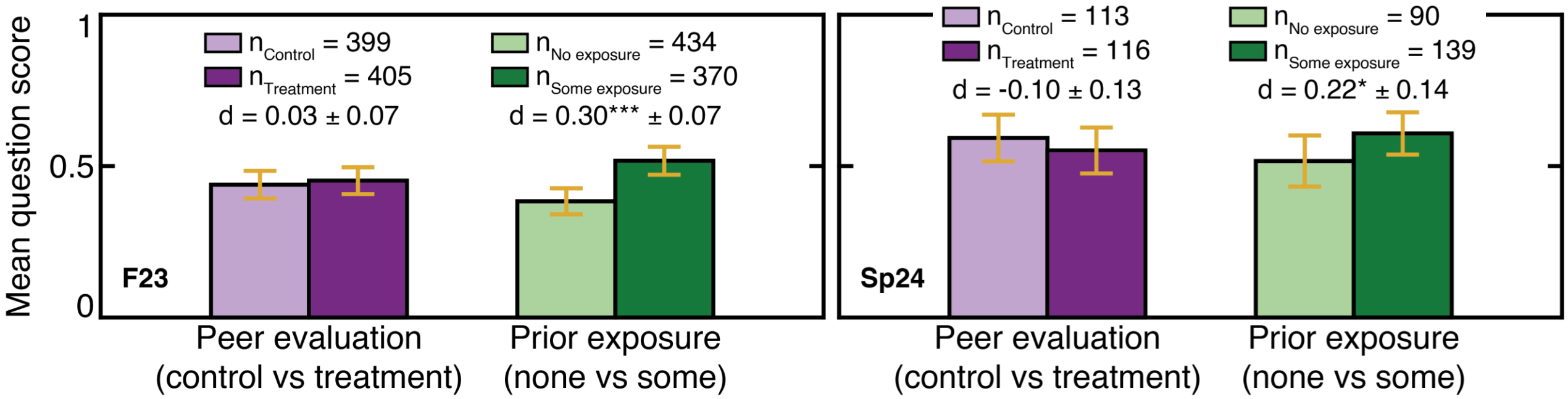
One-sided Mann-Whitney *U* test does not suggest that the Sp24 students improved due to instruction (p = 0.38).

We did not observe significantly greater CTML adherence following instruction.



A one-sided Mann-Whitney *U* test does not suggest student improvement due to instruction on individual CTML principles.

Overall effects on quiz performance are reproduced per semester.



Lower and even reversed effect sizes corroborate common criticisms of CTML within PER.

Multimedia Design Principle	n_{defy}	n_{obey}	Measured effect size	Established effect size [Mayer, 2020]
Coherence: Omit extraneous, seductive details.	31	18	$0.14^{*} \pm 0.07$	0.86
Signaling: Visually guide learners through content organization.	38	11	0.13 ± 0.07	0.70
Redundancy: Avoid text that is redundant with narration or images.	29	20	$-0.25^{***} \pm 0.06$	0.72
Spatial Contiguity: Place corresponding slide contents near each other.	15	34	$-0.22^{**} \pm 0.08$	0.82
Modality: Complement graphics with narration, not blocks of text.	20	29	0.030 ± 0.063	1.00
Personalization: Use a conversational, informal style.	19	30	$0.53^{***} \pm 0.06$	1.00
Embodiment: Augment instruction with dynamic, physical expression.	18	31	0.014 ± 0.064	0.58

$^{*}p < 0.05;\ ^{**}p < 0.01;\ ^{***}p < 0.001$