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Understanding Students' Views of Science Identity Development

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Abstract

Science identity is composed of three key components, including competence (possessing scientific knowledge), performance (the capacity to use scientific tools and language in appropriate settings), and recognition (earning validation from others in the field) (Carlone & Johnson, 2007). The significance of a strong science identity is in shaping a student's future behavior, such as intent to graduate and pursue a STEM career (Chang et al., 2011; Chemers et al., 2011), which is particularly important for those with notable retention challenges within STEM like women, underrepresented minorities, first generation, and rural students (President's Council of Advisors on Science and Technology, 2012). The work of building students' science identity and encouraging their development as emerging scholars and scientists relies on both classroom experiences and the form and quality of mentoring relationships with faculty (Kendricks et al., 2013). This study considers how students see their own science identity development, and which supports they believe most central to science identity.

Literature Review

The theory of science identity has been widely adopted and a rich literature has emerged utilizing both quantitative and qualitative approaches. The perspective is appealing because it recognizes the importance of more traditional aspects of scientific competence and performance while also acknowledging that success within STEM depends heavily upon interaction with gatekeepers and one's experiences with privilege and inequality (Pedersen et al., in press). Due to the power of educational inequalities and experiences of racism, sexism, and classism, science identity development is inherently intersectional and political (Avraamidou, 2020). This identity formation is not a linear or fluid process, nor does development occur as easily for all undergraduate students because of differences in educational opportunities, experiences, and learning. Furthermore, even students who excel in scientific competence and performance may not readily achieve recognition if they hold marginalized identities (Carlone & Johnson, 2007).

A great deal of scholarship justly deals with how mentors can help facilitate student science identity development and the approaches that most effectively provide a scaffolding for student success in the classroom and laboratory (Kuh, 2008; McDaniel & Van Jura, 2020). At the same time, the central importance of personal experience and subjective interpretations to identity, motivation, persistence, and achievement underscore the necessity of scholarship devoted to understanding how students perceive their own development within STEM.

Overview of the Content

US MASTER is a STEM scholarship program at the University of North Dakota, funded by the National Science Foundation and it targets low-income, academically talented undergraduate students. The program features an integrated approach to mentorship and advising, with educational components such as a multicohort seminar course each semester, collaborative student projects, research with faculty, and targeted advising.

IRB approval was secured before data collection efforts were undertaken. Data was taken from interviews with undergraduate students (N = 20) participating in the US MASTER program. Interviews were one hour in length, audio taped and then transcribed. The interview covered 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 discover common threads related to science identity development. In doing so, an inductive approach was adopted through which the content of the data was allowed to dictate the emergence of patterns. This strategy was outlined by Braun and Clark (2006), who identified a process moving from familiarization with the data to identification of important features (coding), searching for and then again reviewing themes across the data (reviewing and organizing codes to create broader constructs of meaning), and final identification.

The patterns that emerged from the data are as follows. Results indicated that research involvement is central to science identity development, along with informal interactions with mentors who provide identity support. Students rated their knowledge and performance skills more highly than recognition, despite noting the affirming work that mentors provide.

Because mentorship is usually provided by a single faculty member, or just a few key people, recognition is perceived as hard to achieve because degree progress and scientific identity is dependent upon multiple academic gatekeepers. Still, students reported that close relationships based on personal authenticity and psychological safety provided a strong scaffolding for success in a challenging STEM environment, thereby indirectly facilitating competence and performance in addition to recognition. Furthermore, such recognition was critical for students facing extreme hardship, often helping them to persist in STEM studies despite overwhelming circumstances.

Conclusion

Competence, performance, and recognition are synergistic aspects of science identity, and as such are promoted in educational strategies like high-impact classroom practices, mentoring, and research involvement. Findings indicated that engagement in science is critical to science identity development, but recognition from faculty is also uniquely predictive of feelings of competence and performance through its association with feelings of encouragement and support. This research supports a holistic approach attentive to the student's personal needs. Pointed efforts to support identity development should be adopted, particularly among students from traditionally marginalized groups and those who face hardship during their studies.

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