

Supporting STEM Identity Development Among Women of Color Through Engagement in a Transformative Counterspace

Bria Davis, Kerrie Wilkins-Yel, and Francesca White
davis217@iu.edu, kgwilkin@indiana.edu, frawhite@indiana.edu
Indiana University

Abstract: This study investigates the impact of the engagement of undergraduate women of color (WoC) within a counterspace, the I CAN PERSIST STEM Initiative (ICP), on the development of disciplinary identity and STEM learning. We highlight the experiences of nine undergraduate WoC who participated in fourteen ICP sessions. Constant comparative analysis of the participants' session reflections reveals productive patterns of disciplinary identity development, which contributed to the scholars' holistic persistence in STEM.

Keywords: Disciplinary Identity, STEM Learning, Women of Color, Counterspace

Introduction and theoretical framework

Inequitable access to learning environments that promote participation in disciplinary practices is a well-researched phenomenon. Yet, institutional and systemic barriers perpetually marginalize underrepresented students, particularly women of color (WoC) in STEM disciplines (Ong, Smith, & Ko, 2018). Institutions of higher education that tend to privilege the dominant culture often position WoC as outsiders of STEM (Yosso et al., 2009) and all too often foster negative social and interpersonal experiences such as uncontested microaggressions and isolation (Wilkins-Yel et al., 2019). Studies have demonstrated the distinct challenges that WoC face in STEM as they navigate multiple systems of oppression (e.g., gender and racial biases), which commonly have revealed detrimental effects on these students' participation in social practice, their construction of disciplinary identity, and their relations between others within the field (Carlone & Johnson, 2007).

While there have been many efforts to increase the recruitment and retention of WoC in STEM, extant STEM environments often counter engagement in disciplinary practices. Evidence of learning is a byproduct of such disciplinary participation. However, evidence of learning manifests through individuals' increased participation in social practice and is often the result of the interplay between constructed disciplinary identities and relations between one's self and others (Barron et al., 2010). Environments that holistically support persistent participation in disciplinary practices 1) must exist for evidence of learning to be revealed, and 2) are crucial to countering deficit narratives and promoting students' persistence and achievements (Bell et al., 2017). This study is positioned within the context of a counterspace called the I CAN PERSIST STEM Initiative (ICP). ICP is a culturally responsive multigenerational mentorship program designed to advance STEM persistence among women from African American, Latinx, Asian, and Indigenous ethnic communities enrolled in STEM programs at a Midwestern Predominantly White Institution (PWI) in the United States. The program employs a multi-theoretical approach to inform its four primary aims. ICP aims to 1) *galvanize STEM belongingness and mitigate feelings of isolation* through the use of a multi-generational STEM community (i.e., comprised of high schoolers, undergraduates, graduate students, and professionals) with identity sharing role-models (i.e., WoC); 2) *cultivate STEM career preparedness* through career development activities; 3) *advance students' science communication skills* by positioning scholars as educators who design and implement socio-scientific outreach activities, and; 4) *promote students' psycho-social wellbeing* by creating supportive and validating spaces. Through the intentional positioning of scholars as doers/experts of STEM, and through the cultivation of holistic learning experiences, ICP aims to support WoC in engaging with STEM learning and developing strategies to persist in STEM. The present study focuses specifically on how undergraduate WoC orient to the career development and science communication structures of ICP, and in turn the ways in which this orientation plays a role in scholars' STEM learning, disciplinary identification, and persistence in their STEM majors over time. We aim to answer the following research question: In what ways does engagement in a multi-generational counterspace promote disciplinary identity development among women of color in STEM?

Methods

We present a case study of nine undergraduate WoC (from African American, Latinx, Asian, and Indigenous ethnic communities) in STEM who participated in fourteen 75-minute sessions of STEM discussions over the course of two academic semesters. Co-facilitated by the ICP director and two graduate students, these sessions allowed scholars to apply learned STEM concepts while exploring real world issues. During the first academic

semester (i.e., sessions 1-5), the ICP curriculum was focused on implementing sessions that encouraged scholars to explore their personal interests, skills, values, and strengths, and then to collectively learn about various strategies to persist in STEM (e.g., rebounding from failure, gaining confidence to engage in help-seeking behaviors, etc.). During the second academic semester (i.e., sessions 6-11) the ICP sessions centered on preparing scholars to facilitate problem-based learning (PBL) activities with high school girls of color. After each session, students participated in a reflection questionnaire that asked the following open-ended questions: 1) What aspect of today's class most resonated with you? 2) How does the above mentioned aspect influence your intentions to persist in your STEM academic major?

Constant comparative analysis (Glaser, 1965) was used to code each participant's reflection questionnaire. Individual responses to each of the two aforementioned questions ranged from one sentence to one paragraph, and the applied codes were emergent from the collective data set. A total of eight themes were then developed based on grouping the twenty-seven emergent codes with similar attributes. Activity Theory (Engeström, 2001) is used as a heuristic tool to make visible 1) how scholars are orienting to the ICP support structures, and also 2) how these mediational tools in turn influence the scholars' disciplinary identification and STEM persistence. We use this framework to highlight scholars' written reflections and show specific ways in which disciplinary identity development and STEM learning and persistence can be promoted or constrained through the support structures provided by the ICP counterspace.

Results and significance

Discursive patterns across scholars' reflections demonstrate a positive experience from the support structures (*Tools*) of the ICP STEM Initiative. In particular, the multigenerational design of the initiative provided multiple entry points for disciplinary identification. On the one hand, STEM teaching experiences with high school students, for instance, contributed to transdisciplinary skills development and social justice values. On the other, opportunities to hear stories from peers and elders offered scholars insights, motivation, and strategies for STEM persistence. Thus, leveraging the multigenerational community of WoC in STEM for various activities was oriented to by scholars as impactful for several aspects of their academic and career pursuits. The value of centering holistic wellbeing was also salient in ICP scholars' reflections. Discussions to explore ICP scholars' values, strengths, and interests among WoC in STEM generated opportunities to reflect upon career and goals alignment. Additionally scholars oriented to wellbeing as tied to academic success and career persistence.

As such, emphasizing holistic wellbeing within a STEM initiative proved to be effective for validating disciplinary identities and providing resources and strategies for coping with isolation and marginalization. The scholars' reflections demonstrate that the multigenerational design was beneficial for promoting increased career certainty, fostering a supportive community, and contributing to STEM persistence. The results also demonstrate the value of multiple inputs for disciplinary and career identification, with differential gains from STEM communication and teaching, career development, and mentored experiences.

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