Investigating the role of question-asking and making contributions in bridging cultures to foster physics identity development

Jyllian Herman, Anne E. Leak, Peter J. Chung, Christian Vaca

NSF 2150298

Introduction

In education, students may have many identities. This includes the self that one presents in an academic sense, the self that one presents to their friends, and the self presented to family. Especially in underrepresented minority (URM) students, these **identities** can be **situational and multifaceted.**[1]

One issue with the integration of these identities is that students often do not see themselves as scientists. This effects the retention-rates of women and URM in STEM-related fields and upper-level education.[2]

A concept known as the **leaky pipeline**[3] refers to this inability to keep women in STEM. More specifically, attempt are made to catch the leak (retain women) without fixing it (solve the reason why women are leaving in the first place).

Research has demonstrated that students **asking questions** as early as high school can aid in fostering a positive physics identity.[4,5] It has also been noticed that the role of **mentorship** can help in fostering this identity.

This project will be looking at the ways that students currently feel about their scientific identities, as well as how positive mentorship, asking questions, and making contributions aid in the development of their sense of self.

Participants

Participants in this study included 4 URM students in a mentorship program at a community college in Southern California.

All are from under-represented backgrounds, first-generation college students, and are low income; three are women.

Journal Data Collection

Participants completed journal activity in the fall following their summer research experience.

Journal prompts were developed in response to initial interviews during participants' summer research:

- Who do you feel comfortable asking questions to about research? Why? How do you decide when and how to ask questions about your research?
- Where do you feel you are on this journey to becoming a scientist or engineer? Why? What do you need to do to feel more like a scientist or engineer? What support would be helpful on this journey?

Data Analysis

First pass emergent coding of data was done by researchers.

Codes were collapsed into broader categories, then recoded by researchers as a priori codes using NVIVO.

Researchers reached interrater agreement and recoded to ensure reliability.

Follow-up interviews and journals will be coded with similar approach to track changes as students transfer to four-year institutions.

1. Atkins, K., Dougan, B.M., Dromgold-Sermen, M.S. *et al.* "Looking at Myself in the Future": how mentoring shapes scientific identity for STEM students from underrepresented groups. *IJ STEM Ed* 7, 42 (2020).

2. Merolla, D.M., Serpe, R.T. STEM enrichment programs and graduate school matriculation: the role of science identity salience. Soc Psychol Educ 16, 575–597 (2013).

3. Liu, S.-N. C., Brown, S. E. V., & Sabat, I. E. (2019). Patching the "leaky pipeline": Interventions for women of color faculty in STEM academia. Archives of Scientific Psychology, 7(1), 32–39.

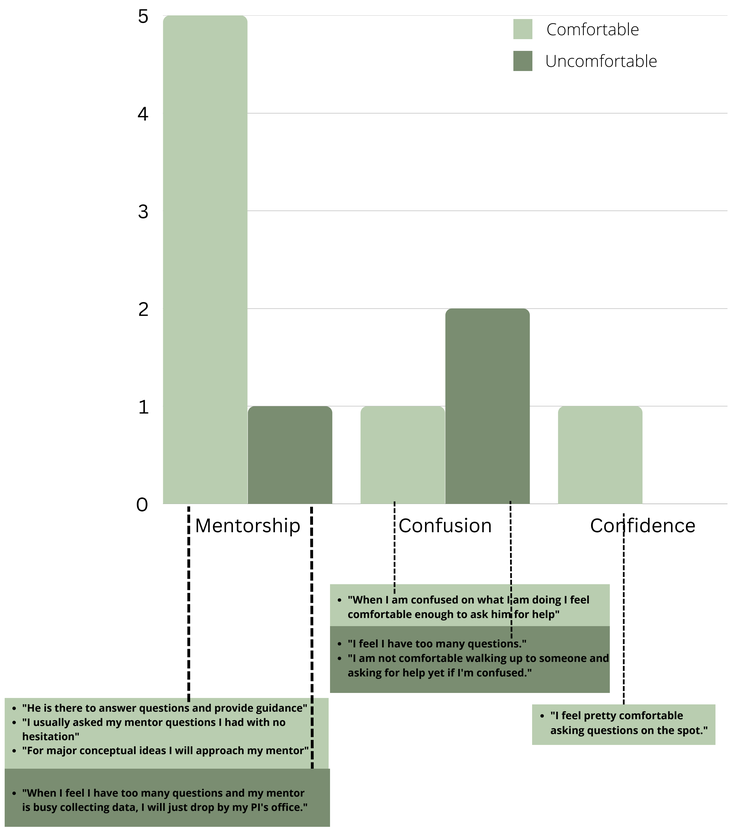
4. Hazari, Z., Sonnert, G., Sadler, P.M. and Shanahan, M.-C. (2010), Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. J. Res. Sci. Teach., 47: 978-1003.

5. Carlone. H., Johnson, A. (2007) Understanding the science experiences of successful women of color: science identity as an analytic lens. J. Res. Sci. Teach, 44 (8) 1187-1218.

6. Zohrabi, Alaee, D., Campbell, M., Zwicki, B. (2022). Impact of virtual research experience for undergraduates experiences on students' psychosocial gains during the COVID-19 pandemic. Phys. Rev. Phys. Edu. Res., 18(010103), 1-18.

7. Hyater-Adams, S., Fracchiolla, C., Finkelstein., n., Hinko. K. (2018). Critical look at physics identity: An operationalized framework for examining race and physics identity. Phys. Rev. Phys. Edu. Res, 14 (010132), 1-19.

Comfort in Asking Questions on Mentorship and Perceived Identity



Coding Dictionary

Identity: Mention of perceived self, whether positive or negative

Community: Mention of lab mates, mentors, perceived placement in STEM or belonging

Confusion: Perceived lack of knowledge, not understanding research or academics

Confidence: Feeling confident in their place or knowledge in research or academics

Mentorship: Any mention of participant's mentor at any point in responses

Asking Questions: Mentions of question asking, attitudes toward question asking, positive or negative

Making Contributions: Mentions of making contributions in their field or otherwise, such as research and academic

Discussion

Preliminary findings conclude that comfort levels in question asking is essential to building one's identity, as they can lead to or alleviate any confusion in the field, as well as build confidence levels. It is also detrimental in building relationships with mentors,[1] as negative experiences in asking questions can lead to avoidance in future experiences with participant's mentors.[5,6,7]

It was also found that many experiences can lead to positive or negative identity in STEM. Having a sense of community, or feeling like you have other people to turn to to ask questions, can foster a more positive identity, and having more confusion leads to a more negative identity. This is why question asking is so important in STEM, because alleviating this confusion will also help build a positive identity.

Going forward, we need to look at student's needs from their mentors in order to better help guide them through their transitions, and use our findings to build better mentors for URM in STEM.

Sense of Identity on Academic Excellence