

Transforming the Preparation of Physics GTAs

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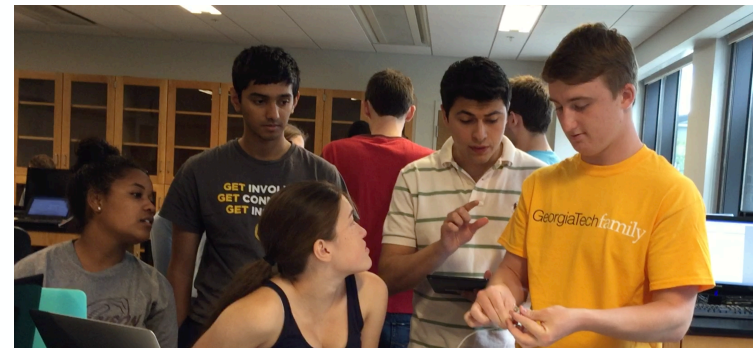
Georgia Institute of Technology

PERC 2020 Meeting

Juried Talk, ID# 8024

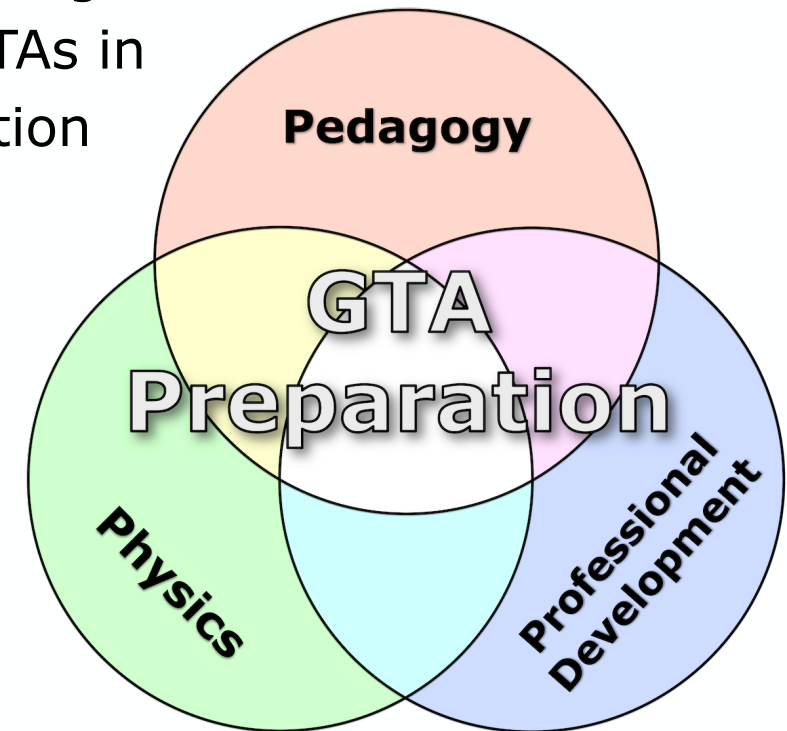
Background

- GTAs are key partners in the education of undergraduate students
- In many large-enrollment intro physics classes, undergrads spend $\sim 50\%$ of their in-class time supervised by GTAs (labs, recitations)
- Potential for large impact on student learning
- **GTAs need preparation for teaching**



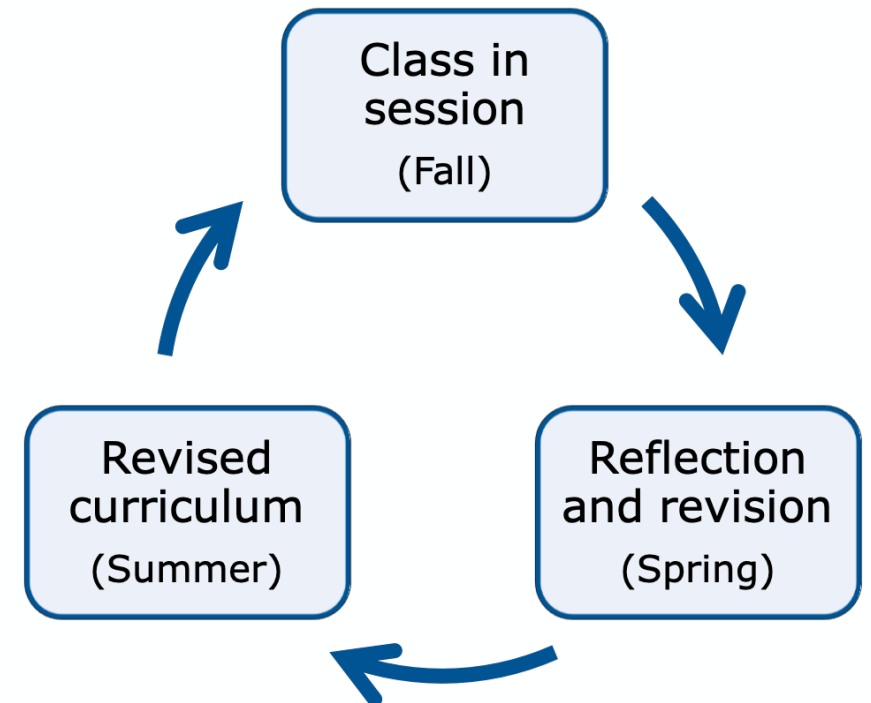
New Perspective on GTA Prep

- A lot of GTA prep literature focuses on preparing future faculty
- Problem: Large fraction of physics PhDs leave academia
- **3P Framework:** in order to have a comprehensive program for GTA preparation that is useful and valuable for GTAs in the classroom and beyond there must be full integration between:
 - ❖ **Pedagogy** – the methodology of teaching
 - ❖ **Physics** – content and PCK
 - ❖ **Professional Development** – transferable skills useful inside and outside academia

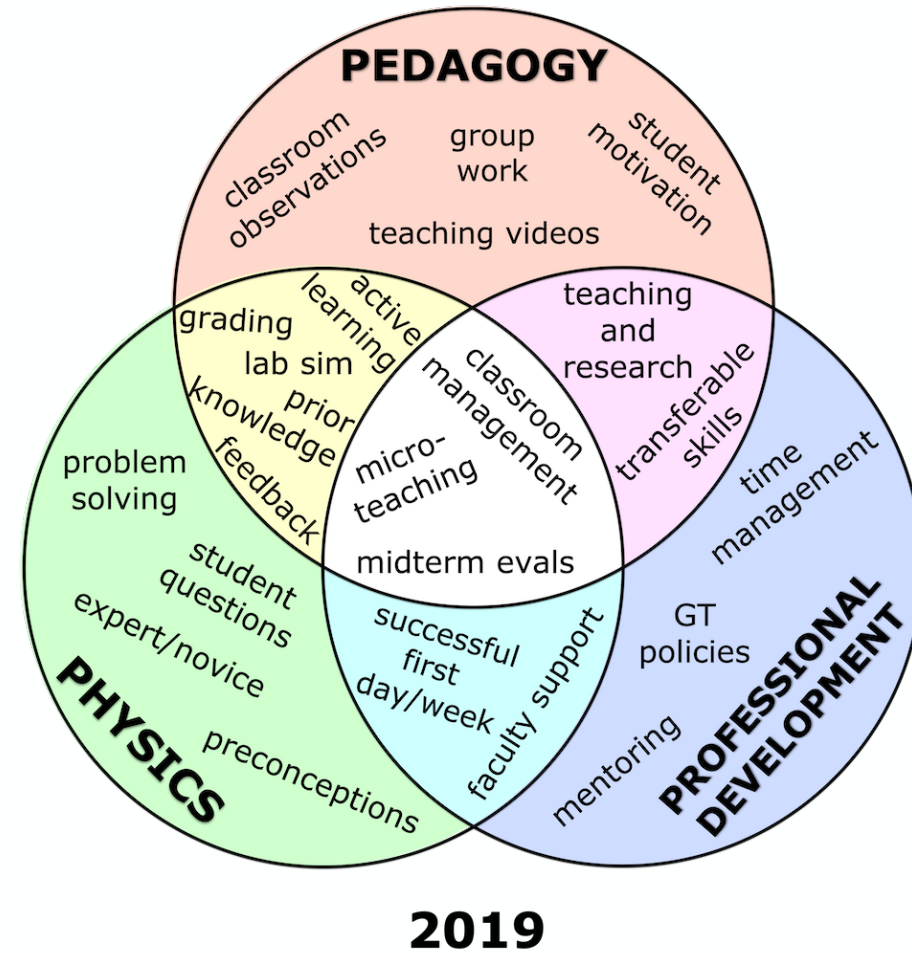
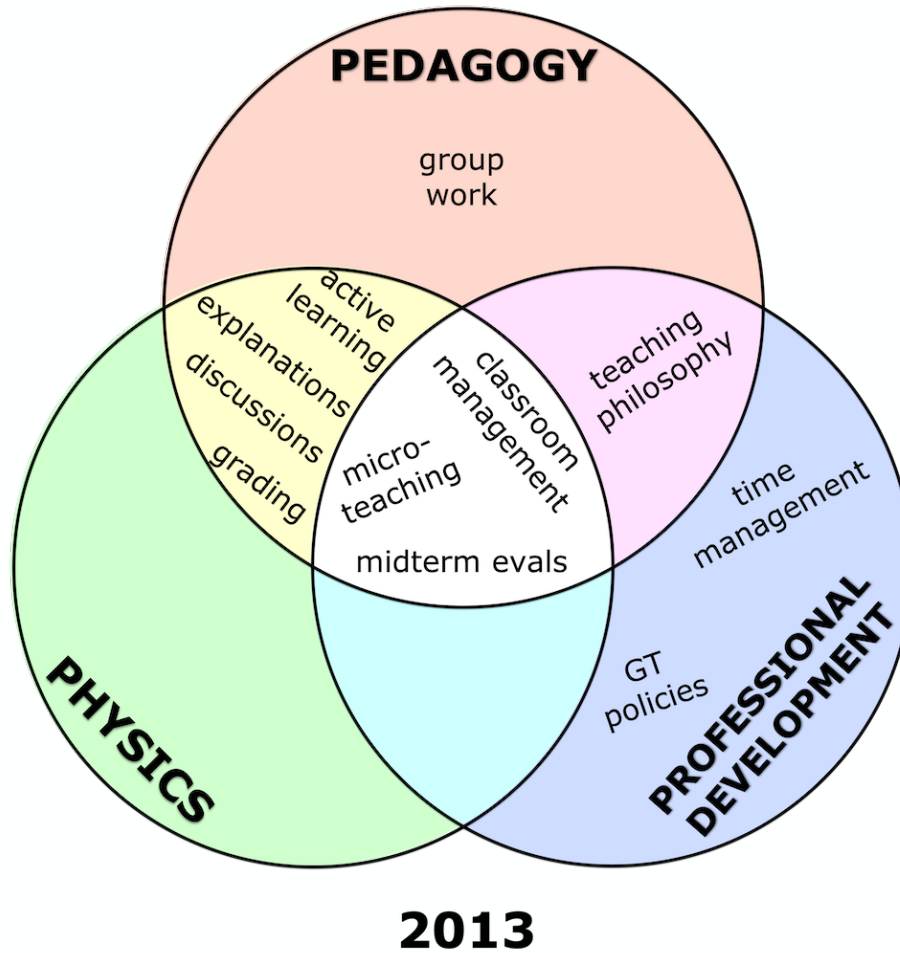


GT Physics GTA Preparation

- One credit hour, pass/fail, required for first-year PhD students who are concurrently first-time GTAs
- Established in 2013; to date has prepared 152 grad students
- Course design follows best practices for GTA preparation found in research literature
- Curriculum development follows a yearly cycle of implementation and revision, based on assessment data and self-reflection



Curriculum Evolution



Course Structure

Orientation

(before GTA duties begin)

1. Introduction & GT Policies
2. Teaching Physics
3. Classroom Management
4. Lab Simulation
5. Microteaching

Follow-Up Meetings

(during Fall semester)

1. Grading
2. Midterm Evaluations & Time Management
3. Teaching Videos
4. Teaching and Research
5. Concluding Remarks

Outside class time: Classroom Observations, Workload Surveys, Peer Mentoring

Research Questions

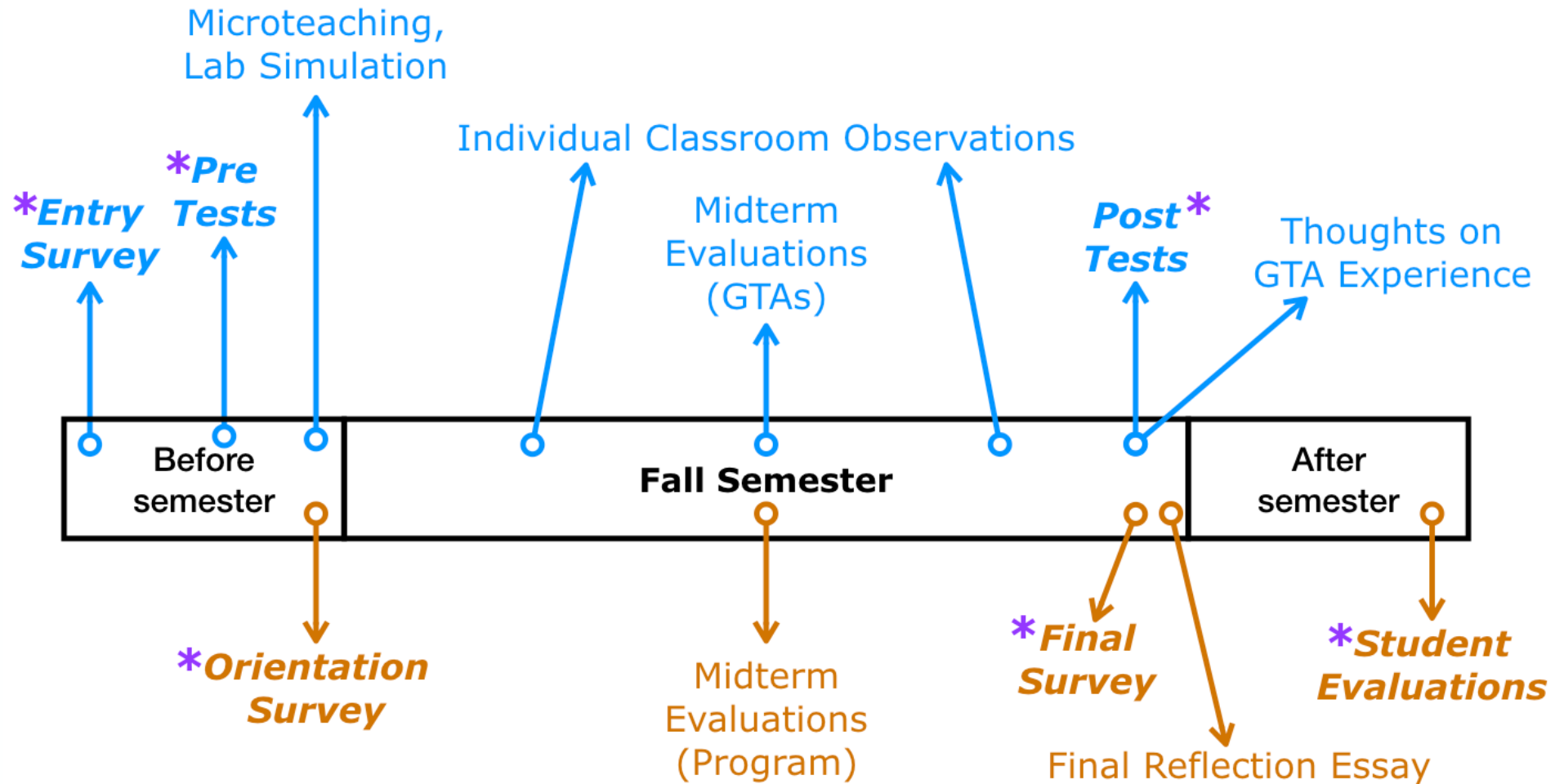
- What elements of a formal GTA preparation program do GTAs perceive as the **most useful** or beneficial for their professional development?
- What effect does a formal GTA preparation program have on graduate students' **teaching self-efficacy** and **attitudes** about teaching?
- Does a formal GTA preparation program have an effect on graduate students' **teaching effectiveness**, as determined by end-of-semester student evaluations?

Course Enrollment

Total enrollment 2013-2019: 152

Year	Enrollment	Informed consent
2013	22	0 (0%)
2014	13	8 (62%)
2015	34	29 (85%)
2016	23	19 (83%)
2017	26	20 (77%)
2018	16	13 (81%)
2019	18	pending
Total 2014-2018	112	89 (79%)

Assessment Points



Assessment Model

- Assessments selected for current analysis give us a broad idea of how effective the GTA prep class has been (the forest); future work will focus on finer details (the trees)
- Modified Kirkpatrick Model*
 - ❖ Reaction – Orientation Survey, Final Survey
 - ❖ Learning – Pre/Post ATI and Knowledge Quiz
 - ❖ Behavior – Classroom Observations (future analysis)
 - ❖ Results – End-of-semester student evaluations (as proxy)
- Mixed methods approach (quantitative and qualitative data)

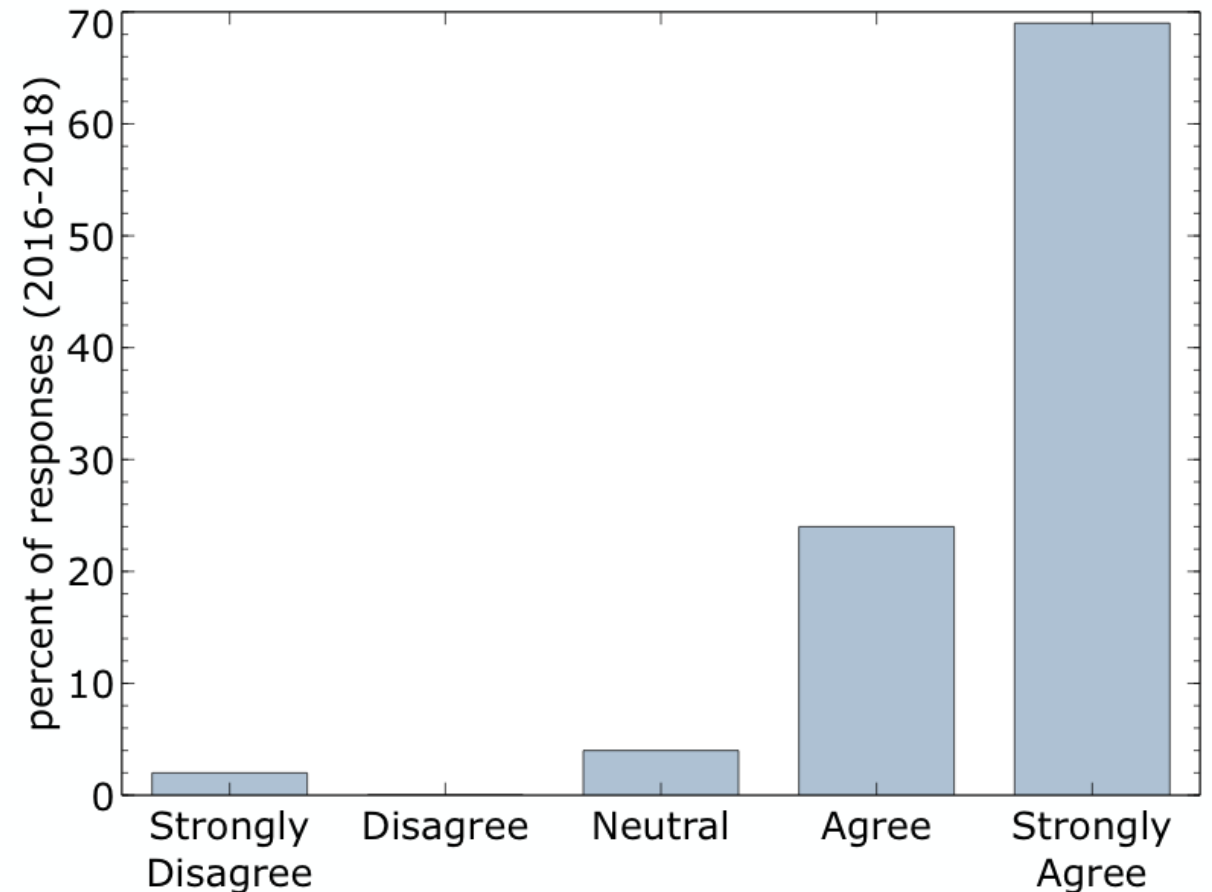
* Kirkpatrick, *Evaluating Training Programs: The Four Levels*, 1994

* Wyse et al, *CBE-Life Sciences Education*, 13, 2014

Results: Entry Survey

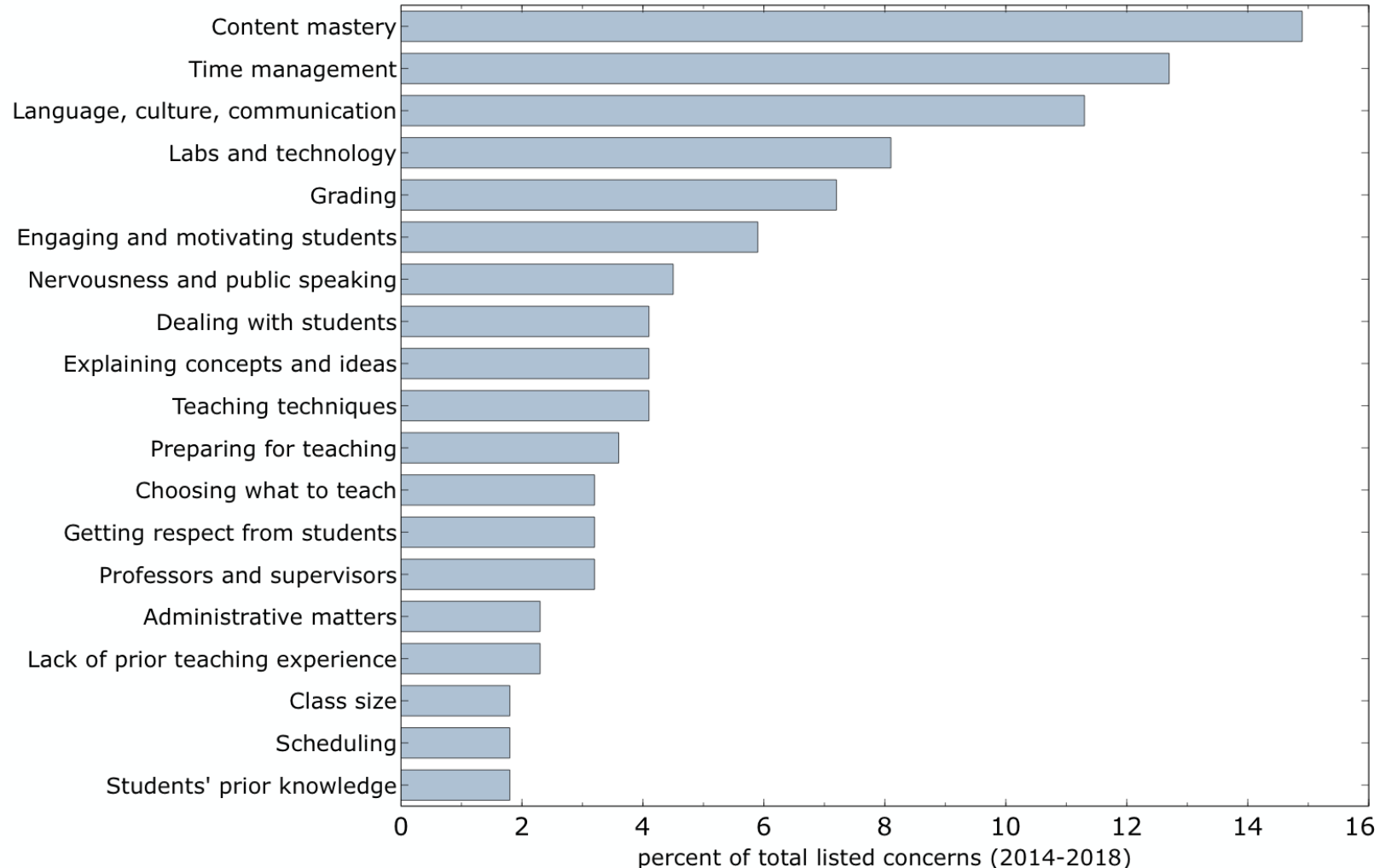
- Not anonymous
- **Item 1:** Prior teaching experience
 - ❖ No = 59%; Yes = 41%
- **Item 2:** Please indicate your level of agreement with the following statement:

“I consider teaching to be an important part of my professional development as a physicist.”



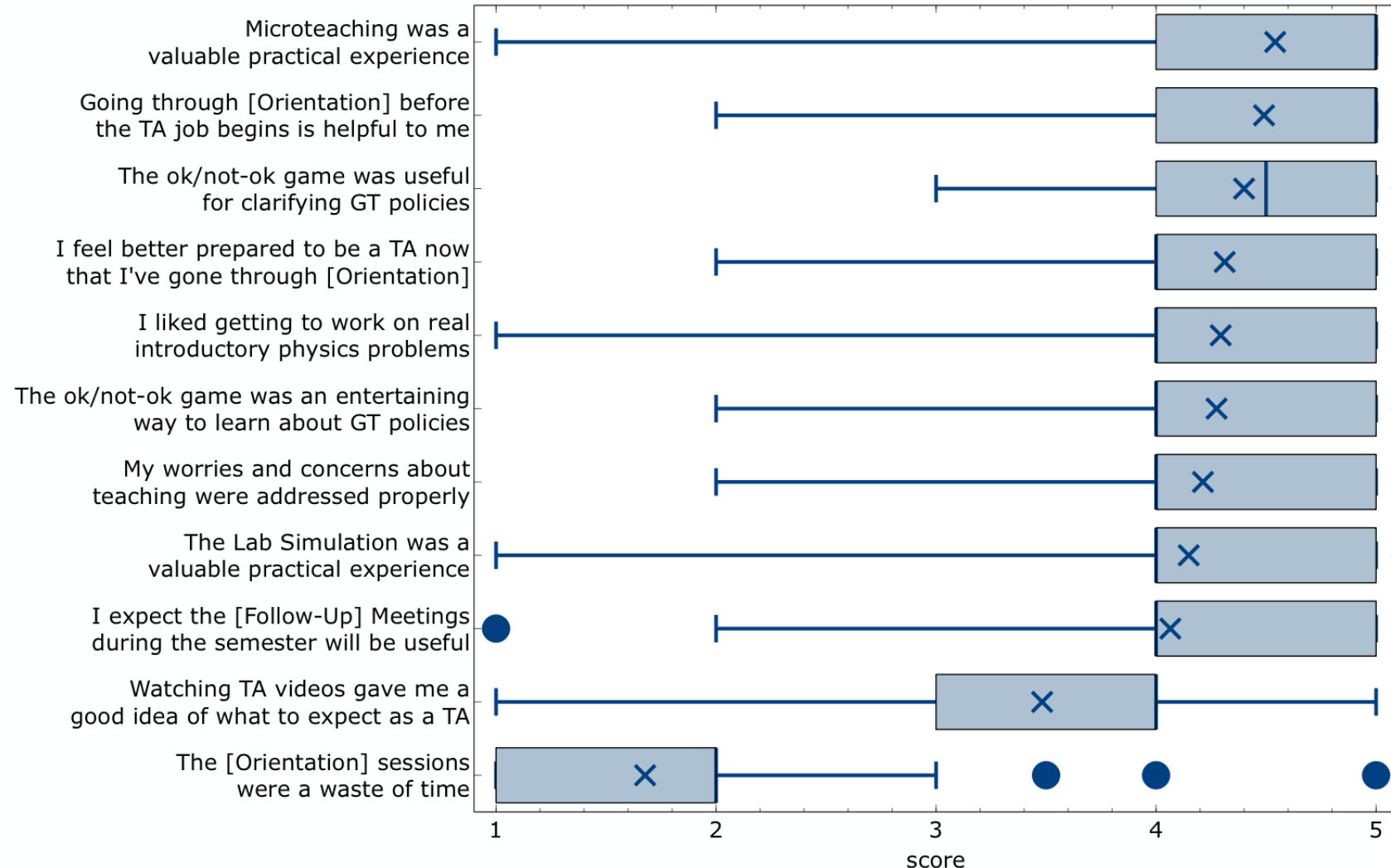
Results: Entry Survey

- **Item 3:** Indicate your top 3 concerns about teaching
- 221 concerns, coded into 19 categories
- First-time GTAs worry about their physics knowledge, time management, communication skills



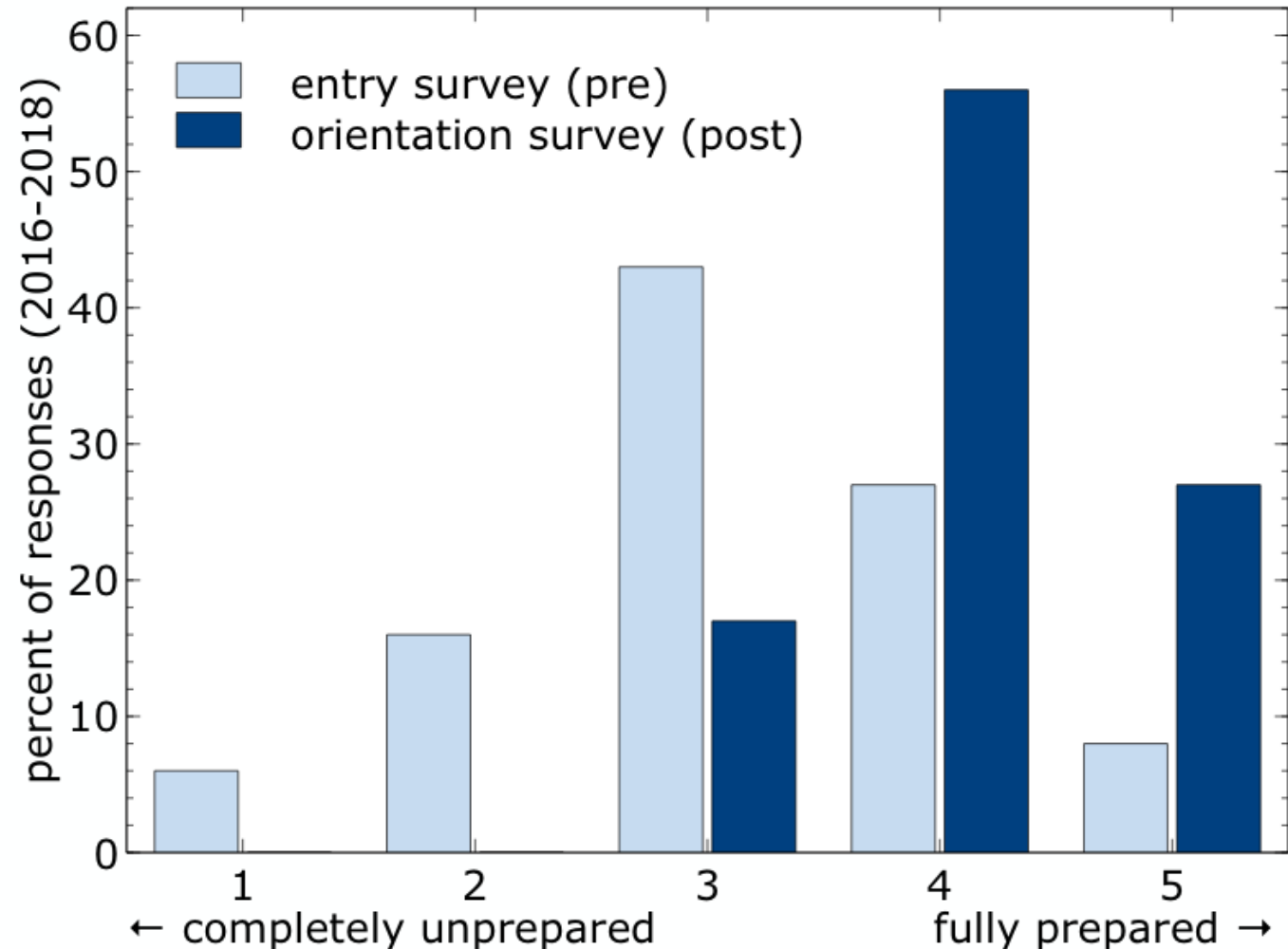
Results: Orientation Survey

- Anonymous
- Likert-like statements
- Ratings suggest GTAs enjoy the interactive nature of the class and consider the Orientation to be useful



Results: Orientation Survey

- “How prepared do you feel for your first GTA assignment at Georgia Tech?”
 - ❖ Pre: Entry Survey
 - ❖ Post: Orientation Survey
- GTAs feel better prepared for teaching after the Orientation
 - ❖ KS test, $p < 0.001$
 - ❖ Very large effect size (Cohen's $d = 1.333$)



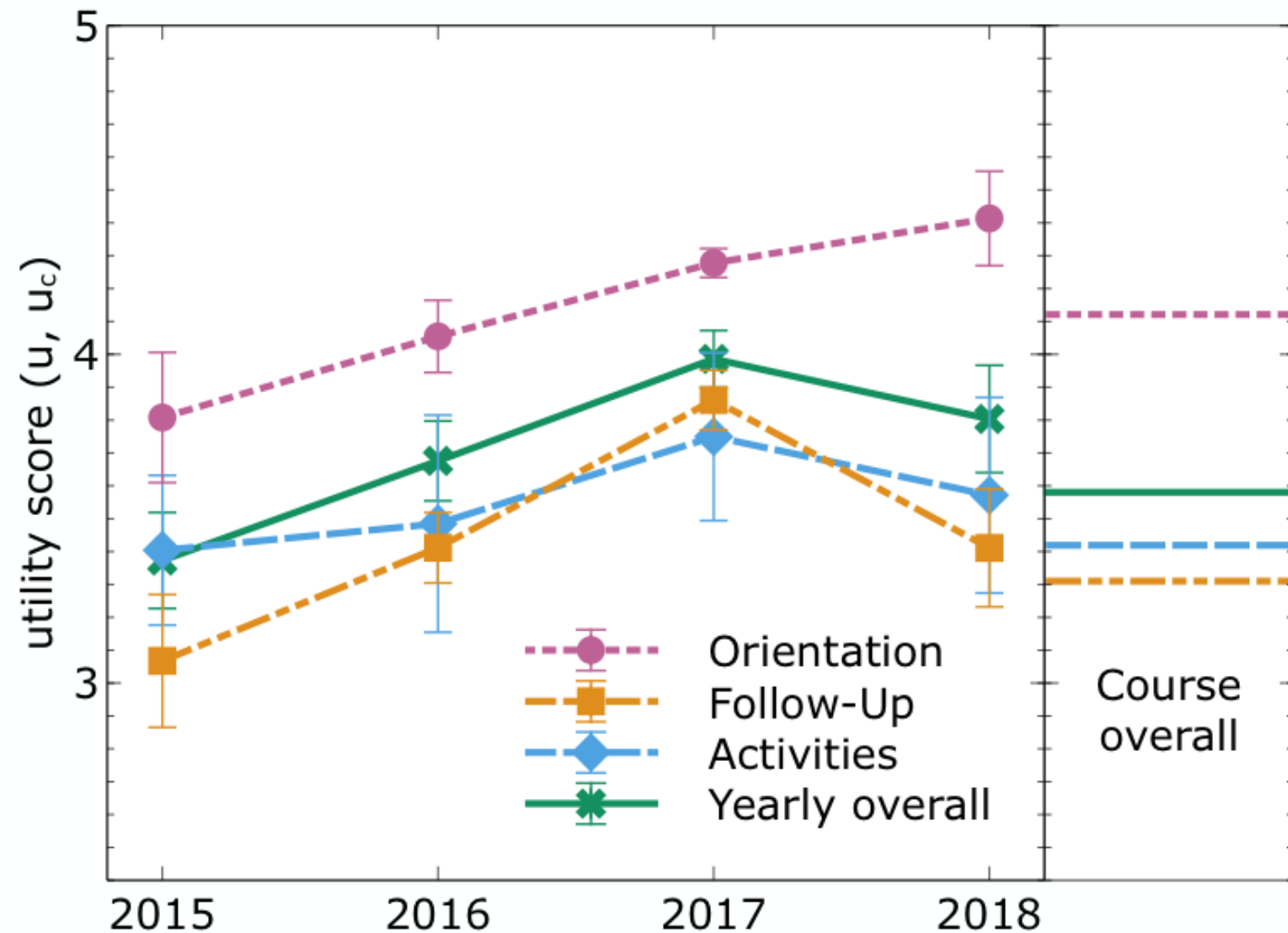
Results: Final Survey

- Overall top 3 most useful: Microteaching, Lab Simulation, Teaching Physics

- Utility scores: mean of means

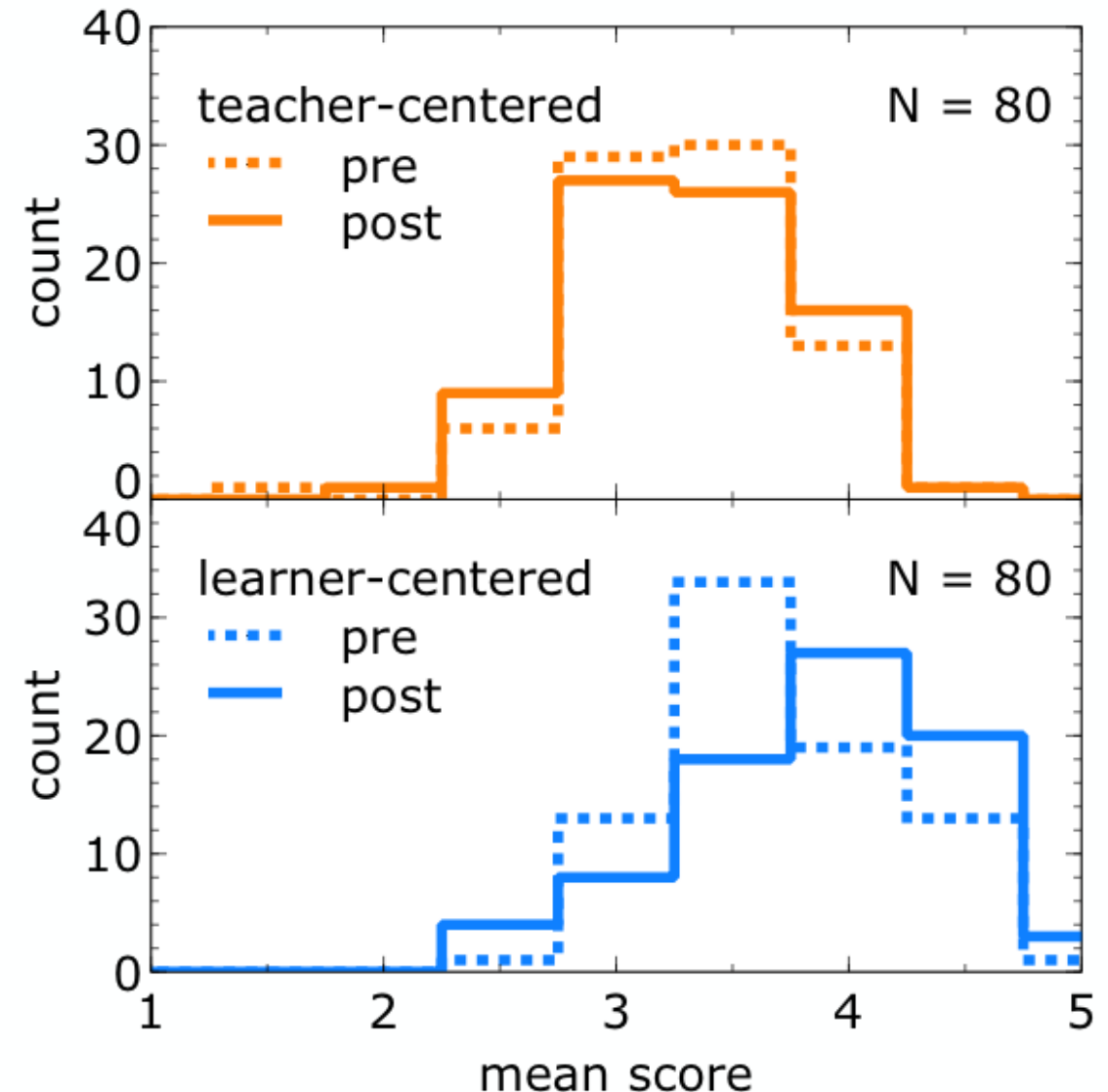
$$u = \frac{1}{N} \sum_i M_i$$

- Orientation: most useful overall AND year-by-year



Results: Pre/Post ATI

- Approaches to Teaching Inventory*
- Two Likert scales: teacher-centered and learner-centered
- Complete case analysis
- No statistical difference in pre/post teacher-centered distributions
- Statistical difference in pre/post learner-centered distributions though small effect size (Cohen's $d=0.254$)



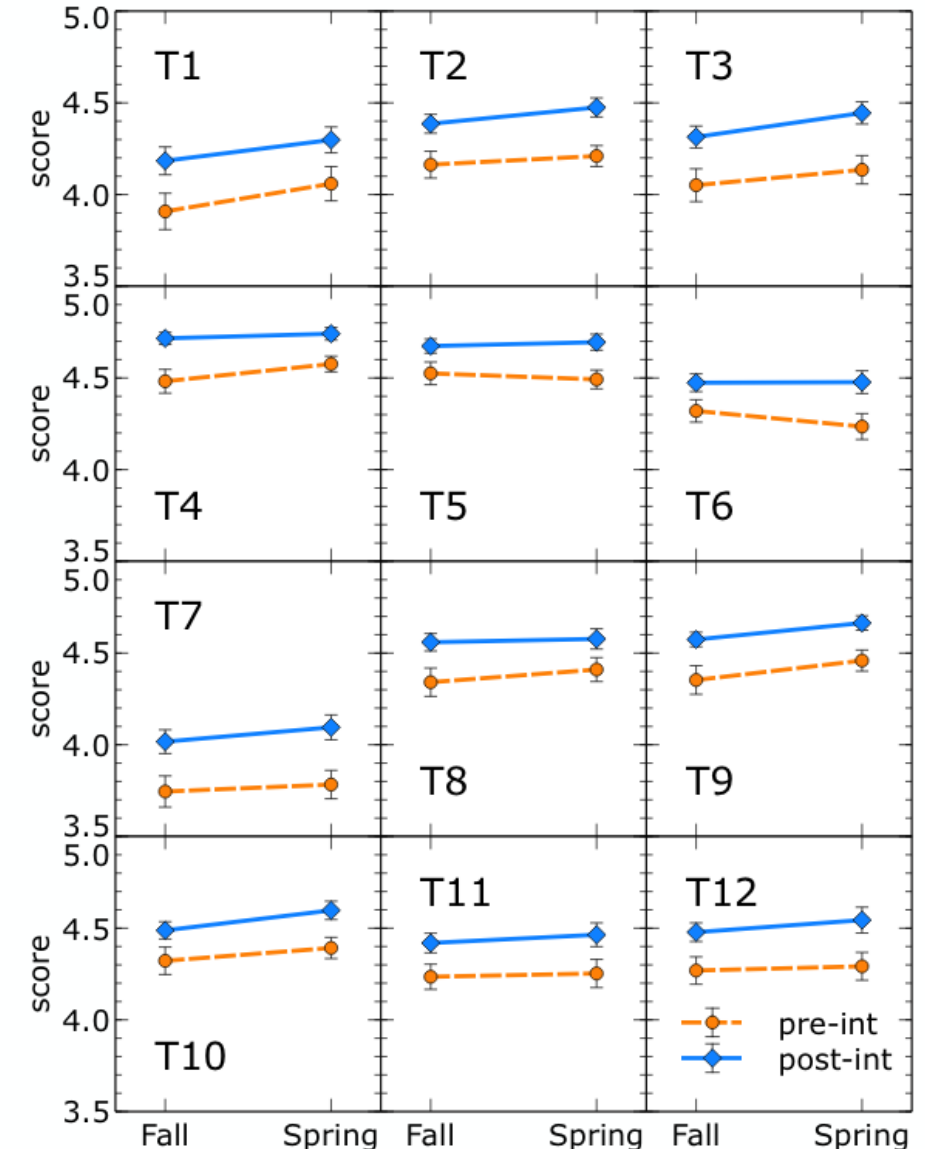
Results: Student Evaluations

- **Caveat:** tons of research showing student evaluations of teaching are biased, cannot be used alone to determine teaching effectiveness
- Data from first Fall and first Spring semesters of teaching
- **Pre-intervention:** GTAs with first teaching experience 2011-2012
- **Post-intervention:** GTAs with first teaching experience 2013-2015

Item Code	Description
T1	Oral communication skills
T2	Written communication skills
T3	Explained concepts clearly
T4	Familiarity with course concepts
T5	Respect for students
T6	Attitude about their teaching role
T7	Stimulated interest in subject
T8	Approachability
T9	Level of preparedness
T10	Classroom management
T11	Actively engaged students
T12	Overall effectiveness

Results: Student Evaluations

- Post-intervention group always rated higher, and most differences are statistically significant
- First Spring generally higher than First Fall
- Highest rated: familiarity with concepts, respect for students, approachability, level of preparedness
- Lowest rated: stimulated interest in subject
- Skewed ratings (few 1's and 2's)



Answering the RQs

- What elements of a formal GTA preparation program do GTAs perceive as the **most useful** or beneficial for their professional development?
 - ❖ *Microteaching, Lab Simulation, Teaching Physics*
 - ❖ *GTAs appreciate hands-on activities in which they get to practice teaching and receive feedback on their performance*
 - ❖ *GTAs are interested in developing the pedagogical content knowledge necessary for teaching physics*

Answering the RQs

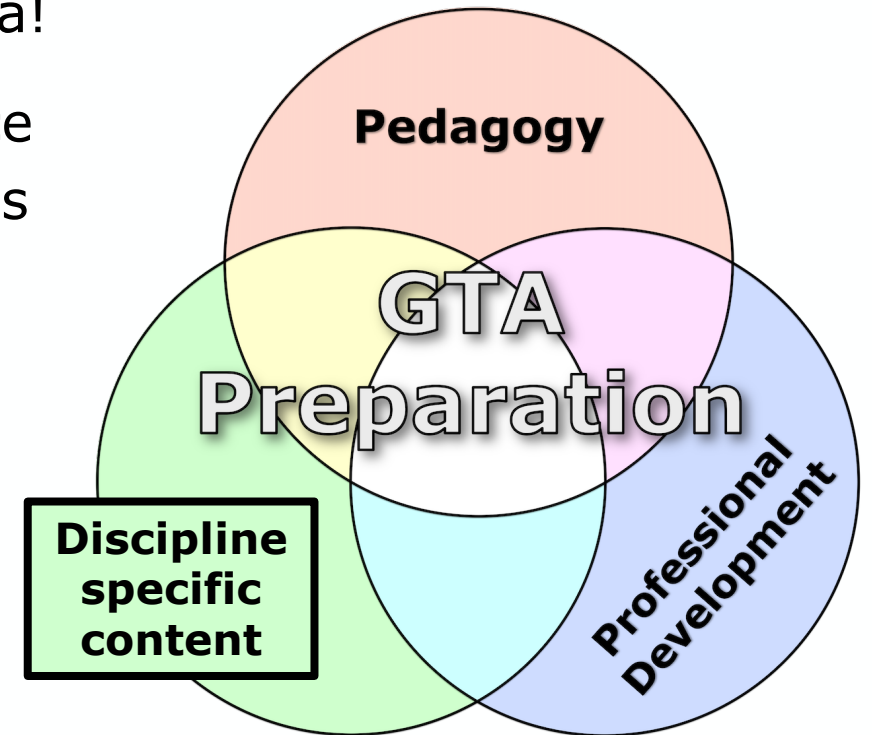
- What effect does a formal GTA preparation program have on graduate students' **teaching self-efficacy** and **attitudes** about teaching?
 - ❖ *GTAs report feeling better prepared for teaching after participating in the Orientation*
 - ❖ *GTAs adopt more learner-centered approaches to teaching after participating in the GTA prep course*

Answering the RQs

- Does a formal GTA preparation program have an effect on graduate students' **teaching effectiveness**, as determined by end-of-semester student evaluations?
 - ❖ *GTAs who participate in the GTA prep course are rated consistently higher in end-of-semester student evaluations than GTAs who predated the course*

Significance to PER

- There is no “one-size-fits-all” approach to GTA preparation
- Lots of work has been done, but most of it focuses on GTAs as future faculty
- We shouldn’t ignore the ones who leave academia!
- The 3P Framework can provide universal guidance that ensures broader professional development as an integral part of GTA preparation
- Generalized to other fields: 3P → PDP (pedagogy, discipline-specific content, professional development)



Summary

- The Physics GTA Preparation course successfully **integrates** pedagogy, physics, and professional development
- Our GTA prep course satisfies the principles for **best practices** in GTA preparation, and is effective at preparing GTAs for their teaching roles
- GTAs consider the practical teaching activities in the class to be useful, feel better prepared for teaching after going through the class, and adopt more learner-centered teaching approaches
- Our method of curriculum development, the 3P Framework, can provide **universal guidance** for GTA preparation that is useful for graduate students no matter what their career goals are

Thanks for watching!

More information:

- **AAPT Invited Talk, ID #10066:** “Roleplaying in GTA Preparation: Microteaching and Lab Simulation” (example of practice/feedback activities for physics GTA preparation)
- **AAPT Contributed Talk, ID #10426:** “Research Results and Best Practices for GTA Preparation” (summary of literature results and recommendations for GTA training)

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GTA preparation research
and course materials:

<https://tinyurl.com/eaaliceaGTAPD>