STEP UP: Supporting Teachers to Encourage the Pursuit of Undergraduate Physics for Women

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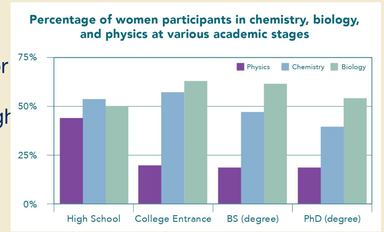
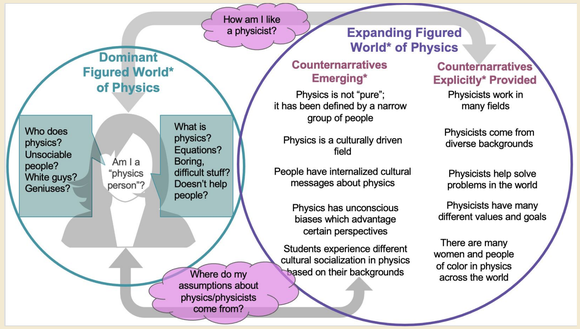
Introduction

- Although approximately half the students (47%) taking at least one high school physics class identify as female, the proportion of female students amongst physics majors in the first year of college is only 20% [1,2].
- These trends differ from trends in biology and chemistry [2,3].
- Furthermore, research has found that the largest proportions of female students who continue to undergraduate physics programs or become physicists became interested in a physics career in high school [4]. Thus, STEP UP focuses at the high school level.



Figured Worlds, Counternarratives, & Physics Identity

- Individuals have internalized figured worlds in physics, which are "a realm of interpretation" or mental models about who does physics and what physics does [5,6,7]. Students perceive physics to be masculine, narrow, individualistic, and difficult based on these figured worlds [8,9,10].
- Counternarratives can disrupt dominant and often marginalizing cultural narratives within figured worlds by posing alternative or opposing examples that offer "new windows into the reality of those on the margins allowing new and different possibilities to be showcased..." (p. 5). [11] [12,13]
- By disrupting narrow figured worlds through counternarratives, new opportunities for physics identity development are enabled [6].
- STEP UP embeds counternarratives to disrupt and expand the figured world of physics.

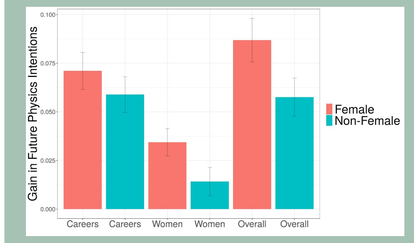


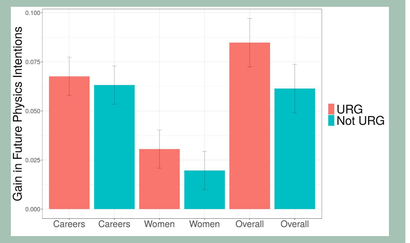
STEP UP Materials

- *Careers in Physics* Lesson - The lesson includes counternarratives through profiles of diverse individuals with a physics bachelors working in many fields. Students are matched with profiles based on their values and goals, discuss profiles, and envision how physics might connect with their future goals.
- *Women in Physics* Lesson - Students examine the statistical trends for women in physics and unconscious bias research about physics and physicists. Reflection and discussion help reveal counternarratives from students' personal experiences. Students establish classroom commitments to support each other in learning physics.
- *Everyday Action Guide* - Recommended actions and reflections for teachers to create a more communal, growth mindset-oriented class environment which helps to disrupt the narrow figured world of physics.

Research on STEP UP Materials

- Pilot and experimental study in high school physics classes over two years
  - 20 teachers, 10 states
  - Diverse contexts (urban/suburban/rural, school demographics)
- 1448 students
  - 49% Female
  - 54% Minoritized Racial/Ethnic Groups (URG)
- Pre/post surveys on future physics intentions





- There were overall significant gains, especially for female students and students from minoritized racial/ethnic groups

STEP UP Propagation

- STEP UP currently hosts a community with more than 2,800 physics teachers, informal educators, college/university faculty, and students.
- Ambassador Program (started in 2019) - propagates STEP UP materials through teacher leaders ("Ambassadors").
  - Two cohorts of Ambassadors including 97 formal and informal physics educators (see the map below)
  - Two cohorts of Ambassador Leads who support Ambassadors regionally including 22 formal and informal physics educators
  - Ambassadors led more than 250 trainings (e.g., workshops, conference presentations and other PD) around the country

- Advocate Program - supports high school physics teachers with the implementation of STEP UP materials in their classrooms. In May 2021, included 186 classroom physics teachers to be supported by Ambassadors.

Research on STEP UP Propagation (In-Progress)

- Leadership survey on teacher agency for Ambassadors (n=86)
- Implementation survey for high school physics teachers across the country (n=387)
- Interviews with Ambassadors and Implementers (n=101)

"Female students in my class towards the end of the year are talking actively about what their experience in class is and that's been really eye opening for the boys to hear about the microaggression they experience and just the way the culture can be more welcoming to them." (Cat, STEP UP Ambassador)

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