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# What a Scientist Looks Like: How Community Colleges Can Utilize and Enhance Science Identity Development as a Means to Improve Success for Women of Color

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# What a Scientist Looks Like: How Community Colleges Can Utilize and Enhance Science Identity Development as a Means to Improve Success for Women of Color

## Abstract

This article explores the application of science identity development theory for women of color interested in the science disciplines; and it advocates for taking an intersectional approach to understanding how women of color form science identities. The article also challenges community college administrators and scholars to focus on redefining science identity development theory within the community college setting as a means to enhance success for women of color pursuing academic work in scientific disciplines.

Women of color are severely underrepresented in science and engineering occupations; they make up approximately 5% of employed scientists and engineers (2% Black, 2% Hispanic, 1% American Indian, Alaska Native, Native Hawaiian, or Other Pacific Islander, and multiple race; National Science Foundation, 2015). Often facing challenges related to sexism and racism within the sciences, many women of color find it difficult to conceptualize themselves as scientists and fail to develop a strong science identity (Carlone & Johnson, 2007; 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. doi:10.1002/(ISSN)1098-2736[Crossref], [Web of Science®], [Google Scholar]). This is particularly troublesome as science identity development has been shown to influence science undergraduate major persistence and interest, especially for women of color (Brickhouse, Lowery, & Schultz, 2000; Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. *Journal of Research in Science Teaching*, 37(5), 441–458. doi:10.1002/(ISSN)1098-2736[Crossref], [Web of Science®], [Google Scholar]; Carlone & Johnson, 2007; 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. doi:10.1002/(ISSN)1098-2736[Crossref], [Web of Science®], [Google Scholar]).

Because community colleges continue to serve as important entry points for women of color into the sciences (Reyes, 2011; Reyes, M. (2011). Unique challenges for women of color in STEM transferring from community colleges to universities. *Harvard Educational Review*, 81(2), 241–263. doi:10.17763/haer.81.2.324m5t1535026g76[Crossref], [Web of Science®], [Google Scholar]; St. Rose & Hill, 2013; St. Rose, A., & Hill, C. (2013). *Women in community colleges: Access to success* (Report). Washington, DC: American Association of University Women. [Google Scholar]; Tsapogas, 2004; Tsapogas, J. (2004). *The role of community colleges in the education of recent science and engineering graduates* (Info Brief). Washington, DC: National Science Foundation. [Google Scholar]), these institutions are uniquely positioned to enhance the science identity development of these women. Knowledge and experience alone are insufficient for sustaining interest in science, technology, engineering, and math (STEM) fields (Carlone, 2003; Carlone, H. B. (2003). (Re)producing good science students: Girls' participation in high school physics. *Journal of Women and Minorities in Science and Engineering*, 9(1), 17–34. doi:10.1615/JWomenMinorScienEng.v9.i1[Crossref], [Google Scholar]); and promotion of a narrow range of science identities could alienate students who reject such identities (Brickhouse & Potter, 2001; Brickhouse, N. W., & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. *Journal of Research in Science Teaching*, 38(8), 965–980. doi:10.1002/(ISSN)1098-2736[Crossref], [Web of Science®], [Google Scholar]; Carlone, 2003; Carlone, H. B. (2003). (Re)producing good science students: Girls' participation in high school physics. *Journal of Women*

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and *Minorities in Science and Engineering*, 9(1), 17–34. doi:10.1615/JWomenMinorScienEng.v9.i1 [Crossref], [Google Scholar], 2004 Carlone, H. B. (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/(ISSN)1098-2736 [Crossref], [Web of Science®], [Google Scholar]; Eisenhart & Finkel, 1998 Eisenhart, M. A., & Finkel, E. (1998). *Women's science: Learning and succeeding from the margins*. Chicago, IL: University of Chicago Press. [Google Scholar]). Thus, community colleges have the potential to lead the way in shaping structures and practices to enable women of color to succeed in the sciences. The purpose of this article is to explore the potential of using Science Identity Development Theory, demonstrate the importance of an intersectional approach to science identity, and suggest implications for community college practice, policy, research, and evaluation.

### **Disciplines**

Critical and Cultural Studies | Gender, Race, Sexuality, and Ethnicity in Communication | Higher Education and Teaching | Science and Mathematics Education

### **Comments**

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## **What a Scientist Looks Like: How Community Colleges Can Utilize and Enhance Science Identity Development as a Means to Improve Success for Women of Color**

Women of color are severely underrepresented in science and engineering occupations, making up approximately 5 percent of employed scientists and engineers (2% Black, 2% Hispanic, 1% American Indian, Alaska Native, Native Hawaiian, or Other Pacific Islander, and multiple race). Often facing challenges related to sexism and racism within the sciences, many women of color find it difficult to conceptualize themselves as scientists and fail to develop a strong science identity (Carlone & Johnson, 2007). This is particularly troublesome as science identity development has been shown to influence science undergraduate major persistence and interest, especially for women of color (Brickhouse, Lowery, & Schultz, 2000; Carlone & Johnson, 2007).

Because community colleges continue to serve as important entry points for women of color into the sciences (American Association of University Women [AAUW], 2013; Reyes, 2011; Tsapogas, 2004), these institutions are uniquely positioned to enhance the science identity development of these women. Given that knowledge and experience alone is insufficient for sustaining interest in STEM fields (Carlone, 2003) and that promotion of a narrow range of science identities could alienate students who reject such identities (Brickhouse & Potter, 2001; Carlone, 2003, 2004; Eisenhart & Finkel, 1998), community colleges have the potential lead the way in shaping structures and practices to enable women of color to succeed in the sciences. The purpose of this article is to explore the potential of using science identity development theory, demonstrate the importance of an intersectional approach to science identity, and suggest implications for community college practice, policy, research, and evaluation.

### **The Potential of Science Identity Development Theory**

Science identity development is based in an understanding of learning rooted in the socialization of a student into the collective norms and practices of a STEM field (Brown, 2004; Kelly, 2007) and spans science experiences, enculturation, and career entry (Christidou, 2011). As such, learning experiences during college can be seen as linked to *becoming* as students forge identities rooted in activities and ways of participating in the world (Lave, 1998). In essence, with each formal and informal learning experience, students are defining their science identity.

From this standpoint, investigations of science identity can offer an understanding not only of individual agency but also of how larger social and organizational structures and situations limit individual opportunities (Brickhouse, 2001). These arguments are particularly significant for the investigation of how women of color are drawn to, pushed out of, and socialized into the White, masculine STEM culture (Carlone & Johnson, 2007). Further, as an analytic lens, science identity can also reveal how current structures and practices lead to success or marginalization of different individuals, how students perceive the worth of the science education available to them and how the emergence of a science identity might transform a student's core identity and goals (Cobb, 2004). Thus, understanding the science identity development of women of color in community colleges can enable these institutions to identify and remove barriers for these students in pursuing degrees and careers in the sciences and reinforce structures that promote their success.

The science identity development model of Carlone and Johnson (2007) focusing on women of color through an intersectional approach provides one starting point for considering science identity development. Their grounded model explores how women of color attach meaning to their science experiences and the way in which society influences those constructs.

To understand the experiences of women of color, the model includes science performance (performances of scientific practices, e.g., use of technical terms, tools), science competence (understanding of content), and science identity recognition (self- and outside recognition as a "science person") as well as an embedded intersectional consideration of race, ethnicity, and gender. This intersectional aspect is key to understanding the complex identities and experiences of women of color at community colleges who may have to negotiate multiple aspects of their identities in becoming scientists.

### **The Importance of an Intersectional Approach to Science Identity**

Even as the past decade has seen a wealth of recent scholarship devoted to understanding the unique educational experiences and challenges of science students (Hurtado, Newman, Tran & Chang, 2010; Museus, Palmer, Davis, Maramba, 2011), few studies (Carlone & Johnson, 2007; Ong, Wright, Espinosa, Orfield, 2011; Riegler-Crumb & King, 2010) have explored the intersection of race/ethnicity and gender. Studies considering these aspects have more often considered them in isolation. This is seen in the substantial focus on *women* in science and *students of color* in science while an understanding of the experiences of *women of color in science* is only just beginning to develop (e.g., Espinosa, 2011; Ong et al., 2011).

However, these intersections are vital to understanding the difficulties women of color have in developing science identities and succeeding in STEM fields. Often, there are no women of color, or few people of color, who may serve as scientific mentors and role models. Women of color fail to see others who *look like* them and share similar backgrounds. Underrepresentation of women of color in the sciences is often the result of a work culture that is masculine, male-dominated, and culturally incongruent to more diverse communities (AAUW, 2010; Carlone, 2003; Williams & Ceci, 2007). Within these environments, women of color experience amplified

challenges related to the simultaneous experiences of both racism and sexism which may affect their ability for educational completion and transition to the workplace (AAUW, 2010; Espinosa, 2011).

An intersectional approach is critical to avoiding oversimplifying or ignoring the complex identity experiences for women of color in science disciplines. Intersectionality calls for a greater consideration of the intersecting identities that women of color in higher education possess, highlighting the link between those individual identities and larger systems of marginalization and oppression (Crenshaw, 1989; Dill & Zambrana, 2009). On an individual level, intersectionality is not merely where multiple identities meet or a “sum of their parts” (Hancock, 2007, p. 251) but rather the way in which identities interact and intertwine to form new, unique identity experiences for women of color (Baca Zinn & Thorton Dill, 1996; Segura, 1992). Such individual intersectional identity experiences often reflect larger, systemic issues of privilege and oppression at the structural level which reinforce educational inequities (e.g. sexism and racism) (Collins, 1991; Crenshaw, 1991; Davis, 2008). As such, identities, like race and gender, are markers not only of individual characteristics but are also ways in which society positions individuals and groups within that society’s structure (Baca Zinn & Thorton Dill, 1996). Ignoring such identity complexities overlooks the dynamic relationship that race, ethnicity, gender, and other intersectional identities play in the science experiences of women of color in the sciences, as well as the question of whom society is asking students to become (Carlone and Johnson, 2007).

However, while an intersectional approach to science identity development provides a critical lens for rethinking the community college experience of women of color in science, much of what is known of science identity development is anchored in experiences at four year

colleges. With science identity development being a complex process, it is necessarily reliant on context. While many concepts in identity development may span both four year and community colleges, in order to best support the success of women of color in science at community colleges, these institutions may need to become contexts for and partners in science identity research.

### **Implications for Community College Practice, Policy, and Research**

Acknowledging and understanding the existence of intersectional identities is the first step to addressing the complexities of science identity development for women of color in the community college setting. From this place of knowing, community college administrators have the opportunity to find solutions for how their institutions might encourage intersectional science identity development and move towards dismantling the systems of inequity and oppression that exist for women of color in the sciences. Because community colleges are an important entry point for women of color and in a unique position to provide needed growth and diversification to the scientific workforce (AAUW, 2013), they have the potential to be a space for enhancing science outcomes for women of color who are often marginalized in the science disciplines. Moving forward, there is an opportunity and indeed a need for community colleges to act on current understandings of intersectional science identity development while simultaneously advocating for and applying new research in this area.

### **Practical Application of Science Identity Development Theory in Community Colleges**

Community colleges can support the science identity development of its women of color students by understanding and applying concepts from science identity development theory while embracing intersectional approaches. Before action can be taken in applying concepts of intersectional identity development, administrators may want to consider how they will provide a

rationale for and integrate the elements of intersectional science identity development theory at their institutions. Community college stakeholders (e.g. administrators, faculty, staff, students) may have varied levels of knowledge regarding these complex concepts. For many stakeholders, these concepts may take time to understand and require significant changes in their current approach to teaching and learning.

In order to gain a more holistic understanding of the challenges facing women of color in the science at a specific institution face, community colleges could go a step further and form focus groups made up of women of color in science majors that meet regularly or semi-regularly to give voice to their experiences. To promote science identity development, community college administrators may need to devote time to building alliances between educational stakeholders in order to build a shared knowledge and vision for enhancing science identity development for women of color. Such coalition building offers an opportunity to create an open dialogue between multiple stakeholders as well as share best practices. Moving towards action, context specific strategies rooted in science identity development theory could be identified and interwoven in various campus curricular structures and cultural norms. For instance, Carlone and Johnson's (2007) science identity theory suggested that *science performance*, *science competence*, and *science identity recognition* as well as a consideration of intersecting identities were important elements to building and sustaining science identity for women of color.

**Promoting science identity performance.** Drawing from this model, *science performance* is key to science identity development. This includes performing science practices such as using particular tools or terminology related to common science tasks. To support this aspect of science identity development, community colleges can support women of color students by encouraging these students to perform as scientists early on in their educational

experiences. Community college faculty members might do this by connecting science subjects to everyday life through classroom content and interactions, such as highlighting relevant topics in the news or events on and off campus related to these areas. As their science discipline becomes part of their life, students will have the ability to integrate and share their knowledge on a more regular basis with science and non- science peers. Faculty members and other instructors can also encourage performance by giving women of color the opportunity to speak in classes and discussion sections in order to build an authoritative tone and space for performing competence. Finally, community college administrators could consider implementing a research, application-based, or problem-based learning requirement for students interested in the science disciplines. Such a requirement might allow women of color who have not had these experiences elsewhere to place themselves in an active role in their learning and connect those experiences to the development of their science identity.

**Encouraging science identity recognition.** Carlone and Johnson's (2007) model of science identity development also suggested that *science identity recognition* was essential for women of color in the sciences. Self and outside recognition can be fostered by creating spaces for women of color to develop and perform science identities through engagement with peers and faculty members and by mirroring real world experiences found in scientific careers. One way that community colleges may do this is by getting women of color involved with research projects then holding symposia that promote women of color in science in order to showcase students' academic capabilities and encourage peers and faculty to recognize those abilities. By doing so, not only is a level of familiarity added, but the scientific actions can become normalized, helping the students to see these activities and their accompanying roles as part of their own set of norms for academic and vocational work.

Community College administrators may consider enhancing *science identity recognition* by supporting targeted programming, such as learning communities and mentorship programs, for women of color in the sciences. Learning communities further science discourse outside of classrooms, encouraging women of color in science to see their science identity as pervasive in all parts of their lives, not just curricular. Learning communities may also encourage women of color in science to meet and interact, perhaps promoting a community of women scientists and limiting feelings of isolation these women face. Creating or enhancing existing mentoring relationships between women of color students and professionals could connect community college women of color in science with professionals in their field. These connections could not only reinforce a sense of science identity within these students, but could also provide pathways for understanding the profession in greater detail while building a network of professional contacts needed for the career search.

**Supporting science identity competence.** Through such interventions, community colleges may empower women of color in the sciences to feel more confident in their knowledge and their ability to apply it both in and outside of the classroom, thus developing their *science competence*. The development of such confidence in both knowledge and application is critical to science identity development and can create a bridge that enables persistence in scientific study and careers. Faculty members can encourage the building of science competencies through scaffolding engagement activities, which encourage scientific experiential learning, and inquiry leading to increased knowledge and skill-building. Through these activities, faculty members encourage women of color to build their scientific understanding in an environment of high expectations and high support. Building competence in the scientific disciplines can encourage women of color not only to feel more confident in their abilities but can encourage women of

color to recognize themselves as scientists (and be recognized as such) as well as perform their science identities in the presence of the scientific community.

**Taking an intersectional approach to science identity development.** In taking steps towards harnessing the potential of science identity development concepts for enabling success for women of color in science, community colleges could benefit from the insights of an intersectional approach to science identity development. Such an approach not only acknowledges, but highlights that community college students are in no way a homogenous group. Individuals come to the classroom from diverse backgrounds and with varied experiences. Students often have full time jobs, complex family relationships and other commitments they balance in addition to their roles as students. Each role and identity the student identifies with or is asked to take on adds a layer of complexity as it brings with it context-specific, real and imagined responsibilities, expectations, advantages and disadvantages. These complex identities can influence how students at community colleges experience policies, communities, and roles related to their interests as a future scientist. An intersectional approach gives space for understanding the complex identities of women of color at community colleges and acknowledges that the intersecting identities and experiences of each student will shape her science identity development and that policies and practices need to acknowledge and value such intersectional identities.

An approach centered on intersectionality can allow community colleges to consider how students negotiate their science identity in light of their intersecting identities. This may include considering how policies and practices might be experienced from various perspectives, including what particular intersections of race and gender, such as being a woman of color, might mean for a student's experience at the institution and in the science community.

Identifying such complexities can also allow community colleges to understand the challenges facing these students, see potential directions for empowering these students and helping them become a part of scientific communities, and ultimately change the inequitable structures that underlie racism and sexism within the sciences.

### **Opportunities for Expanding Science Identity Development Theory for Women of Color**

Given the critical position of community colleges in the pipeline of women of color in the sciences, these institutions have the potential to contribute critical insights to the further development of science identity theory as well as the enhancement of institutional practice and policy. Community college researchers can expand existing science identity theory to address a wider range of contexts. Since the complexity of science identity development suggests contextual factors play a role, the lack of nuance concerning the overall higher education environment in which students develop science identities leaves science identity theory incomplete. To truly understand the many facets that contribute to science identity development, the critical context of community colleges must become a focus of future research in the science identity development of women of color. This is important because issues related to the intersectional science identity development for women of color in this setting may be different than for women of color at four-year institutions. While the current theory, developed primarily from studies at four-year institutions, has provided a useful groundwork, research now needs to build on that theory by incorporating insights from women of color at community colleges.

In pursuit of this goal, community colleges and scholars can partner to conduct more rigorous, grounded studies centered upon science identity development, particularly for women of color, that will extend our collective knowledge of women of color in the sciences beyond the four-year institutional setting. Through partnership, community colleges can provide valuable

contributions that inform theory, which in turn can inform practices that lead to the success of women of color in community colleges. As science identity theory becomes refined and contextualized for community college settings, researchers, educators and administrators can develop new practices, policies and interventions grounded in this theory. Such studies may also be of interest to four-year institutions as they support community college students through their transfer process. A greater understanding of the way in which science identity is developed during the community college experience may provide greater detail to four year institutions on how these institutions can continue to nurture and provide additional experiences that will continue to reinforce science identity development for women of color in the sciences.

Subsequently, continued partnerships can allow for the evaluation and refinement of these interventions. By evaluating their own practices, community colleges may discover ways to make their institutional and administrative structures more equitable. Strengthening equity in this regard may create an environment that is more conducive to women of color in science in developing their science identities. Science identity theory and a contextualized understanding of science identity development in a community college setting can inform the development of new evaluation frameworks for science programming, practices and policies at the community college level and beyond. These theoretically driven frameworks can allow for evaluation studies that can provide needed insights into the various interventions seeking to help women of color in science to succeed. As a body of work is developed, simpler heuristics may arise that in combination with evaluation studies and ongoing theory development can serve as guides to future decision making and policy development. Through the combined efforts of researchers and the community college community, science identity theory can be furthered and contextualized, new practices and policies can be developed, implemented and refined, and new

evaluation frameworks and heuristics can be developed to provide practical pathways to supporting women of color in the sciences.

### **Conclusion**

By committing to practical application, expansion of current theory, and continued research partnerships concerning the intersectional science identity development of women of color, community colleges stand to make major contributions to the field and solidify their commitment to the success of these future scientists. Such work can empower educational stakeholders to enhance science identity development and, ultimately, improve community college and undergraduate persistence and/or workforce outcomes for women of color in scientific disciplines. In doing so, community college administrators will equip women of color with the tools needed to continue to develop and sustain their science identities during their college experiences and into their future careers.

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