The state of graduate education

Graduate education has historically focused on preparation of future academics/scholars. 

The reality today is that most science graduate students go on to non-academic careers.

As educators, it is our aim to equip every graduate student for success, inclusive of all career aspirations.

We need to focus our efforts on preparing a new type of scholar—one with a strong professional identity that they can carry into their career—rather than preparing a student for a specific type of career.

The Carnegie Initiative on the Doctorate asserts that graduate education should produce stewards of the discipline: people who “creatively generate new knowledge, critically conserve valuable and useful ideas, and responsibly transform those understandings through writing, teaching, and application.”[2]

The importance of professional identity

Professional identity is the “internalization of the norms of the profession into the individual’s self-image...(and) the acquisition of the specific competence in knowledge and skills, autonomy of judgment, and responsibility and commitment of the profession.”[5]

Components of a disciplinary identity are competencies (knowledge), performances (ways of being/doing in a particular discipline), and recognition (internal/external).[6]

Professional identity formation requires one not only to learn the competences and performances related to that discipline, but also why the discipline is important, and how to use one’s expertise for the greater good.

Disciplinary stewardship as a means to form professional identity

Graduate education should support the growth of “the personality, character, [and] habits of heart and mind.”[7]

More specifically, graduate education should allow students to consider how their disciplinary knowledge can solve real-world problems,[8] and serve a purpose that is larger than one’s career trajectory.[2]

The P4 model

The Physics and Preservice Teacher Partnership Project (P4) was created in 2016 in response to research findings that describe soft skills science graduates typically need to be successful, including: o working in a team, o working with others from non-science professions, o communicating technical information to a non-technical audience. o teaching/training others.[9]

Graduate students in PHYS 515 have the chance to: o Observe faculty member using SE, an inquiry learning model[10] o Work with teacher candidates to teach a physics concept and support their development of a lesson around that topic. o Engage in other workshops and discussions on topics in pedagogy. o Develop reflective skills through course activities.

Methods

Participants

• Spring 2016: 4 graduate students (three female, one male).

• Spring of 2017: two graduate (one female, one male) – love numbers due to addition of GCOLL 516 without communicating about benefits of the project to advisors of graduate students.

• Spring 2018: 10 graduate students (6 female, 4 male).

• Spring 2019: 2 graduate students (1 female, 1 male).

• Spring 2020: 9 graduate students (10 female, 1 male). Participating teachers

• Two teachers (one male, one female) from elementary schools in the Boise area.

• Teachers selected based on having a teaching license and being in their third or fourth year of teaching.

• Teachers completed surveys before and after the semester.

The P4 model, continued

The flowchart below illustrates the process of the interactions between graduate students (GSs) and teacher candidates (TCs).

Data collection, Spring 2016

Teacher candidates (N = 11)

• Completed surveys with their graduate student partners.

• Questions included topics such as how often they met, how helpful the instruction was, how helpful the feedback from the GSs was, and what could be done to improve the collaboration.

• Interviewed to follow up on responses to the surveys.

Graduate students (N = 4): o Wrote reflections about their experiences working with the TCs, whether or not they believed their content knowledge was impacted, and what could be done to improve the collaboration.

• Interviewed to follow up on responses.

Data collection, Spring 2017

Teacher candidates (N = 12)

• Took the same survey as the previous year to triangulate responses from the GSs’ surveys.

Graduate students (N=4), partially via GCOLL 516, completed:

• A reflection on their meeting with the first and third author to discuss the content and plan their instruction for the TCs.

• A reflection on their three meetings with the TCs.

• A reflection on their observation of ED-CIFS 333 SE class with the TCs.

• An end-of-semester reflection on what have they have learned and how they had grown educationally and professionally in terms of topics related to their GCOLL 516 experiences.

• GSs also completed a survey in 2017 that combined questions from the previous year’s written reflection and questions from the TC’s survey.

Findings

Methods

Graduate students in PHYS 515 and GCOLL 516 had the chance to:

• Write about their teaching in the CIFS 333 5E class with the TCs.

• Learn about teaching, and how to use their expertise as educators. They will have the opportunity to break down material so that even those with no background in the science will be able to understand it.

Changes from Iteration 1 (Sp16) to 2 (Sp17)

We found that by adding the requirement of GCOLL 516 in Year 2 positively impacted the experience of the graduate students and the partnership overall. These impacts included:

• The graduate students were able to dedicate more time to P4. → OUTCOME: Resulted in more refined lesson plans from the TCs.

• GS had a much stronger focus on pedagogy and teaching as a result of activities related to GCOLL 516. → OUTCOME: GS lessons for TCS were much more active and engaging as compared to those in Year 1, which relied more heavily on lecture.

• GS were engaged in the full cycle of the teaching experience (after teaching lesson to TCS, they met more often with the TCs, reviewed the TCs’ lesson plans, and observed the TCs practicing the lesson). → OUTCOME: GS saw teaching as more of an iterative process than a one-time event.

• As a result of taking GCOLL 516, GSs’ reflections were much richer; they were better able to analyze what they struggled with in the project. → OUTCOME: the addition of GCOLL 516 to P4 afforded the students the chance to develop metacognitive awareness.

Benefits to graduate students’ skills

“I think it gives a glimpse of viewing it from the outside perspective of how other people view what we do and how to interact with them. what do to those who aren’t entrenched in this kind of scientific concept... Perspective is good because if we don’t have the perspective, then we can’t work out our own problem.”

“I definitely would recommend future students to take part in this. Even if you’re not interested in teaching, it will at the very least improve your communication skills. They will have the opportunity to break down material so that even those with no background in the science will be able to understand it.”

Taking GCOLL was definitely a lot extra work, but when I got to visit the elementary school and see the lessons I thought, “This is was better than writing a term paper.” GCOLL gave me the opportunity to learn about teaching, and I’m going to take the experience with me moving forward. I would probably have forgotten what I researched in the term paper as soon as the semester ended.”

Next steps

Fall 2017:

• Submitted NSF Innovations in Graduate Education to expand project to other STEM disciplines.

Spring 2018:

• Collect additional data focused on development of graduate students’ professional identity.

• Interviewing research advisors about impact of P4 on GSs’ skills.

• Streamlining GCOLL 516 to increase its appeal to GS and advisors.

Beyond Spring 2018:

• Addressing the following additional research questions:

In what ways does participation affect development of graduate student professional identity?

In what ways do impacts on the graduate student participants vary depending on their attributes, for example discipline, academic level, planned career path, and demographic background?

References

5. Bass, San Francisco, CA
6. Office of Science Education and National Institutes of Health Report 3 American Institute of Physics Statistical Research Center Reports 60
11. Office of Science Education and National Institutes of Health Report 3 American Institute of Physics Statistical Research Center Reports 60
12. DEWEE, DeWitt, & Stone, 2017 (Council of Graduate Schools, Washington, DC
16. Next steps

In what ways does the context of the academic discipline and surrounding setting impact design decisions and hence scalability and transferability?

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