Identity as a Research Lens in Physics and Science Education Research

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Introduction

Gender research in physics education has traditionally focused on learning differences between male and female students, how to present content in a way that is more accessible for female students, or explanations for observed differences in engagement with physics. These lines of investigation all consider gender to be a binary category that is defined as either male and female. This approach is limiting because it:

- Equates gender with biological sex
- Silences those who do not fall cleanly into categories
- Does not account for intersection of multiple identities
- Assumes a static definition of gender
- Essentializes gender
- Positions females as deficient

There has been a call for a move from a binary definition of gender toward a performative view (Traxler, Cid, Blue, & Barthelemy, 2016) and also for a careful consideration of how gender is categorised to avoid reinforcing gendered inequalities of power (Francis & Paechter, 2015).

An Alternative Approach: Identity

Researchers who take a socio-cultural approach consider learning to be not just about mastering content, but also about behaving in ways that are consistent with the Discourse of the classroom.

> "...students are understood as not only learning to do physics (in the sense of acquiring knowledge and skills) but also learning to become physicists"
>
> — Anna Danielsson (2012)

This learning to behave in ways that are acceptable to a given field is commonly referred to as **identity formation**. Gee (2000) defines identity as being recognized as a certain "kind of person" at a given time and place (p. 99). Sfard & Prusak (2005) view identities as narratives- the stories we tell about ourselves. Sfard and Prusak distinguish between narratives which describe how we currently see ourselves (actual identity) and how we see ourselves in the future (designated identity). These designated identities are often constrained by a lack of roles within the Discourse of physics that appeal to students who do not fit the stereotypical norms of people who "do" physics. That is, **they are not clever, middle-class, heterosexual, white men.** Drawing from these works I will use the phrase "physics identity" to describe the way that students perceive the field of physics and their own place in it.

Existing Research Using Identity

A model of science identity formation

To better understand the experiences of women of color studying science, Carlone and Johnson (2007) created a model for identity formation which includes 3 elements: (a) **competence**, (b) **performance**, and (c) **recognition**.

Secondary students' physics identity formation

Recognition of competence by physics teachers is crucial for students' physics identity formation (Hazari, Brewe, Goertzen, & Hodapp, 2017). Discussions about the under-representation of women in physics provide an opportunity for students to change their views of physics and who does it (Lock & Hazari, 2016).

Reformed teaching impacts identities

Carlone (2004) found that reformed teaching methods valued different class behaviors and endangered the "good student" identities that students, especially girls, had cultivated in previous courses.

Effects of the masculine nature of physics

Identity provided insights into how students positioned themselves relative to the masculine field of physics and how they performed femininity while doing physics (Archer, Moote, Francis, DeWitt, and Yeomans, 2016; Danielsson, 2012; Gonsalves, 2014).

Science identity trajectories

Jackson and Seiler (2013) modeled students' identity work as trajectories which are disrupted or encouraged by different teaching modes.

Conclusion

The studies highlighted above demonstrate that the use of identity as a theoretical lens allowed for novel insights into student learning and how students form physics identities over extended periods of time. Identity can also be used to capture the intersection of multiple identities, such as gender, ethnicity, and socio-economic status.

Next Steps

While conversations about the under-representation of women in physics has been shown to positively affect students' physics identities, the precise types of changes that may occur in their thinking have not been established. In addition, while recognition of students' competence is a critical element of their physics identity formation, the forms that this recognition may take and the frequency with which it need occur are not well known. The interplay between students' backgrounds and the modes of teaching employed by their instructors has been documented, but warrants further investigation with respect to intersectional aspects of their identities, such as socio-economic class. I am designing a long-term qualitative study grounded in a performative definition of gender to better understand how students' physics identities can best be promoted, especially with an eye for interventions that can be embedded into traditional instruction without disruption.

References

Archer, L., Moote, J., Francis, B., DeWitt, J., & Yeomans, L. (2016). The 'exceptional' physics girl: A sociological analysis of multimethod data from young women aged 10-16 to explore gendered patterns of post-16 participation. *American Educational Research Journal*, *54*(1), 88–126.

Carlone, H. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, *41*(4), 392–414. doi:10.1002/tea.20006

Carlone, H. & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, *44*(8), 1187–1218. doi:10.1002/tea.20237

Danielsson, A. T. (2012). Exploring woman university physics students 'doing gender' and 'doing physics'. *Gender and Education*, *24*(1), 25–39.

Francis, B. & Paechter, C. (2015). The problem of gender categorisation: Addressing dilemmas past and present in gender and education research. *Gender and Education*, *27*(7), 776–790.

Gee, J. P. (2000). Identity as an analytic lens for research in education. *Review of Research in Education*, *25*, 99–125.

Gonsalves, A. J. (2014). "Physics and the girly girl—there is a contradiction somewhere": Doctoral students' positioning around discourses of gender and competence in physics. *Cultural Studies of Science Education*, *9*(2), 503–521.

Hazari, Z., Brewe, E., Goertzen, R. M., & Hodapp, T. (2017). The importance of high school physics teachers for female students' physics identity and persistence. *The Physics Teacher*, *55*(2), 96–99. doi:10.1119/1.4974122

Jackson, P. A. & Seiler, G. (2013). Science identity trajectories of latecomers to science in college. *Journal of Research in Science Teaching*, *50*(7), 826–857.

Lock, R. M. & Hazari, Z. (2016). Discussing underrepresentation as a means to facilitating female students' physics identity development. *Physical Review Physics Education Research*, *12*(2), 020101. doi:10.1103/PhysRevPhysEducRes.12.020101

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher*, *34*(4), 14–22.

Traxler, A. L., Cid, X. C., Blue, J., & Barthelemy, R. (2016). Enriching gender in physics education research: A binary past and a complex future. *Physical Review Physics Education Research*, *12*(2), 020114.

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