

Physics students who teach cultivate a deeper sense of professional identity

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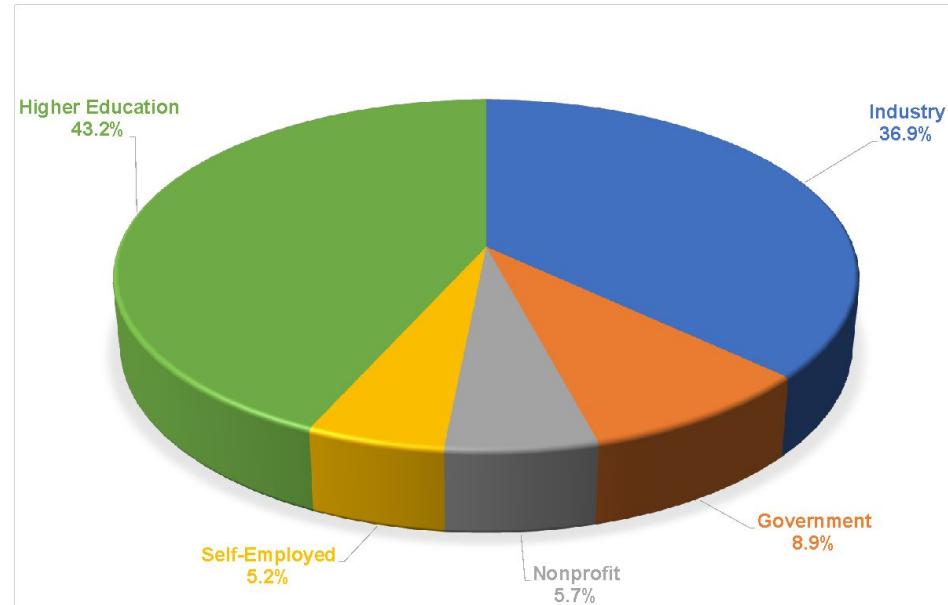
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Most science & engineering PhDs do not go on to academic careers

...but many PhD programs still focus primarily on preparing students for faculty positions

PhD students hence often underprepared in skills needed for non-academic careers

We should be equipping PhDs for success, regardless of career aspirations



Source: National Science Foundation, Science and Engineering Indicators 2020

Most science & engineering PhDs do not go on to academic careers

Instead of focusing on specific careers, we need students to build strong *professional identities*

Professional identity encourages sense of belonging, helping students persist in their field

Connecting ideas across disciplines & applying abstract knowledge to real problems is key

Helping students cultivate professional identity is largely missing from physics graduate education

Professional identity:

Internal & external recognition as a professional

Requires:

- disciplinary expertise
- understanding of importance of discipline
- how to use knowledge for greater good

How do we help physics graduate students cultivate a deeper sense of professional identity?

Disciplinary Stewardship - a quick overview

- A disciplinary steward is one who "...will creatively **generate** new knowledge, critically **conserve** valuable and useful ideas, and responsibly **transform** those understandings through writing, teaching, and application" (Golde, 2006, p. 5).
- Elkana (2006) argues one cannot be a professional in the sciences without also being a teacher and one who adds to the public understanding of science. Professional scientists must be able to communicate science so that it is responsive to social context rather than simply regurgitating explanations.

How do we help physics graduate students cultivate a deeper sense of professional identity?

Our project: **GIFT: Graduate Identity Formation through Teaching** (NSF-IGE #1806698)

GIFT promotes **graduate student (GS)** professional identity via disciplinary stewardship

Focuses on the transformation component through teaching/communication

Encourages students to consider how their disciplinary knowledge can:

- be communicated across disciplinary boundaries (Lawson, 2014)
- solve real-world problems (O'Meara & Jaeger, 2006)
- serve a purpose larger than one's career trajectory (Golde, 2006)



GIFT: Graduate Identity Formation through Teaching

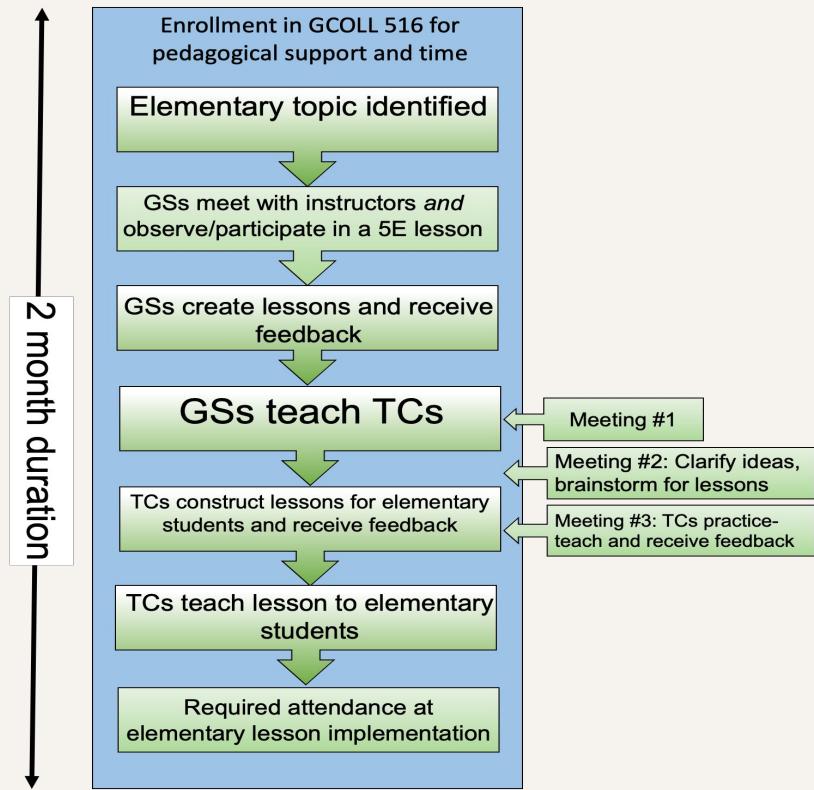
In GIFT, GSs are supported to construct adult-level, inquiry-based, 30-minute lessons based on specific K–6 Next Generation Science Standards

GSs serve as disciplinary experts by teaching their lesson to **elementary teacher candidates (TCs)**

TCs then turn this knowledge into 15-minute mini-lessons for elementary students

Finally, GSs observe TCs teaching the lesson to K–6 students, and reflect on the entire experience

GIFT: Graduate Identity Formation through Teaching



Methods

Four semesters of GIFT

Participants

- 31 STEM GSs from physics, plus biology, engineering & geology
- 28 consented to study
- 15 self-identify as female, 13 self-identify as male
- 3 Black, 2 Hispanic, 2 Asian, 1 two or more races, 20 White

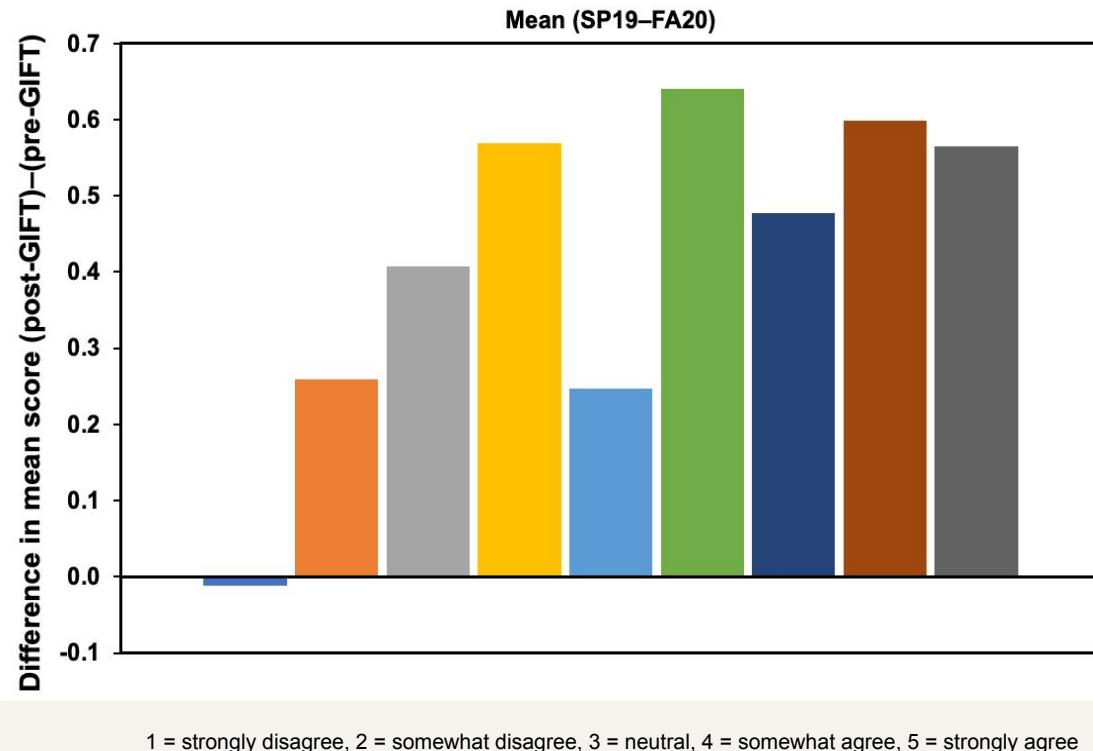
Data Collection

- Assignments from 1-cr course (written reflections)
- Interviews (n=25)
- Pre/post-survey to share thoughts on personal growth over semester, their experiences, and potential impact of GIFT on their career (n=22 pre-, n=21 post-; survey completion fell during pandemic)



Findings relating to confidence in abilities

- I can appropriately use tools and skills necessary in my field
- I understand and can explain big concepts in my field
- I can identify the 'giants' in my field and summarize their contributions
- I can identify unique and meaningful contributions and problems to investigate in my field
- I can conduct research that meets the standards of credible work in my field
- I can articulate the core values and ethical responsibilities of my field
- I can communicate big ideas in my field to those outside of my field
- I can identify ways in which my field can contribute to society.
- I can articulate the accepted behaviors, attitudes, and norms in your field (in terms of philosophies, approaches, research, etc.)



Findings relating to confidence in abilities

“I can articulate the core values and ethical responsibilities of my field”

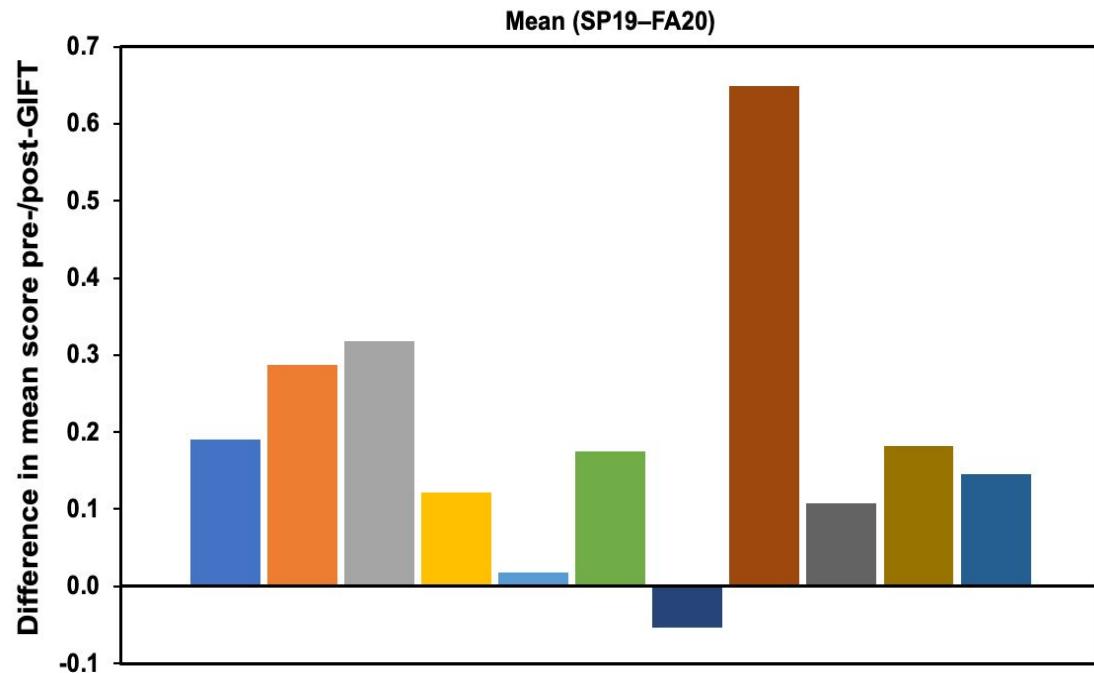
Mean response increased from 3.59 in the pre-survey to 4.29 on the post-survey ($P = 0.003$).

Some GSs reported feeling an increased responsibility to share their work with the public, “*especially those that aren't in a STEM or related field.*”

“GIFT has made me consider how I will represent my discipline as a STEM professional. This includes making ethical research decisions, not ignoring injustices within my field, and communicating ideas from my field to others. It's made me think a lot more about how important it is to be able to share my findings with a larger audience. It's also made me think about my responsibility as a STEM professional to teach and mentor students within my field.”

Findings relating to professional identity

- Being a scientist/engineer is an important part of my self-image
- I have a strong sense of belonging to the community of scientists/engineers
- Being a scientist/engineer is an important reflection of who I am
- I believe I have the knowledge and skills to be a valuable part of the science/engineering community
- Others whose opinions I value view me as a scientist/engineer
- I am a scientist/engineer
- I intend to work in a job related to science/engineering
- I feel committed to my science/engineering field
- I believe I can integrate 'who I am' as a person with 'what I do' in my science/engineering field
- I expect a career in this field will be very satisfying
- Others in my field view me as a competent member of our community



1 = strongly disagree, 2 = somewhat disagree, 3 = neutral, 4 = somewhat agree, 5 = strongly agree

Findings relating to personal identity

“I feel committed to my science/engineering field”

Mean response increased from 4.06 in the pre-survey to 4.65 on the post-survey ($P = 0.020$).

For some GSs, this increased feeling of commitment came from realizing that their graduate degrees would allow them to have broader interests and career possibilities, so they did not need to choose between their current field and something else.

“GIFT has made me realize that being a PhD student does not mean I must become a researcher to put my expertise to use. I can still utilize science for the public good by other means.”

Others felt increased commitment to their field because they were able to acknowledge their expertise.

“GIFT helped me feel more like an expert in my field by having to interact with others and share the knowledge I have. As such, I am more confident as an engineer now than before starting GIFT.”

Does GIFT help physics GSs cultivate a professional identity and feelings of disciplinary stewardship?

Someone with a strong professional identity might say, *“I see myself and am recognized as a member of the physics professional community, and acknowledge my knowledge and skills in the field.”*

Our results show GIFT nurtured this feeling in GSs via the transformation aspect of disciplinary stewardship

GSs found that GIFT supported them in:

- feeling more committed to (and belonging to) their field
- allowing them to consider their field's core values and responsibilities to the public
- seeing more ways to share their passion for their field with others

In sum, becoming disciplinary stewards (via GIFT) helped GSs deepen their professional identity

GIFT is a promising addition to efforts to provide a graduate education that will serve physics PhDs in a variety of careers, while helping them feel as though they belong and can persist

Importantly, GIFT is transferrable to any STEM PhD program, does not place a huge burden on GSs in terms of coursework, and does not require grant money or university appropriations to run successfully

References and contact information

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