

**TITLE:** Imposter Syndrome and Science Identity Development in a STEM Mentoring Program

**AUTORS:** Daphne E. Pedersen, Alena Kubátová

**ORGANIZATION:** University of North Dakota

#### DESCRIPTION OF PROBLEM

Representation of underrepresented minorities in STEM has long been a central concern within academic and employment sectors. Recent growth in STEM enrollments has been a promising trend, although it has been coupled with declining graduation rates in these fields (NSF, 2016). Studies indicate that nearly half of all STEM students do not go on to graduate with a STEM degree, either leaving college or opting instead for a different field of study (Le, Robbins, & Westrick, 2014). It remains the case that underrepresented groups have lower enrollment and completion rates in STEM, particularly students who are female, first generation, Native American, African American, and Hispanic (Nimmesgern, 2016; Premraj et al., 2021) and more of these students are lost at each stage of the STEM pipeline.

A variety of methods have been utilized to help address recruitment, retention, and graduation rates among underrepresented students in STEM including curricular and pedagogical approaches, targeted mentoring programs, high impact classroom practices, undergraduate research, and so on (Pedersen et al., 2022). A range of theories – pedagogical, educational, developmental, cognitive, and psychosocial – have also been used to frame these efforts, focusing on a variety of influential factors in determining best practices and approaches. We argue that both individual and structural factors shape the success of underrepresented students pursuing STEM studies, utilizing the theory of science identity (Carlone & Johnson, 2007) to examine feelings of imposter syndrome and the protective effects that external recognition from key gatekeepers may play in determining STEM success.

#### LITERATURE REVIEW

In their theory of science identity, Carlone and Johnson (2007) argue that for some who pursue STEM studies and careers, the development of a professional identity is more challenging - despite academic talent and hard work. Notably, those who are underrepresented minorities in STEM face added barriers in being recognized as legitimate scientists. This legitimacy is related to one of three interrelated aspects of science identity: recognition from others who serve as gatekeepers in the field. In addition to recognition, competence and performance are also critical components of one's science identity that determine STEM trajectories and success. In this model, competence refers to the development and expression of scientific knowledge, whereas performance refers to the ability to conduct scientific practices and utilize a disciplinary skill set.

For women, racial minorities, first-generation students, and others who may be minoritized within the STEM fields, the development of both competence and performance may be restricted due to unequal opportunity, as well as conscious or unconscious actions taken by gatekeepers who help determine access and recognition. As noted by Collins and colleagues (2020), there is “a

disconnect between the manifestation of these talents and the appreciation for them within formal educational settings” (p. 174). Furthermore, the discrepancies between talent and skill and recognition from others “play a role in the early inception of imposter syndrome in women of color” (p. 174). Such barriers to achieving recognition from others are in line with work by other scholars who find that the social networks and social capital of women and URM students in STEM are more restricted than among other students, and this limits persistence and retention (see for example Skvoretz et al., 2020).

## OVERVIEW OF THE CONTENT

Supported by funding from the National Science Foundation S-STEM grant program, US MASTER is a program developed at the University of North Dakota to target low-income, academically talented undergraduate students and provide a scaffolding of funding and support structures to facilitate STEM success. The program features an integrated and multi-tiered advising and mentoring approach. Program components include an ongoing seminar course, collaborative student projects, research with faculty, and targeted advising. Here, we examine reports of imposter syndrome and its intersection with science identity development among students enrolled in the US MASTER program.

Data were taken from interviews with twenty undergraduate students participating in the program, with Institutional Review Board approval secured before proceeding. Interviews were one hour in length, audio taped and then transcribed. The interview focused on students’ interest in and trajectories into STEM fields; supportive and challenging experiences within STEM majors; relationships developed within the context of STEM studies; and access to and quality of mentorship. Thematic analysis was performed to find common threads related to imposter syndrome and science identity development.

A strong science identity includes competence, performance, and recognition (Carlone & Johnson, 2007). These factors are synergistic and intertwined, with recognition influencing development of competence and performance. As we learned from students, recognition is critical in circumventing feelings of imposter syndrome. A strong mentoring program that includes targeted identity support can scaffold student success, despite feelings of inadequacy. As students progress through their programs, recognition from mentors and research advisors plays an important role in developing confidence and shaping future aspirations in STEM as well as having a marked effect on persistence and graduation.

## CONCLUSION

Competence, performance, and recognition are the foundational constructs making up a strong science identity and are supported using a variety of means (e.g., high-impact classroom practices, mentoring, and research involvement). We find that recognition is uniquely predictive of growth in competence and performance, in part because it helps students overcome feelings of imposter syndrome. A holistic approach that includes attention to the personal needs of students and pointed efforts to support identity development should be adopted.

## REFERENCES

Carlone, H. B., & 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.

Collins, K.H. (2018). Confronting colorblind STEM talent development: Toward a contextual model for Black student STEM identity. *Journal of Advanced Academics*, 29(2), 143-168.

Collins, K. H., Price, E. F., Hanson, L., & Neaves, D. (2020). Consequences of stereotype threat and imposter syndrome: The personal journey from STEM-practitioner to STEM-educator for four women of color. *Taboo: The Journal of Culture and Education*, 19(4), 161 - 180.

Le, H., Robbins, S. B., & Westrick, P. (2014). Predicting student enrollment and persistence in college STEM fields using an expanded P-E fit framework: A large-scale multi-level study. *Journal of Applied Psychology*, 99(5), 915–947.

National Science Foundation. (2016). *Science and engineering indicators 2016*. Retrieved from <https://www.nsf.gov/statistics/2016/nsb20161/>

Nimmesgern, H. (2016). Why are women under-represented in STEM fields? *Chemistry—A European Journal*, 22(11), 3529–3530.

Pedersen, D. E., Kubátová, A., & Simmons, R. B. (2022). Authenticity and psychological safety: Building and encouraging talent among underrepresented students in STEM.” *Teaching and Learning Inquiry* 10 (September). <https://doi.org/10.20343/teachlearninqu.10.31>.

Premraj, D., Thompson, R., Hughes, L., & Adams, J. (2021). Key factors influencing retention rates among historically underrepresented students groups in STEM fields. *Journal of College Student Retention: Research, Theory & Practice*, 23(2), 457–478.

Skvoretz, J., Kersaint, G., Campbell-Montalvo, R., Ware, J. D., Smith, C. A. S., Puccia, E., Martin, J. P., Lee, R., MacDonald, G., & Wao, H. (2020). Pursuing an engineering major: Social capital of women and underrepresented minorities. *Studies in Higher Education*, 45(3), 592 – 607.