



"I've felt out of place sometimes in STEM but my cultural roots say otherwise." Latina college students' identity conundrums and opportunities in a science research internship

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Abstract

In this study, we explored (a) how Latina undergraduate students negotiated their multiple identities while participating in a research internship designed to create spaces that counter master narratives, and the forms of cultural wealth that were implicated in these identity negotiations, and (b) ways in which the various elements of the research internship impacted the student's identity negotiations. The theoretical framing brought together conceptions of identity and identity construction, the marginalization of Latin*s in science and science education and the master narratives shaping identity intersectionalities, and the creation of counter narratives that make use of multiple forms of community cultural wealth. Using phenomenology, we analyzed four Latina interns' work artifacts generated in various activities within each element of the research internship that aimed to provide Latin* students with opportunities to explore and build on their cultural assets while studying the monarch butterfly population in relation to milkweed restoration and utilization. We found that the research interns referred to different forms of cultural wealth as they grappled with their multiple identities and their intersectionalities, and the various science research internship elements offered different pathways for their grappling. The findings point to (a) structures at the macro- and micro-levels, and enduring master narratives and distal identities, that influence proximal identities and are implicated in identity conundrums; (b) the role of cultural wealth in creating productive spaces and places of science engagement and counter narratives; and (c) the explicitness needed in educational activities so that science students may engage with the intersectionalities of their multiple identities.

Keywords Latinas · Identities · Cultural wealth · Counternarratives · Science research internships

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Resumen

En este estudio, exploramos (a) cómo las estudiantes latinas de licenciatura negociaron sus identidades múltiples mientras participaban en una pasantía de investigación diseñado para crear espacios que contrarrestan narrativas maestras y las formas de riqueza cultural que fueron implicadas en estas negociaciones de identidad, y (b) las maneras en que los varios elementos de la pasantía de investigación impactaron las negociaciones de identidad de las estudiantes. El marco teórico reunió concepciones de identidad y construcción de la identidad, la marginalización de los latinos en ciencias y educación de ciencias y las narrativas maestras formando identidades que dan forma a las interseccionalidades de la identidad, y la creación de contra narrativas que hacen uso de múltiples formas de riqueza cultural comunitaria. Utilizando la fenomenología, analizamos los artefactos de trabajo de cuatro latinas internas generados en varias actividades dentro de cada elemento de la pasantía de investigación dirigido a proveer a estudiantes latín*s oportunidades para explorar y construir sus bienes culturales mientras estudiaban la población de la mariposa monarca en relación con la restauración del algodoncillo y su utilización. Encontramos que las internas de investigación refirieron diferentes formas de riqueza cultural mientras luchaban con sus identidades múltiples y sus interseccionalidades, y los varios elementos de las pasantías de investigación científica ofrecieron diferentes caminos para su aferramiento. Los hallazgos apuntan a (a) las estructuras a nivel macro y micro, y a las narrativas maestras duraderas y a las identidades distales, que influyen las identidades proximales y están implicadas en acertijos de identidad; (b) el papel de la riqueza cultural en la creación de espacios y lugares productivos para compromiso científico y contra narrativas; y (c) la explicitación necesaria en las actividades educacionales para que los estudiantes de ciencias se comprometan con las interseccionalidades de identidades múltiples.

Re-envisioning formal STEM settings as more equitable and inclusive for historically minoritized students necessitates creating spaces that value and support the intersectionality of people's multiple identities. Focusing on equity centered science education, a growing body of research has explored the development of STEM identities of Latin* (term justified below) students as they pursue STEM degrees and documented the link of such development to retention and graduation (Camacho, Vasquez-Salgado, Chavira, Boynsm, Appelrouth, Saetermoe and Khachikian 2021. Elsa Gonzalez and colleagues (2022) and Sarah Rodriguez and colleagues (2019) have argued for studying the development of STEM identities vis-à-vis Latin* people's experiences, culture, and knowledges that inform this development. The focus on Latin* people partly stems from the recognized underrepresentation in obtaining STEM degrees. For example, Latinas earn only about a 6% share of bachelor's degrees in biological sciences (National Science Foundation 2017).

Efforts to attract more women of color, including Latinas, to STEM fields often focus on appealing to their interests. Scholars such as Kris Gutiérrez and colleagues (2019), Angela Johnson and colleagues (2011), Hosun Kang and colleagues (2019) and Natalie King and colleagues (2019) have found that such efforts are misguided and the issue is not a lack of interest in science. Turning inward, then, the underrepresentation of women of color, and Latinas in particular, in STEM has been attributed to the nature of the STEM enterprise in the USA characterized by eurocentric, individualistic (McGee and Bentley 2017), and male dominated practices that dismiss and ignore the values, assets, and experiences of Latinas. This positions students with non-dominant ethnoracial, gender, and other identities as outsiders needing to reconfigure themselves in order to gain access to science, which has been

argued for more recently by scholars such as Maria Ong and colleagues (2011), Tesha Sengupta-Irving and Vossoughi (2019), and Tammie Visintainer (2020) and makes invisible and undesirable the assets that these students bring to STEM fields (Annamma and Morrison 2018). Such marginalization of students of color force them into lack of confidence in their academic abilities and identification with STEM, as they explicitly and implicitly experience racism and sexism as noted over the years by Lucy Avraamidou and Renee Schwartz (2021), Rosa M. Banda (2020), and Maria Ong (2005). Embracing, celebrating, and sustaining the multiple identities of students of color while engaged in science pursuits is not only needed for equity purposes but it is also a moral and political commitment toward transforming structures that have been historically discriminatory.

In this study, we focused on one such effort, a research internship for undergraduate students pursuing a biology degree in a large Midwestern city in the USA, which brings together science and cultural knowledges and practices, and studied how four Latina interns made sense of their cultural capital and negotiated their various identities and how the internship elements were implicated. In the manuscript, we use Latin* as the ethnoracial identity which we elaborate later in the theoretical framing, whereas some of the study participants use Latinx.

Theoretical framing

Identity construction

Identities are the traits and characteristics, social relations, roles, and social group memberships that define who one is (Oyserman, Elmore and Smith 2011, p. 69), that shape and are shaped by how we position ourselves and how others position us. Positions we take in social events and interactions mediate how we act and how we act mediates positions (Davies and Harré 1990). People have multiple identities that are foregrounded or backgrounded in particular contexts at particular times and this process may be intentional as Maria Varelas and colleagues (2022) Varelas and colleagues (2022) recently documented with new high-school teachers and had previously explored with science graduate students learning with practicing teachers (Ye, Varelas and Guajardo 2011). As this unfolds over time and in various contexts, who one is and who one desires to be at any given moment is always under negotiation (Avraamidou 2020, p. 326; Holland, Lachicotte, Skinner and Cain 1998). Thus, identity construction is ongoing as people's roles and positions are negotiated within various contexts. Both interactional and affective elements influence people's commitment to their multiple identities as noted by Timothy Owens and colleagues (2010) and Jan Stets and Peter Burke (2000), while they encounter structures, which influence their actions, behaviors, thinking, and emotions, and exercise their agency, which strengthens or weakens these structures (Varelas, Settlage and Mensah 2015).

Jean Lave and Etienne Wenger (1991) assert that one way to think of learning is as the historical production, transformation, and change of persons (p. 51–52). Thus, learning is inextricably tied to the development of identities, and a cultural process by which people learn with and from one another (Nasir, Rosebery, Warren and Lee 2014), negotiating between actual identities who they believe themselves to be, and designated identities who others expect them to be (Sfard and Prusak 2005). Moreover, identity construction does not stay bounded within time and space, as proximal identities shape and are shaped by distal identities (Cole 1996; Polman 2006). Thus, trajectories of identification (Polman and

Miller 2010) that acknowledge peoples past, present, and future experiences and positionings over time and space need to be considered when focusing on identity construction. Given that both macro-level (containing references to institutional and societal structures) and micro-level (containing references to structures encountered at the individual level) narratives and storylines impact learners positionings as legitimate knowers and doers in learning spaces, for historically minoritized students in a domain such as science, where master narratives often challenge their presence in many and different shapes and forms, attending to identity construction is of paramount importance (Varelas, Kane and Wylie 2011).

Science, science identity, and the marginalization of Latin* people

The institution of western science has been shaped by and reinforces a hegemonic science culture in capitalistic societies as argued by Lyn Carter (2008) and Daniel Morales-Doyle and colleagues (2019). (Carter 2008; Morales-Doyle, Childress Price and Chappell 2019). Moreover, through the guise of objectivity (Le and Matias 2019), western science hides its colorblind and assimilationist ideologies (Brown and Mutegi 2010). Uncritical viewpoints of western science underpin the master narratives that are ubiquitous in science education. These master narratives have shaped science learning toward privileging white middle class knowledges and forms of discourse (Bang, Warren, Rosebery and Medin 2013). Felicia Mensah and Iesha Jackson (2018) conceptualized science as white property to capture how the dominant narrative in science limits what counts as science and who does science. Because science is white property, it promotes the use of exclusionary practices in science education, which results in the disengagement from science of historically minoritized students.

A growing body of literature by scholars such as Edna Tan and colleagues (2013) and Blanca E. Rincón and Sarah L. Rodriguez (2021) has explored how the development of a science identity plays a particularly important role for historically minoritized students. Heidi Carlone and Angela Johnson (2007) illuminated the various ways in which women of color negotiated their positioning within the culture of science and how this experience supported or constrained the development of their science identities. They highlighted how one's development of science identity is impacted by both self-recognition and others recognition as a science person. For historically minoritized students, this recognition is impacted by factors such as racial and gender discrimination (Rodriguez, Cunningham and Jordan 2019). Felisha Herrera, Sylvia Hurtado and Gina Harcia Josephine Gasiewski (2012) builds on Heidi Carlone and Angela Johnson's science identity model that draws on an intersectionality lens and considers how STEM and non-STEM contexts inform STEM identity construction. Thus, attending to science identity construction in science education can offer historically minoritized students opportunities to share how they see themselves as science people, how they make sense of master narratives around science, and how they negotiate their multiple identities (Varelas, Menig, Wilson and Kane 2020).

For Latinas in science education, master narratives have been shaped by the complex interaction of gender and racial discrimination that permeate science spaces. Kimberlé Crenshaw (1989) coined the term intersectionality to capture the oppressions resulting from the intersection of race and gender in the inequality and discrimination experienced by Black women. Patricia Hill Collins and Sirma Bilge (2016) argue the importance of taking on an intersectional lens to recognize the complexities of intersecting systems of power (Harris and Leonardo 2018; Ibourk, Hughes and Mathis 2022). Building on Patricia Hill

Collins and Sirma Bilge's work, Lucy Avraamidou (2021) highlighted how recognition is meshed with overlapping qualities of power, social relationships, contexts, and inequality (p. 6) in the formation of a physics identity. An intersectional lens, thus, has the potential to illuminate the complex ways in which Latinas navigate science spaces, and negotiate their multiple identities that exist and evolve within multiple systems of power (Sparks, Pryzmus, Silveus, De La Fuente and Cartmill 2021).

Countering master narratives for Latinas

Latinas are severely underrepresented in earning bachelor's degrees in STEM fields (National Science Foundation 2017), and their decision to pursue a STEM degree and maintain their participation in a STEM undergraduate program are mostly shaped by factors associated with structural inequities and injustices. Dolores Delgado Bernal (2002) articulated how structural inequities perpetuate deficit narratives where "although students of color are holders and creators of knowledge, they often feel their histories, experiences, cultures and languages are devalued...within educational settings" (p. 390). In their K-12 experience, Latinas often face barriers to opportunities for meaningful STEM experiences due to "cumulative historical, sociopolitical, economic and educational practices and policies" (Calabrese Barton and Tan 2019, p. 617; as Gloria Ladson-Billings (2006) argued for minoritized students). Moving to higher education, even as Latinas have an interest in STEM, they encounter a weed out culture prevalent in undergraduate STEM education, which is rooted in elitist conceptions of science and stereotypes of inherent ability (López, Basile, Landa-Posas, Ortega and Ramirez 2019). Latinas in higher education face a "double bind," discrimination related to their gender and ethnicity (Malcom, Quick, Janet, and Brown 1976), and challenges brought on by cultural and academic transitions (Rendon, Nora and Kanagala 2014).

Furthermore, Latinas experience science classrooms that perpetuate science as aligning with dominant White conceptions of science (Bang and Vossoughi 2016) and, thus, are not seen as legitimate doers of science in these spaces. It is, thus, family that plays an important role in attaining a STEM degree (Rodriguez, Pilcher and Garcia-Tellez 2021). When Latinas feel supported by family members, their own expectations related to their academic performance are strengthened as noted over the years by Rosa M. Banda (2012) and Alma Stevenson and colleagues (2019). Latinas in academic science settings are negotiating multiple identities, co-constructing identities as daughters, students, Latinas, and as science people. Thus, employing an intersectional lens becomes a valuable tool for understanding the ways in which Latinas are developing their science identities in relationship to other multiple identities, and for shedding light on master narratives prevalent and responsible for marginalizing Latinas relative to pursuing STEM degrees.

In schools, as Jean Aguilar-Valdez and colleagues (2013) and Dyke and Erin colleagues (2020) emphasized, deficit narratives often proliferate and position students of color and their families knowledges as "lacking" valuable social and cultural capital. As a counter to these cultural deficit narratives that students of color face, Tara Yosso (2005) conceptualized community cultural wealth rooted in critical race theory (CRT) that focuses on the "accumulated assets and resources in the histories and lives of Communities of Color" (p. 77). Shifting from traditional Bourdieuean cultural capital theory, where cultural capital refers to the accumulation of valued cultural knowledge, skills, and abilities acquired by schooling or family, and, therefore, some communities are culturally poorer than others, Tara Yosso (2005) presents community cultural wealth as the accumulated assets found

in communities of color. This framework, through a CRT lens, places value on the experiential knowledge of communities of color (Elenes, Gonzalez, Bernal and Villenas 2001; Yosso 2005) outlined cultural wealth through six forms of cultural capital: aspirational, navigational, social, linguistic, familial, and resistant. Aspirational capital is the ability to maintain hope and motivation for the future for self and others despite hurdles. Navigational capital consists of the skills necessary to navigate through social institutions. Linguistic capital centers on language and communication assets. Social capital encompasses networks of people and associated resources. Familial capital is the cultural knowledges that come from family and community. Resistant capital derives from knowledges and skills that become resources to oppose inequities and oppressions. These forms of cultural wealth are not mutually exclusive or static (Yosso 2005) and are used by communities of color to survive oppressive circumstances (Rendon, Nora and Kanagala 2014, p. 17).

As mentioned earlier, we are intentional in the use of the term Latin* when referring to the Latin American community broadly. First let us note that there is no consensus on whether an ethnoracial term could or should be inclusive of all people of Latin American descent. The terms “Latin@/x/é/*” have all been used to highlight the collective experience of discrimination and marginalization of people in the USA with ancestry in Latin America. However, critics of using such ethnoracial terms, like Latinx, argue that although such a term “is meant to bring under an umbrella category different communities from distinct nations and racial backgrounds...such that they can be grouped for political purposes,” the result is that “several racial nuances are ignored, flattening out differences and histories that matter (Santiago, De los Ríos and Gutiérrez 2021, p. 206).

Being mindful of the affordances and limitations of such ethnoracial terms, we embrace Maribel Santiago and colleagues’ use of Latin*. We chose to use “Latin*” to: (a) decenter the binary nature of o/a (also combined as “@”) in “Latino/a”; (b) avoid the appropriation of Latinx that was originally used as a gender identifier for people who do not identify along the gender binary (Salinas 2020); and (c) avert a potential homogenization that Latiné may connote. We find that the “*” in “Latin*” allows and encourages for how an individual chooses to self-identify and underscores the distinctiveness of national and racial backgrounds (Salinas and Lozano 2021).

Countering master narratives for Latin* students requires intentional pedagogical shifts that cultivate opportunities for students to “contextualize...their family stories and immigration histories as assets, strengths, and knowledges” (Jimenez 2020). Such shifts necessitate exploring pedagogies that center the community cultural wealth of Latinas, valuing their cultural and experiential knowledges, and identifying possibilities that emerge as Latinas multiple identities are not only allowed in educational settings but also embraced and celebrated. In this study, we explored: (a) ways in which four Latina undergraduate science students negotiated their multiple identities while participating in a research internship designed to create spaces that counter master narratives, and the forms of cultural wealth that were implicated in these identity negotiations; and (b) ways in which the various elements of the research internship impacted the students’ identity negotiations.

Method

We conducted a phenomenological study to answer the above research questions since “the goal of phenomenology is to describe the meaning of this experience—both in terms of what was experienced and how it was experienced” (Neubauer, Witkop and

Varpio 2019, p. 91). In this study, we explored how four Latina science undergraduate interns negotiated their intersecting identities and made sense of their lived experiences considering who they were both as Latinas and as science people, while engaging in a science research internship. The internship is part of the Monarch Butterfly Project (pseudonym), which aims to provide Latin* students with opportunities to explore and build on their cultural assets while studying monarch butterfly populations in relation to milkweed restoration and utilization. Using a variety of interns' work artifacts (that captured interns' experiences) to explore the meaning of their individual experiences (Groenewald 2004), we examined commonalities and differences across interns' experiences (Creswell and Poth 2018), and the ways in which the internship provided each with opportunities to negotiate their own intersecting identities (Teherani, Martimianakis, Stenfors-Hayes, Wadhwa and Varpio 2015).

Context and participants

The monarch butterfly project (MB project) is a university-based project in a large Midwestern city in the USA designed primarily by the third author and supported by the second author and other faculty and staff. The university has been designated as a Hispanic serving institution (HSI), which means that it has at least 25% of its full-time undergraduate population identifying as Latin* (Hispanic Association of Colleges and Universities 2021). In 2019, 66.8% of Latin* undergraduate students were enrolled in an HSI (Hispanic Association of Colleges and Universities 2021). This underscores the need for HSIs to improve the effectiveness of their undergraduate STEM programs in supporting and retaining Latin* students, which aligns with the goals of the MB project that includes various student- and faculty-centered components. One of the components is an 8-week research internship, which is the focus of this study and is overseen by the fourth author in terms of recruitment and selection of interns, and daily schedules and activities. The internship engages students in investigating monarch butterfly ecology by collecting and analyzing data taken through field observations of milkweed utilization. In addition to this ongoing monarch butterfly and milkweed science research project, the internship also provides opportunities for interns to explore connections between culture and science through curricular activities with the university's Latino cultural center.

Table 1 Profile of participants

Pseudonym	Gender	Ethnicity	Year in University	STEM Major
Jessica	Woman	Mexican	Senior	Biological Sciences and Earth and Environmental Sciences
Ariana	Woman	Puerto Rican and German	Senior	Biological Sciences
Jocelyn	Woman	Mexican American	Senior	Biological Sciences
Yesenia	Woman	Mexican	Sophomore	Undeclared

Gender and ethnicity are self-identified

Table 2 Elements of the research internship

Element	Curricular activities	Timeframe
(1) Ongoing monarch butterfly and milkweed science research project	Formal research paper	Weekly data collection, and ongoing analysis and formulation
	Written reflection on internship	Last week of the internship
(2) Periodic meetings with project staff centering interns' cultural/ethnic identities	Identity exploration	Week 1
	Life stage zine	Week 2
	Oral history project	Week 5
	Peer interview	Week 5
(3) Ongoing reflection on connecting culture and science	Journal entries	Weekly
	Response videos	Weekly

The four interns, Jessica, Ariana, Jocelyn, and Yesenia (all pseudonyms), were undergraduate students pursuing degrees in the natural sciences. Table 1 provides brief participant profiles.

Data collection

As part of the 8-week research internship, the interns completed various activities and their work was collected for project record keeping purposes. After the completion of the internship, the work of the interns who have consented was de-identified for research purposes. This work captured the ongoing experiences, meaning making, and identity negotiations that interns were undergoing as they engaged in each of the three elements of the research internship: (1) an ongoing monarch butterfly and milkweed science research project; (2) periodic meetings with the Latino Cultural Center (LCC) and project staff centering their cultural/ethnic identities; and (3) ongoing opportunities for reflection. These elements and the corresponding activities are further described below and are outlined in Table 2.

- (1) The research project aimed at exploring reasons for the decline in monarch butterflies. As part of this research, each intern located multiple sites for planting two species of milkweed, *Asclepias incarnate* and *Asclepias tuberosa*, and monitored the monarch butterfly usage of the milkweed plants. Each intern completed weekly observations at each site and recorded the number of monarch eggs and larvae (caterpillars). At the end of the research project, each intern wrote a formal research paper to describe how their data supported whether monarch butterflies have a milkweed preference. The interns were also asked to reflect and write about their overall experience as the final section in their research paper. In addition, the interns also prepared a presentation to share their findings to MB project staff members.
- (2) The interns had periodic opportunities to engage with the LCC and MB project staff, constructing connections between human immigration and the monarch butterfly migration, exploring their personal histories, and examining their cultural/ethnic and science identities. The *Life Stage Zine* asked interns to create an autobiographical zine associating various significant experiences in their lives with the four stages of the monarch's life cycle. In the *Identity Exploration*, the interns wrote five words that

capture how they identify and five words capturing how others identify them. As part of their *Oral History Project*, interns recorded and transcribed interviews with a family member to capture their migration story and connect that story to the migration of monarchs, and shared these stories with each other and the MB Project staff. The interns also conducted orally a *Peer Interview* to get to know each other and documented in writing what they learned about their peer.

- (3) The interns had two types of opportunities for ongoing reflection: (a) weekly response videos, centered on the particular activity during their weekly meetings and guided by a specific prompt for which they recorded their answers in short videos and (b) weekly journal entries, centered on general prompts to guide their ongoing reflection on anything they found significant. The interns were guided to think and write on ideas about monarchs and/or milkweeds that have been on their mind that week; experience(s) that have contributed to their thinking about these ideas; connections they have been considering between culture and science; and considering their own cultural heritage, experiences they have had or have been narrated to them from others that bring out the significance of, and understandings about, monarchs and/or milkweeds to the natural and social/cultural world.

Data analysis

We engaged in an interpretative analysis process that involved iterative cycles of analysis to capture how the data informed our evolving understanding of the interns' experiences (Bynum and Varpio 2018). This process included coding the interns' work in the context of the various activities, memoing about similarities and differences we were noticing across activities and interns, and identifying emerging themes. After immersing ourselves in the data to gain an overall understanding of what each participant shared, we began by chunking the data by internship element. Guided by the theoretical framing presented above, we coded, across all internship elements, the various experiences the interns invoked. The dimensions of experiences that we focused on were: (a) form(s) of cultural wealth that was implicated; (b) settings where these experiences occurred; and (c) identities foregrounded (see Table 3). To answer the first research question, we developed themes by searching for commonalities and differences between the forms of cultural wealth invoked and the identities foregrounded among the interns and across all the internship elements. We then looked for which curricular activities these themes were most commonly found. To answer the second research question, we focused on the commonalities and differences of the emerging themes across the internship elements and analyzed the features of each of the elements and how they may have offered pathways for the interns' engagement in identity negotiations (Bynum and Varpio 2018; Neubauer, Witkop and Varpio 2019).

Findings

The analysis points to two findings. First, the research interns referred to different forms of cultural wealth as they grappled with multiple identities and their intersectionality, and the cultural wealth in their identity trajectories was instrumental in countering

master narratives. Second, the various internship elements offered the interns different pathways for identity explorations, as each curricular activity provided particular affordances for engaging with their multiple identities.

Cultural wealth in grappling with identities

Throughout the internship, the research interns had opportunities to think about their various identities and consider what we call ‘identity conundrums’—tensions of fit and alignment between or among multiple identities. As they engaged in these identity conundrums, they evoked to different degrees various forms of cultural capital and used them to grapple with master narratives and storylines associated with identities.

Intersectionality of science and Latina identities

One of the most salient conundrums that the interns grappled with was centered on the intersectionality of their science and Latina identities. Jessica invoked her cultural wealth in the form of resistant and familial capital, and noted structures that not only complicate but also prevent a synergistic coexistence of Latina and science identities. Jocelyn grappled with her multiple identities as a woman, a first-generation student, and a Latina, and invoked her resistant capital to affirm that all these identities not only belong in science spaces but they also have value.

In her first written reflection, Jessica was describing connections she was making between culture and science, and noted how the monarch butterfly is closely related to her “Mexican culture,” but also how this presented “an irony.” In the USA, “Latinos are not similarly associated with STEM careers” even though Latin* people have “a culture so deeply rooted in nature and science (traditional customs and ancient cultural knowledge).” She continued: “the older Mexican men in [her] family...have an impressive amount of knowledge on plants. Usually, this knowledge comes from their upbringing.” For Jessica, Latin* people’s cultural wealth is not recognized as science and therefore Latin* people are not seen as science people, to which Jessica pushed back by identifying it as ironic and acknowledging the depth of such wealth of science knowledge of her ancestors, and specifically those in her family, linking resistance and familial capital. Jessica also resisted the deficit narrative of attributing Latin* underrepresentation in science careers to lack of interest in science, and rejected this as a Latin* misidentification with an emphatic “biology is in my blood!” In this way, she recognized the alignment of her Latina and science identities and appeared to have settled that identity conundrum for herself.

It is also important to note that Jessica may be also considering another identity conundrum, the one involving gender. Jessica mentioned “older Mexican men” as possessing knowledge on plants. She may have identified these “older Mexican men” as a way to challenge traditional gendered notions of who performs gardening roles. Alternatively, Jessica may be alluding to the patriarchal ideology that has been documented as part of the Mexican culture. In this way, only men would possess this valuable knowledge and capital. Thus, there may be an identity conundrum for Jessica across her gender, science, and Latina identities of which we do not have sufficient understanding.

Later in the internship, Jessica reflected again on the connections between culture and science, while discussing knowledge that is passed on through generations during an LCC activity, and noted that the generational knowledge she possessed “is very significant although it may not always be considered ‘hard science.’” She continued describing

Table 3 Codes, definitions, and illustrative examples

Code	Definition	Example
Cultural wealth-aspirational capital	Hope, motivation, confidence for the future for themselves and others, even despite current hurdles	"I always see a lot of international students on campus, for me a Latina, it kind of boosts my confidence."
Cultural wealth-familial capital	Cultural knowledges that come from family, expansively defined to include community	"The older Mexican men in my family, for example, have an impressive amount of knowledge on plants, their properties, and how to care for them. Usually, this knowledge comes from their upbringing."
Cultural wealth-social capital	Networks or communities of people and resources	"I believe that living in a Mexican community outside of a major U.S city facilitated my ability to develop a relationship with my own cultural roots."
Cultural wealth-navigational capital	Skills and strategies necessary to navigate through social institutions	"Once that generation accomplishes what has never been done, the next generation reaps the benefits of having someone in their family to guide them and possibly succeed in ways that the first generation could not."
Cultural wealth-linguistic capital	Language and communication assets	"We have something special that we can contribute because we speak the language."
Cultural wealth-resistant capital	Knowledges and skills that come from oppositional behavior	"Being a minority woman in the STEM field and being a first generation student can get intimidating. I've had to face imposter syndrome. I have to remind myself that I do belong and I have made it thus far for a reason."
Setting-higher education	Any postsecondary academic environment	"Just the academic circles at [name of university] are just diverse. On the daily basis I will always see international students and staff."
Setting-K-12 education	Any elementary, middle, and high school contexts	"I was raised and went to school in a predominantly Mexican community."
Setting-MB project research internship	Any element of their current internship	"The science and research component of the [MB project] internship allowed me to feel more comfortable with the idea of becoming a scientist."
Setting-STEM field	Reference to undifferentiated STEM field	"A person's cultural background can impact their decision to join the STEM field"
Setting-familial context	Within the context of family and family's history	"I guess my mother moving from Puerto Rico to Indiana to go to school."

Table 3 (continued)

Code	Definition	Example
Setting–community	Within the context of geographic and/or social community	“As I got older it became more apparent and I started to feel how I don’t really belong in one community more than another.”
Identity–ethno-racial	Associated with being a member of a racial and/or ethnic group	“I am a Mexican American and I feel like I am both equally.”
Identity–STEM person	Associated with affiliation with STEM fields	“Personally, I feel that Biology is in my blood.”
Identity–family member	Associated with being a member of a family	“Connection between culture and science, would be that my family has all been farmers before my parents, and worked in the agriculture labs.”
Identity–community member	Associated with being a member of a community	“Thus, when I hang out with old friends or even with my family, they tend to tell me how I am different.”
Identity–student	Associated with being a student	“This internship proves to me and all of the other Hispanic students that we are being heard, we are wanted, and we belong.”
Identity–First generation student	Associated with being a first-generation student	“Being a first-generation student is daunting”

how ancient civilizations in Latin America “were pioneers in many areas of science...I’ve just reflected on how I feel out of place sometimes in STEM but my cultural roots say otherwise.” Thus, although it appeared early on that Jessica may have settled the science and Latina identities conundrum, the tension persisted. Jessica was referring to tensions between her culture and Western science. She invoked her familial capital in describing how passing on cultural knowledge is “significant” but also recognized that this familial capital is not valued as a form of wealth in Western science spaces. Jessica invoked resistant capital to acknowledge the wealth of knowledge that is part of her culture’s history and traditions, but she also expressed that “this may not be apparent to others.” Jessica’s identity conundrum was unsettled as others’ viewpoints matter in the assessment of alignment between identities. Others do not recognize the alignment she considers (or if they do, they consider cultural knowledge as possibly a *soft* science), which contributes to feelings of doubting her belonging in STEM spaces and othering her from the field she was pursuing as an undergraduate student. Structures that reproduce dominant narratives of Western science and do not recognize the non-western scientific contributions create (implicitly or explicitly) STEM spaces that ignore or devalue her forms of cultural wealth, which contribute to Jessica’s unsettled tensions between her Latina and science identities, despite invoking resistant capital.

Jocelyn, in one of her first reflections discussing connections between culture and science, described how the monarch butterfly project was important to her because it is “a representation of her culture” and of her “love of nature.” She continued that the internship provided her an opportunity to work with other Latina interns and it allowed them “to show what we can bring to the table and that we do belong.” Jocelyn implicitly acknowledged the existence of science spaces that perpetuate the deficit narratives of minoritized people and, thus, are not places that welcome her intersectional identities as a woman and Latina in science. She invokes her resistant capital in opposition to this deficit narrative by acknowledging that she had knowledge and skills that are capital in these science spaces and that she does belong. Jocelyn acknowledged that this deficit narrative is related to the underrepresentation of Latinas in STEM and added that she and her peer interns were “breaking statistics.” Jocelyn was determined to settle the conundrum between Latina and science identities and considered the internship as a place where she could achieve that.

In her Life Stage Zine, Jocelyn noted “how being a minority woman in the STEM field and being a first generation student can get intimidating. I’ve had to face imposter syndrome.” The identity conundrums that Jocelyn was grappling with were thickening as she added the first-generation college student identity in the mix, and she labeled the othering she was experiencing, which Jessica also noted, as the “imposter syndrome.” Western science has set the standards, structures that define who is considered in and who is considered out and everyone that according to the standards should not be in, is an “imposter.” But Jocelyn resisted this framing: “I have to remind myself that I do belong and that I have made it thus [sic] far for a reason.” Her resistant capital rejected this dominant narrative and was instrumental in her reclaiming of the denied place in science settings. As she reminded herself that she had made it that far for a reason, she implicitly acknowledged her skills and knowledge that she carries with her into the science spaces despite the limited access to resources she had as a first-generation college student. She also implicitly acknowledged the value of her presence and work in these spaces.

Reimagining barriers

As the interns engaged in reflecting on their experiences growing up and how these informed the development of their identities, their different forms of cultural wealth surfaced as indispensable resources for grappling and reimagining barriers that they had encountered. For Jocelyn, growing up in a predominantly Mexican community afforded her the opportunity to develop her Latina identity, but it also brought about barriers due to structural inequities in her community and schooling. Her linguistic and familial wealth helped her overcome the adversity she experienced. Jessica experienced a similar identity conundrum brought on by the structural inequities present in her Mexican community. Her familial capital supported her in developing her Latina identity, but she also recognized that she felt “stress” and “confusion” as she navigated higher education. Aspiring to provide guidance for future family members was the capital needed to persist against the barriers associated with being a first-generation college student. For Yesenia, though, her aspirational capital to materialize her family’s hope of becoming successful was not sufficient to reduce the added pressure she was feeling to be able to help her family by succeeding in college without the resources that first-generation students would need. Thus, each of the interns invoked their aspirational, familial, and linguistic cultural capital in different ways to reimagine the barriers brought by the structural inequities that marginalize their Latina and first-generation identities.

Both Jocelyn and Jessica discussed that they grew up in predominantly Mexican communities. In this way, Jessica’s and Jocelyn’s families made the decision to live in neighborhoods that reflected their cultural, ethnic, and linguistic identities. In her Life Stage Zine, Jocelyn foregrounded growing up in a Mexican neighborhood in two of the 4 stages. As part of an early stage, she described growing up in the same community all her life: “Me gustan los tacos, bailar Norteñas y estar en el rancho [I like tacos, dancing Norteñas and being at the ranch].” Jocelyn’s linguistic capital, namely being able to speak Spanish, was an integral part of the cultural relationship she had with her community that also included other dimensions of her Mexican culture. She continued to foreground her linguistic capital through code switching by describing in English how she also “love[s] cheeseburgers, cookouts and watching football. I am Mexican American.” Using both Spanish and English she was intermingling both her Mexican and American identities, although she also experienced tensions as she claimed both identities that we will elaborate in a later finding. In the next stage of the Life Stage Zine, Jocelyn expressed that she was “blessed to be part of [a Mexican community] and thankful for the culture I grew up in.” Growing up in a Mexican community provided her the sense of bonding to her Mexican culture. However, Jocelyn at the same time recognized the barriers to living in a predominantly ethnically marginalized community: “as I have gotten older, I have begun to see how underprivileged my community is.” The inequities in her K-12 schooling were most salient as she noticed that young people were “not being encouraged to pursue careers in the STEM field.” Despite the cultural and knowledge rich community Jocelyn grew up in, formal schooling experiences continued to proliferate deficit narratives. It was her familial capital that helped her push back on this deficit narrative—“in my case, my family instilled in me how important it is that I succeed in my academics.”

Like Jocelyn, Jessica also grew up in a Mexican community, which she believed “facilitated [her] ability to develop a relationship with [her] own cultural roots,” and positioned herself as “privileged to be able to navigate my heritage the way [she] did at a young age.” Jessica’s familial capital was used to set up a contrast to her peer intern who grew up

"feeling out of touch" with her culture. However, for Jessica, the privilege of a strong cultural identity also led to "confusion and distress when weighing [her] identity against other experiences in [her] life, such as in higher education." Her Latina/Mexican identity led her to having negative and stressful experiences in higher education where Latinas' community knowledge and cultural assets are often not recognized and not aligned with student and science identities, leading them to experience being in *nepanila* (Aguilar-Valdez, López-Leiva, Roberts-Harris, Torres-Velásquez, Lobo and Westby 2013; Anzaldúa 2012), an in-between state marked with unsettlement. Jessica aligned her first-generation college student identity and her Latina identity as she reflected on the significance of monarchs to her cultural world, connecting the monarch butterflies to "immigrants looking to break into the world of higher education." Jessica connected the struggles in the journey of the monarch butterfly to the struggles of a first-generation student, because "being a first-generation student is daunting." First-generation college students in higher education have to navigate a complex system, and often a system with structural injustices, without the benefit of their elders and others in their social networks being familiar with these structures. Although Jessica found the path "daunting," being able to provide in the future social capital to relatives going through higher education so they could "reap the benefits of having someone in their family to guide them and possibly succeed in ways that the first generation could not" gave Jessica strength to persevere. Lifting up her family and contributing to the collective good of her peoples stood in contrast to the dominant Western narrative of individual success.

This aspirational capital that Jessica used to negotiate her identities was also expressed by Yesenia, who also brought up emotional challenges that first-generation college students experience, including increased pressure to succeed so that they would be able to help their families. Yesenia noted that through pursuing a science degree, she "want[s] to make the field more diverse and [she] want[s] to make [her] community proud by being successful." Her family's aspirational capital was the motivator to pursue a science degree carrying "that hope that many minority immigrant families have when they cross the borders." But the aspirational capital also leads to "a much greater weight, which is the cost of a STEM degree, the systemic discrimination, the stress of balancing that family duty and that care for your family, and also all the work that is school." Although Yesenia's identities as a daughter and a Latina made her want to pursue a science degree to make her family proud and to increase the representation of Latinas in science, she was negotiating them with her science and student identities. This bittersweet feeling of stress and pride is felt by Latinas who want, and are expected, to serve as role models for the rest of their families.

Identity trajectories

Experiences impact identity trajectories and the interns leaned on their various forms of cultural wealth as they were constructing and negotiating their multiple identities over time and in various spaces. Jessica recognized disparities that impacted her science identity trajectory by limiting her access to meaningful science activities in school. She resisted dominant narratives of what counts as science learning to further develop her science identity. Jocelyn also felt that science identity trajectory was impacted by her schooling that limited her familiarity with Western science practices. However, her familial capital helped her to develop her science identity and pursue a science degree. For Ariana, her two ethnoracial identities needed to be negotiated as she was growing up so she could push back on dominant narratives that marginalized her Latina identity in order to (re)claim it. Similarly,

for Jocelyn, dominant narratives that dichotomize other ethno-racial identities and an American identity presented tensions for her as she was constructing her Mexican American identity, which she resolved by resisting this dichotomy and recognizing the beauty of claiming having both identities as an asset. The interns' cultural assets provided various pathways for negotiating their identity trajectories.

Jessica noted in a weekly response video that she lived in "a low-income community and so that just meant that we had the bare minimum in our school system...so it made it harder to get into STEM." Economically stressed communities endure the same disparities in schools situated within the community as in everyday life, namely a lack of resources. A perpetuated disinvestment in particular schools, thus, acts as a gatekeeper that perpetuates inequities and the dominant culture of power. Jessica noted that this disinvestment in schools limited her science learning because her schooling "didn't really facilitate [her] journey into STEM." Because of her K-12 schooling experience, Jessica's science identity trajectory was compromised from lack of access to meaningful experiences with science. In a later reflection, Jessica noted that "needless to say, I found my own way into the STEM field based on my interest in nature and a desire to learn more about it." Despite Jessica's upbringing in K-12 schooling where meaningful opportunities to engage with science were not provided, Jessica's own interest in nature facilitated her identification with science. In this way, Jessica resisted traditional science education, championing how nature, and not schooling, and her own pursuit of knowledge helped her to develop her science identity.

Jocelyn, responding to the same weekly response video as Jessica, similarly noted limited resources in her K-12 schooling. "So, I realized that my community is very under privileged when it comes to the education system...there wasn't many extracurricular activities, funds were always being cut down." The enrichment activities, along with classes, were compromised due to perpetual budget cuts, but necessary for developing a science identity—"if you are not getting these STEM related classes...you're really not introduced to it so that would definitely impact it so, as opposed to being in a suburban high school." Jocelyn recognized a structural inequity that restricts opportunities to access science in minoritized communities in the city that are not as privileged as suburban communities. However, her family supported her in the pursuit of a science degree. "My family has influenced me a lot in joining the STEM field because they tell me that I have the platform to do more and to do better, which is why I want to make them proud." Despite her inadequate access to science in her K-12 schooling, her family positioned Jocelyn as a science person and offered her their hope as a platform to pursue a science degree. Jocelyn's familial capital, rooted in her family's aspirational capital, was instrumental in the development of her science identity.

Ariana grappled with being "Puerto Rican" and "White" but others positioning her as a "White, not really a Latina" and not seeing her as both, as she noted in the Identity Exploration activity. In the "egg stage" of her Life Stage Zine, she associated this grappling with being "mixed race," and how she saw herself in addition to how others saw her. "My cultural heritage is difficult. And in all honesty, I am not super comfortable with. I am mixed race." Being positioned by others in certain ways had contributed to her own grappling as a "mixed race" person—"I have been told that I am not truly Latina. That I am lesser." However, Ariana resisted such positionings focusing on the cultural aspects of her Latina ethno-racial identity: "while I constantly have to prove that I belong, I still feel I belong in these spaces because I grew up with Puerto Rican culture." Her familial capital, which was nurtured throughout her upbringing, helped her push back on others' positionings of her in ways that marginalized her Latina identity while she was identifying herself as "mixed race."

Jocelyn grappled with her ethno-racial identity in a different way, focusing on being both Mexican and American. Jocelyn initially presented this tension in her Identity Exploration activity where she identified herself as “Mexican American” and expressed that others would identify her as “Mexican.” This tension had impacted Jocelyn’s Mexican American identity trajectory over the years. In the Peer Interview, she described how living in a Mexican community in a metropolitan city helped to nurture her Mexican American identity, but also contributed to the tension she was feeling. “As I got older it became more apparent and I started to feel how I don’t really belong in one community more than another. I am a Mexican American and I feel like I am both equally.” Jocelyn focused on the cultural aspects of being American to claim her American identity: “I celebrate American Holidays and American traditions.” However, she noted that she was not recognized as American by “a lot of (white) people...because of [her] physical differences.” Jocelyn implied that master narratives in the US associate being American with being phenotypically white and, therefore, another ethno-racial identity compromises the American identity. On the other hand, her Mexican identity was also problematized over the years—“when I am around older generations of Mexicans...I do also feel like I’m not Mexican enough either.” For Jocelyn, claiming both an American identity and a Mexican identity was “beautiful and hard at the same time. You have a more open perspective, and you share values of each culture.” Without distinguishing between ethno-racial and cultural dimensions of identity, Jocelyn resisted dominant ethno-racial narratives that dichotomize American and other, historically marginalized ethno-racial identities.

Identity explorations and the research internship

Throughout the research internship, the interns engaged in three types of work that, as noted in the Method section, we organized as follows: (1) ongoing monarch butterfly and milkweed science research project; (2) periodic meetings with project staff centering cultural/ethnic identities, and (3) ongoing opportunities for reflection. The three types of work or internship elements offered the interns similar and different opportunities to engage in explorations of their multiple identities and their intersectionalities, including identities as Latinas, daughters, and science people.

A scientific research paper and a reflection: co-mingling of genres and identities

Throughout the ongoing monarch butterfly and milkweed science research project, the research interns collected and analyzed field data for the purposes of their research project, which included a research paper. At the conclusion of the research internship, the interns also reflected on the research experience and the components of it that were most salient to them. The final research paper and the reflection on the research internship showed how the interns were constructing their science identities and indicated the continuing tensions they were experiencing between their cultural and science identities.

The interns had already been socialized in their K-12 and postsecondary education on what scientific research is and how it should be presented, and this was reflected in their construction and content of their research papers. Their science identities as people who follow the accepted rules and norms of how scientific research is written up were communicated throughout their papers. For example, each intern described their research on the

monarch butterfly in their final research paper using a format that included methods, results and discussion on findings. The research paper invited the interns to conform with publication practices in science, and thus re-affirm historically proliferated science identities, but did not offer a pathway to nuance these identities and also bring into their research papers their ethno-racial, gender, cultural, and other identities. As part of the methods section, each research intern described the locations of the field sites used. Ariana's sites for data collection were located at the university campus whereas Jessica's sites included the university campus and her neighborhood. Jocelyn's data collection sites were all in her neighborhood while Yesenia used both her neighborhood and two other nearby neighborhoods. Despite the centrality and connections of these locations to their other identities (i.e., cultural, ethno-racial, student), these identities remained separate from their science identities in their research papers.

The invitation to reflect on the internship, as a whole, seemed to have invited the interns to describe their experience in the research internship, and in doing so they offered us insights into how they saw the internship as supporting the development of their science identities and the ways in which they were recognized and saw themselves as competent science people. Although indirectly, their written reflections also offered us insights into ways in which the interns were constructing alignments or experiencing tensions between their Latina and science identities at the end of the internship.

For Jocelyn, "this internship proves to me and all of the other Hispanic students that we are heard, we are wanted, and we belong." Being a Latina in a science space, doing scientific research, and being together with other interns who shared the same ethno-racial identity were significant for Jocelyn. The internship provided for Jocelyn a space that recognized both her Latina and science identities and thus became a science place where both her identities were seen, desired, and nurtured. She continued with "through this project I have felt appreciated as a female Latinx scientist," in which she layered her gender identity along with the two others, and she explicitly positioned herself as a "female Latinx scientist." The grammatical construction she used is important to consider. She did not use Latina, but rather included an adjective in front of the gender inclusive ethno-racial designation "Latinx," a construction that emphasizes more strongly the duality of her identities in terms of gender and race/ethnicity. The intersectionality of her three identities came through loud and clear in her writing. What Jocelyn pointed out in her written reflection also alluded to the tensions and misalignments she had experienced among these identities in other spaces.

Jessica was more explicit than Jocelyn regarding the misalignments she was feeling prior to the internship between her Latina and science identities. In describing her decision to apply for the research internship, Jessica noted that her Latina identity contributed to her feeling "intimidated to put herself in academic settings" so she was initially hesitant to apply for the internship. She further described how this changed with the internship, now feeling "more confident about my abilities to do research regardless of my background" and "more comfortable with the idea of becoming a scientist." Jessica seemed to associate her ethno-racial identity ("my background") as deficient, linking implicitly her ethno-racial identity to her feeling intimidated by formal science spaces and feeling apprehensive about her abilities as a scientist. Jessica concluded her reflection with stating that she "applied to the program seeking research experience more than anything else because there is so much value placed on skills directly related to hard sciences." For Jessica, the focus of the internship was access to research experience to develop the skills that "hard sciences" are known for and would be important for her academic success. Her conundrum between her science and Latina identities has

led her to focus more exclusively on her science identity, seeking to overcome the lack of opportunities she may have had in the past. Her emphasis on ability, competence, and skills was in the context of her desire to be seen as equal, as a Latina who has research experience and skills.

Similar to Jocelyn, Yesenia's reflection brought out how the internship provided opportunities to further develop her skills as a scientist by having an opportunity to do a different type of research. Yesenia noted that although she had previously "worked in a microbiology laboratory...[she] enjoyed learning how to conduct field work style research" because she loves "being outdoors, interacting with people, interacting with nature, and learning techniques of data collection." It was in this type of research experience where she noted that she had learned more than in her "actual college classes." Her student identity and her science identity were brought up and juxtaposed here, as she noted less knowledge development in classrooms than in the field and linked knowledge to developing competence as a science person. Yesenia also noted that what she found central in the internship was "being able to connect scientific concepts...to cultural aspects was something that many programs lack. Often times there seems to be a gap to what is accomplished in science and how it connects back to humanity." Although Yesenia did not address explicitly any of her other identities, by bringing up "cultural aspects" linked to "scientific concepts," she positioned herself as someone who found both necessary to engage with, as a person who participates both in culture and in science. It is not clear whether Yesenia associated "humanity" with the intermingling of culture and science, or only with culture, but this is clearly her attempt to foreground the multiplicity of ways of being and of identities as part of "humanity."

The restrictive format of the final research paper did not provide a pathway for the interns to explicitly engage with the intersectionalities of their identities, as the genre they had associated with it did not suggest to them that this was allowed although the emphasis of the project was to create opportunities of co-mingling and negotiating their multiple identities. The written reflection on the internship invited more engagement with the intersectionality of their identities. However, the fact that reflection followed their research paper may have influenced which identities the interns foregrounded. Thus, one way to understand the salience, in their reflections, of their science identities vis-à-vis their references to the development of competence, skills, and comfort, is that it was embedded in the same activity that was characterized by the dominance of science as a practice.

Culture, self, and journey: multiple identities and cultural wealth

As the research interns were interacting with project staff during weekly meetings, the curricular activities that centered their cultural/ethnic identities (identity exploration, life stage zine, oral history project, and peer interview) became sites where they grappled with multiple identities mostly focusing on their cultural/ethnic identities without explicitly linking them to their science identities.

The identity exploration activity provided the interns an opportunity to grapple with the alignment or dissonance between their own ways of seeing themselves and those of others. For most of them the salient identity that they engaged with was their ethno-racial/cultural identity. Jocelyn self-identified as "Mexican American" but noted that others would think of her as "Mexican." Although she was embracing both national and cultural identities, and she was feeling at home with both of them, she knew that others would see her country of origin as her only defining identity, excluding her from access to the identity

associated with the place that her family had immigrated to. Similarly, Ariana shared that others would view her as “White” although she self-identified as “Puerto Rican,” referring to the often unexamined and complex relationship between ethnic/cultural identity and race, frequently judged by one’s skin color. Moreover, Jessica self-identified as “Mexican” and a “woman,” but noted that others would see her as “Hispanic” and a “girl.” Although for Jessica her ethnic identity was specifically linked to her country of origin, she was aware that it is the norm in the US to uncritically group many diverse ethnicities under the “Hispanic” label. She was challenging this unilateral categorization in the distinction she made between an identity she was claiming for herself vs. how she thought she was seen by others. She also brought up another distinction, that of a grown, adult woman and that of a “girl” who has not reached adulthood yet and is still considered a child. In fact, the intersectionality of being a Hispanic girl to others but a Mexican woman to herself raises the identity ruptures that she was attempting to negotiate as she had a chance to engage with thinking about them in the Identity Exploration activity.

In contrast, the Life Stage Zine, which invited the research interns to engage with events/stages in their lives that correspond to stages of a monarch’s life, offered them opportunities to think about the evolution of their experiences, intertwined with how their multiple identities were part of their journeys. For all of them, their ethnic/cultural identities were prominent in the Life Stage Zine and offered them opportunities to juxtapose them with their student and science identities. Jocelyn’s early upbringing in a predominantly Mexican community allowed her to engage in learning to code switch between Spanish and English, an important part of her linguistic capital. Later, her experiences in schools and formal science spaces were limited by living in an economically stressed community, but her familial capital (“my family instilled in me how important it is that I succeed in my academics”) offset these limitations so she could progress. For Yesenia, it was her parents’ “culture and stories” (both parents being from the same state of Mexico) that shaped her early life and the development of her Latina identity. And, in contrast to Jocelyn, as she was growing up, experiences in out-of-school settings, such as robotics club, helped her to foster a love for, and identification with, science. Yet, a different evolution was unearthed in Jessica’s zine. As Jessica, at an early age, moved from living in the Mexican neighborhood to living in a predominantly White suburban neighborhood, she was “coming to terms with my identity in a place that I felt like I didn’t belong.” Later, for her, it was “schooling [that] has allowed me to become more confident in my abilities.”

In the Oral History Project, the interns collected stories of family migration and made connections to that of the monarch butterfly. There, the interns did not engage directly with who they were and were becoming, their identities, but they uncovered family members’ experiences and identities, and particularly their ethnic/cultural ones, that the interns refracted in their own identity construction journeys. Their relatives’ identities mostly pronounced in their journeys were cultural/ethnic ones with several different salient elements, exposing grappling and master narratives associated with these identities.

Yesenia interviewed her father who shared his migration story from Mexico. Her father shared that holding a naturalized US citizen identity was different than that of a US born citizen. For her father, an immigrant “tiene que poner un poco de mas esfuerzo doblé el esfuerzo a comparación a la persona que nace aquí, estudia aquí, va a la escuela aquí [has to put forth a little more effort, double the effort, in comparison to a person that is born here, studies here, goes to school here].” Her father’s hard work became the familial capital that Yesenia was drawing on as a first-generation college student. Jocelyn’s Oral History project also shed light on relatives’ identity grapplings. Jocelyn interviewed her uncle who shared his tensions in identifying as Mexican and American when he moved from Mexico

to the US. Her uncle shared: "I feel you know that I'm more American because I've spent more time here but...I won't say I am American because I wasn't born here." This tension of claiming both American and Mexican identities in terms of negotiating duration of living in a country and birthplace was also part of Jocelyn's grappling of her identities rooted in her ethnicity, culture, and nationality. Thus, the Oral History Project shed light on the ways in which families, familial histories, and perspectives were intertwined in the interns' identities.

Jessica's conversation with her grandmother about her migration story from Mexico added an additional layer to this grappling. Her grandmother did not think that she and the monarch butterfly had similar journeys because the monarch butterflies have "more merit" for completing their journey without the help of family and friends. Although Jessica's grandmother was elevating the value of achieving on one's own (a part of the master narrative of associating individual effort, persistence, and grit with success), she also highlighted the familial capital she felt she had as she navigated a new country. For Jessica, who had shared that first-generation students may not have family members that can guide them through higher education, the hope that her struggles would benefit future generations showed how her grandmother's familial capital had become aspirational capital for her as she embarked on higher education.

Finally, for Ariana, it was her mother's adaptation that surfaced in the Oral History Project linked with her university experiences, as she migrated from Puerto Rico to the US to go to a veterinary school. Her migration experience was "overwhelming but smooth at the same time. It's, it's hard to explain...I felt a little isolated, but I didn't feel like completely separate from everybody else at the same time...I felt like I adapted well and fairly quickly and it seems to be the same way with the butterflies they just moved to a new location find their favorite plants and go live there." As Ariana's mother elaborated on her experiences, the fact that the university where she came to study did not have "a lot of Hispanic classmates around" led to the isolation. Because she "spoke the formal you learn in school type English not though the everyday English" she could not engage comfortably "in casual conversations with classmates and teachers." In this way, she nuanced what linguistic capital as a form of wealth means. Since there were not enough classmates speaking Spanish and her colloquial English was not as strong as her "school type" English, language skills were linked with feelings of isolation, struggling to feel included. Her narrative is consistent with the master narrative of the need of immigrants to adapt and put aside cultural, ethnic, and linguistic identities in order to assimilate and survive.

The last activity in this cluster, the Peer Interview, complemented the Oral History Project, as the research interns interviewed each other and wrote about similarities and differences in their peer's experiences relative to their own. This activity afforded them an opportunity to explicitly recognize elements in their experiences that were salient in how they were constructing who they were and who they were becoming. Jessica's realizing that her peer had not grown up in her Latina culture helped her see herself as "privileged" to have grown up in a space that nurtured her Mexican identity. However, for Ariana, the Peer Interview amplified her grappling between her two ethnic/cultural/racial identities. She wrote about the "obvious" difference between her and her peer because as she wrote: "You can definitely tell which one of us is the mixed one. (Hint it's me.)" As she was raised "anglicized," she struggled with the tension between seeing herself as Puerto Rican and white. Like Jessica and Ariana, in this activity, Jocelyn only engaged with her ethnic/cultural identity, and like Ariana, she focused on the negotiations involved, which for her were between her "Mexican" and "American" identities. Differently for all the other three interns, Yesenia, focusing on similarities in her and her peer's experience of being Latinas

in science, focused on the intersectionality of her ethnic and science identities. Foregrounding the hope that a “STEM degree” would bring her opportunities and success, she also noted the weight brought on by this responsibility. Thus, the Peer Interview offered the interns an opportunity to be authoring their selves in relation to peers with whom they shared ethnic/cultural identities to differing degrees. In this activity, as in the other activities in this cluster, the interns mostly engaged with their ethnic/cultural identities and only rarely explicitly considered their science identities.

Ongoing connecting of culture and science: catalyzing intersectionality of identities

In the two types of ongoing activities that the interns engaged in (e.g., weekly journal entries, and weekly response videos on specific themes) they brought together various identities in different configurations. For the interns, the journal entries and response videos, where they were invited to consider their experiences and their communities in relation to science, were places where their science and Latina identities were juxtaposed and stitched together foregrounding their cultural capital in science, albeit in different ways.

In her journal, Jocelyn connected her family’s and immigrant families’ experiences with the monarch butterfly both metaphorically and literally. “My grandparents represent the monarch butterfly...It makes me think about all the hard work that they did to give their children a platform.” But Jocelyn also shared the ways in which her family had been involved in the conservation of monarch butterflies—“It also made me happy because my uncle and aunt were able to talk to me about how beautiful the migration is, which I’ve never seen before. They were also able to describe how they collect monarch eggs and help them grow.” Moreover, Jocelyn’s familial capital was not limited to her being aware of her family’s expertise and knowledge, but also became a resource for her conservation work during the internship—“I also enjoyed getting advice from my dad when planting and maintaining the plants. He would tell me what I needed to do in order to keep them alive and when they wilted my mother took me to buy supplies and my father installed the plant tools.” Eventually, Jocelyn’s identities as Latina and scientist led her to consider the role that she and her community should play in conservation efforts: “we have something special that we can contribute because we speak the language, we are a part of the culture, and we represent them...I can go over there and communicate with the communities over there.” This was made more explicit in the response video on conservation efforts as Jocelyn shared: “I do think that us as Latinx, Hispanic students, we are able to connect and advocate to these people because we understand them more.” For Jocelyn, her ethno-racial, cultural, and linguistic identities were intertwined with her science identity as she considered her role in facilitating collaboration across local communities in Mexico to advance conservation efforts. Moreover, her Latinx community, and her identities associated with it, was front and center when, as a science student engaged in the internship, was asked to ponder environmental racism. In her response video that prompted her to describe an instance of environmental racism in her community, Jocelyn discussed how a coal plant in her community was knocked down without notifying her community of the environmental impact this would have. “This was very unfortunate because we weren’t given any warning, we weren’t being taken into consideration...It’s just really sad that a corporation could do this to a community and potentially harm these people in the community.” Jocelyn’s own experiences in the community in which she grew up were mediating the intersectionality of her identities.

Yesenia too, similar to Jocelyn, used the journal entries and response videos to foreground how her family's and community's experiences mediated the intermingling of her identities. "My family is from Mexico specifically the state of Michoacan...So for me this week's planting brought me one step closer to better understanding the magnificent and honored creatures of my second home, Michoacan, Mexico." As Yesenia was creating spaces where who she was as a Latina, an aspiring scientist, and a science student engaged in a research internship were all legitimate identities, she made connections in her journal entries about "the delicate journeys of immigrant families and monarch butterflies." She noted that she had a chance to be reminded "of how monarchs who represent the dreamers and all the hopes Mexicans carry when trying to move forward in life and escape poverty." In her response video related to environmental racism, she was more explicit than Jocelyn in terms of naming the intentionality of those in power to suppress others' voices: "I mean purposely factories are built where people don't have the resources to fight back." She also explicitly tied her developing science identity and positioning in the field of science with communities that she associated with: "I feel like it is important to think about how we can help these communities once we are in positions of science or even now."

Like Jocelyn and Yesenia, Ariana too contemplated her multiple identities in the journal entries and video responses as she pondered her family's and community's experiences. "My family has all been farmers before my parents, and worked in agriculture...If you come from a family where everyone is a farmer, you are more likely to go into farming than you are to go into STEM just because that is all you have ever known." However, she later added: "family culture is the reason I went into my field," giving us a glimpse of how she saw her cultural and science identities coming together. The intersection of these identities was also brought up as she pondered environmental issues and noted: "my hometown is right on the river. Knowing science can help fix the water issues we've been having." For Ariana, who was living in a predominately White, rural area, "environmental problems are a class based thing." Addressing these problems could come from the intersection of belonging in her community and the science community.

Whereas Jocelyn, Yesenia, and Ariana brought up their families' and communities' experiences as bridges for connecting identities, for Jessica such bridges were mediated via her own sense of competence in science. Jessica noted in her journal that at the start of the internship she was doubting her "abilities as a STEM student...[to] contribute to the project." She later wrote that "traditional customs and ancient cultural knowledge are not well-represented in STEM," and that "being a first-generation student" meant that she was the one to have to establish the foundations needed for her family. "The first generation of immigrants that arrives somewhere doesn't always reap the immediate benefits of their move...My grandmother mentioned to me the way that my uncle changed their lives when they got here. I feel that immigrants establish a legacy for their families and that is something we see in the way monarch's make an effort across many generations." The way that Jessica's identities were intersecting was centered on how she was seeing her own positioning in science—a field that does not embrace her cultural identity. In response videos, she also highlighted the importance of confidence in herself as a bridge between her Latina and science identities. Sharing on how conservation efforts of the monarch butterfly could benefit from international collaboration, she noted: "For me as Latina, it just kind of boosts my confidence and it makes me feel like if I were to put my ideas out there, they would be appreciated." Later she became more explicit on the intersectionality for her identities: "my own perspective will always be a bridge between my culture and the world of science, because sometimes it is hard to translate the two worlds so I want to be a tool for the people around me." As the journal entries and response videos offered the interns opportunities for

contemplating both their science and cultural/ethno-racial identities, the interns made connections with their experiences and those of their families and communities and revealed how they were constructing the intersectionality of their multiple identities.

Discussion

In this study, we explored how four Latina undergraduate students, engaged in a research internship aimed at bringing together science and cultural knowledges and practices, were negotiating multiple identities and how their sense of their cultural wealth was involved in their identity conundrums. The findings point to several conclusions: (a) structures at the macro- and micro-levels (Bronfenbrenner 1976), and enduring master narratives and distal identities, influence proximal identities and are implicated in identity conundrums; (b) cultural wealth plays a role in creating productive spaces and places of science engagement and counter narratives; and (c) explicitness is needed in educational activities so that science students may engage with the intersectionalities of their multiple identities.

Macro- and micro-level structures played an important role in the Latina interns' negotiation of identities as students and daughters, and were implicated in their trajectories and proximal identities as college science students. For Jocelyn, growing up in a predominantly ethnically marginalized community presented barriers to developing her science identity because of the prevalence of deficit narratives in her formal pre-college schooling experiences where she was not encouraged to pursue a STEM career. The school system she had attended (re)produced inequities similar to many other districts in the US (Elmesky 2018), where schools in economically stressed communities often lack resources and/or conviction for providing meaningful science experiences when the mandated focus is on reading and mathematics due to demands of standardized testing as other scholars have shown, such as Audrey Amrein and David Berliner (2002) and Kevin Anderson (2012). (Amrein and Berliner 2002; Anderson 2012). While micro-level structures like her K-12 schools, and macro-level structures like deficit and racist orientations, were discouraging Jocelyn to pursue a STEM degree, the micro-level structure of her family was enabling her to push back on the deficit master narratives to persist in pursuing a STEM degree. Identity construction happens over time and in various contexts. Daily experiences that impact the ways Latinas are negotiating their multiple identities have a cumulative effect on shaping how they position themselves. This cumulative process of identity construction is not just additive and is not linear, but it is a rather complex process, where different identities are negotiated at different times in relation to the various structures framing different contexts.

For Jessica, higher education as a macro-level structure was fueling tensions between her Latina/Mexican identities and her student identity. Jessica's Latina/Mexican identities were "weighing" on her in college where Latinas' cultural assets are often not recognized and not aligned with student and science identities. Historically higher education has been a system fraught with structural injustices where Latinas face discrimination related to their gender and ethnicity (Malcom, Quick, Janet, and Brown 1976), and stress brought on from transitioning from their communities to higher education (Contreras Aguirre, Gonzalez and Banda 2020). When community knowledges and cultural assets are not recognized in higher education, Latina students are forced into *nepantla*-a state after a hurtful experience within the dominant society (Anzaldúa 2012) that brings on the feelings of "distress" and "confusion." For Yesenia, higher education as a structure and the distal identities of college students shaped her grappling between her identities as a daughter and a first-generation

student. Systems of higher education often place the navigational burden on first-generation students who do not have an older relative to help guide them through the system, creating for Latinas the bittersweet feeling of simultaneously experiencing “stress” and “reward” associated with their cultural obligations to serve as role models for the rest of their family (Gloria and Castellanos 2012; Contreras Aguirre, Gonzalez and Banda 2020). Jocelyn noting on “how being a minority woman in the STEM field and being a first-generation student can get intimidating. I’ve had to face imposter syndrome,” pointed to her grappling with a proximal identity as a Latina, first-generation, science student that was not aligning with a distal identity of who is considered as a scientist and a science student.

Moreover, for both Jocelyn and Ariana, nationality, as a macro-level structure, and contemplating two nationalities associated with their ethno-racial identities were implicated in their identity negotiations as science people. For Jocelyn, dominant ethno-racial narratives pull apart her Mexican American identity to the point where the two parts are positioned as mutually exclusive. Thus, although Latinas in science in the US face the double bind of discrimination related to their gender and ethnicity, as students studying and practicing science in the US, they also carry the compounded weight of master narratives that challenge the authenticity of being Americans. Macro-level structures such as schooling systems, racial segregation, immigration policies, and racial capitalism (Robinson and Kelley 2000) play a crucial role in the ways in which multiple identities are complexly negotiated and co-constructed.

As the four Latina interns grappled with identity conundrums, their cultural wealth was instrumental in negotiating, and at times resisting, master narratives and storylines associated with their multiple identities as Latinas, daughters, community members, first-generation college students, and science people, and creating counternarratives. As long as systemic disparities exist, there is a need for counternarratives to center the stories of Latinas to tell “the story of those experiences that are often not told...and a tool for analyzing and challenging the stories of power” (Solorzano and Yosso 2001, p. 475). In counternarratives, socio-historical contexts that position certain identities at odds are challenged. Jessica and Jocelyn, who grappled with aligning their science and Latina identities, denounced the “science as white property” (Mensah and Jackson 2018) master narrative that forces Latinas to “leave their emotions, their bodies, their cultures, and their values outside of the classroom walls, stripping them of wholeness” (Gutierrez 2016, p. 271). Instead, they used their familial and resistant cultural capital to acknowledge the depth of the wealth of science knowledge of their ancestors and families and to recognize their own knowledges and skills as capital in science spaces. In this way, the interns’ acknowledgement of their cultural wealth became a counterweight to the alienation from science that permeated the master narrative about Latinas and science that they had experienced.

Albeit limited, Jessica and Jocelyn had experienced in their K-12 schooling and higher education spaces of exploration and engagement with science. However, in these spaces, there is often a prevalence of deficit narratives of Latin* people and lack of recognition of their cultural assets. The interns’ homes, in contrast, were what Yi-Fu Tuan (1977) called places (instead of spaces) that provided them with a sense of belonging, fostering different forms of cultural wealth. However, home was mostly a place for these Latinas and not a space of science exploration due to dominant narratives that narrow what counts as science. For Jessica, Jocelyn and Yesenia, the monarch butterfly (MB) project was at times both a place of belonging and meaning as Latina science students and a space of science exploration, conducting ecological research while also centering cultural practices. The MB Project transcended to a place where the interns felt “wanted,” “heard,” and “more

comfortable with the idea of becoming a scientist” and their multiple identities could be embraced. However, there were still times when the master narratives prevalent in science continued to fuel their identity conundrums, pointing to the emerging, but not solidified, counternarratives they were creating as they were bringing their various forms of cultural wealth in contact with science research.

The MB project included various elements that engaged the interns in the exploration of their multiple identities and their intersectionalities. Different elements and their curricular activities provided structures that afforded or constrained how and to what degree each intern engaged in thinking about their multiple identities. On the one hand, the research paper and the associated reflection on the research internship did not explicitly offer a pathway to consider the ways in which the interns were constructing their science identities in relation to their other identities, and, thus, the interns did not engage with the multiplicity of their identities and the intersectionality of their Latina science identities in that activity. On the other end, the weekly journal entries provided a structure through explicit prompts that invited the interns to consider their experiences and their communities in relation to science. This explicitness of inviting juxtaposing multiple identities offered the interns a pathway to ponder their multiple identities and reflect on the ways in which they co-mingled, creating counternarratives that were built on their cultural wealth. Educational activities require explicitness and intentionality in order to provide a place for science students to reflect on the intersectionality of their multiple identities. Science educators should regularly support identity construction (Varelas, Kane and Martin 2012), creating opportunities for learners “to voice how they see themselves, what counts as science, for whom, in what ways, how they accept or resist positionings by others and how they position themselves” (Varelas, Menig, Kane and Wilson 2020).

The study’s findings demonstrate the need to center and elevate students’ cultural wealth since it is a source of counternarratives that students construct regarding their multiple and intersecting identities. We echo the position that Herrera and Kovats Sánchez (2022) take that this centering and elevating are necessary for “legitimizing the contributions of communities of color to the world of science and acknowledging how STEM is enacted and validated within communities of color” (p. 138).

Furthermore, this establishes the need for intentionality in the design of science settings so that they become places and spaces (Varelas 2018) that value and explore cultural wealth in science and nurture students’ multiple identities well before Latinas enter higher education. Planning for this level of intentionality requires sociopolitical and sociohistorical understandings around the exclusionary nature of science as a discipline. Further empirical research is necessary to explore what this can look like in various science education settings. Without this intentionality, science spaces will continue to marginalize Latinas and position them as illegitimate knowers and doers of science. Rooted in the notion of hope as “an ontological need” (p. 2) that Paulo Freire (1994) advanced, we imagine a transformed world where Latinas can draw on their cultural roots to nurture their “rightful presence” (Calabrese Barton and Tan 2020) in science.

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Declarations

Competing interests The authors declare no competing interests.

References

- Aguilar-Valdez, J. R., LópezLeiva, C. A., Roberts-Harris, D., Torres-Velásquez, D., Lobo, G., & Westby, C. (2013). Ciencia en Nepantla: The journey of Nepantler@s in science learning and teaching. *Cultural Studies of Science Education*, 8(4), 821–858. <https://doi.org/10.1007/s11422-013-9512-9>
- Amrein, A. L., & Berliner, D. C. (2002). An analysis of some unintended and negative consequences of high-stakes testing. In *Education Policy Research Unit*. Education Policy Studies Laboratory. <http://edpolicylab.org/http://edpolicylab.org/EPST%7C>
- Anderson, K. J. B. (2012). Science education and test-based accountability: Reviewing their relationship and exploring implications for future policy. *Science Education*, 96(1), 104–129. <https://doi.org/10.1002/sce.20464>
- Annamma, S., & Morrison, D. (2018). DisCrit classroom ecology: Using praxis to dismantle dysfunctional education ecologies. *Teaching and Teacher Education*, 73, 70–80. <https://doi.org/10.1016/j.tate.2018.03.008>
- Anzaldúa, G. (2012). *Borderlands/la frontera: The new mestiza* (4th ed.). Aunt Lute Books.
- Avraamidou, L. (2020). Science identity as a landscape of becoming: Rethinking recognition and emotions through an intersectionality lens. *Cultural Studies of Science Education*, 15(2), 323–345. <https://doi.org/10.1007/s11422-019-09954-7>
- Avraamidou, L. (2021). Identities in/out of physics and the politics of recognition. *Journal of Research in Science Teaching*, 59(1), 58–94. <https://doi.org/10.1002/tea.21721>
- Avraamidou, L., & Schwartz, R. (2021). Who aspires to be a scientist/who is allowed in science? Science identity as a lens to exploring the political dimension of the nature of science. *Cultural Studies of Science Education*, 16(2), 337–344. <https://doi.org/10.1007/s11422-021-10059-3>
- Banda, R. M. (2012). *Perceptions of social support networks and climate in the persistence of Latinas pursuing an undergraduate engineering degree*. ProQuest Dissertations Publishing.
- Banda, R. M. (2020). From the inside looking out: Latinas intersectionality and their engineering departments. *International Journal of Qualitative Studies in Education*, 33(8), 824–839. <https://doi.org/10.1080/09518398.2020.1735565>
- Bang, M., & Vossoughi, S. (2016). Participatory design research and educational justice: Studying learning and relations within social change making. *Cognition and Instruction*, 34(3), 173–193. <https://doi.org/10.1080/07370008.2016.1181879>
- Bang, M., Warren, B., Rosebery, A. S., & Medin, D. (2013). Desetting expectations in science education. *Human Development*, 55(5–6), 302–318. <https://doi.org/10.1159/000345322>
- Bernal, D. D. (2002). Critical race theory, Latino critical theory, and critical raced-gendered epistemologies: Recognizing students of color as holders and creators of knowledge. *Qualitative Inquiry*, 8(1), 105–126. <https://doi.org/10.1177/107780040200800107>
- Bronfenbrenner, U. (1976). The experimental ecology of education. *Educational Researcher*, 5(9), 5–15. <https://doi.org/10.2307/1174755>
- Brown, B. A., & Mutegi, J. (2010). A paradigm of contradictions: racism and science education. In E. Baker, E. Peterson, & B. McGaw (Eds.), *International encyclopedia of education* (1, pp. 554–564). Oxford: Elsevier. <https://doi.org/10.1016/B978-0-08-044894-7.00124-X>
- Bynum, W., & Varpio, L. (2018). When I say' hermeneutic phenomenology. *Medical Education*, 52(3), 252–253. <https://doi.org/10.1111/medu.13414>
- Calabrese Barton, A., & Tan, E. (2019). Designing for rightful presence in STEM: The role of making present practices. *Journal of the Learning Sciences*, 28(4–5), 616–658. <https://doi.org/10.1080/10508406.2019.1591411>
- Calabrese Barton, A., & Tan, E. (2020). Beyond equity as inclusion: A framework of “rightful presence” for guiding justice-oriented studies in teaching and learning. *Educational Researcher*, 49(6), 433–40. <https://doi.org/10.3102/0013189X20927363>
- Camacho, T. C., Vasquez-Salgado, Y., Chavira, G., Boyns, D., Appelrouth, S., Saetermoe, C., & Khachikian, C. (2021). Science identity among latinx students in the biomedical sciences: The role of a critical race theory-informed undergraduate research experience. *CBE Life Sciences Education*, 20(2), 1–10. <https://doi.org/10.1187/cbe.19-06-0124>

- 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. <https://doi.org/10.1002/tea.20237>
- Carter, L. (2008). Globalization and science education: The implications of science in the new economy. *Journal of Research in Science Teaching*, 45(5), 617–633. <https://doi.org/10.1002/tea.20189>
- Cole, M. (1996). *Cultural psychology: A once and future discipline*. Harvard University Press.
- Collins, P. H., & Bilge, S. (2016). *Intersectionality*. Polity Press.
- Contreras Aguirre, H. C., Gonzalez, E., & Banda, R. M. (2020). Latina college students' experiences in STEM at Hispanic-serving institutions: Framed within Latino critical race theory. *International Journal of Qualitative Studies in Education*, 33(8), 810–823. <https://doi.org/10.1080/09518398.2020.1751894>
- Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of anti-discrimination doctrine, feminist theory, and antiracist politics. *University of Chicago Legal Forum*, 1989(1), 39–52. <https://doi.org/10.4324/9780429499142-5>
- Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE.
- Davies, B., & Harré, R. (1990). Positioning: The discursive production of selves. *Journal for the Theory of Social Behaviour*, 20(1), 43–63. <https://doi.org/10.1111/j.1468-5914.1990.tb00174.x>
- Dyke, E., El Sabbagh, J., & Dyke, K. (2020). “Counterstory mapping our city”: Teachers reckoning with latinx students' knowledges, cultures, and communities. *International Journal of Multicultural Education*, 22(2), 30–45. <https://doi.org/10.18251/ijme.v22i2.2445>
- Elenes, C. A., Gonzalez, F. E., Bernal, D. D., & Villenas, S. (2001). Introduction: Chicana/Mexicana feminist pedagogies: Consejos, respeto, y educacion in everyday life. *International Journal of Qualitative Studies in Education*, 14(5), 595–602. <https://doi.org/10.1080/09518390110059900>
- Elmesky, R. (2018). Can students learn science while navigating oppressive schools within an oppressive society? In L. Bryan & K. G. Tobin (Eds.), *13 Questions: Reframing education's conversation: Science* (pp. 391–399). Peter Lang.
- Freire, P. (1994). *Pedagogy of hope*. Continuum.
- Gloria, A. M., & Castellanos, J. (2012). Desafíos y bendiciones: A multiperspective examination of the educational experiences and coping responses of first-generation college latina students. *Journal of Hispanic Higher Education*, 11(1), 82–99. <https://doi.org/10.1177/1538192711430382>
- Gonzalez, E., Aguirre, C. C., & Myers, J. (2022). Persistence of Latinas in STEM at an R1 higher education institution in Texas. *Journal of Hispanic Higher Education*, 21(2), 151–164. <https://doi.org/10.1177/1538192720918369>
- Groenewald, T. (2004). A phenomenological research design illustrated. *International Journal of Qualitative Methods*, 3(1), 42–55. <https://doi.org/10.1177/160940690400300104>
- Gutiérrez, K. D., Becker, B. L. C., Espinoza, M. L., Cortes, K. L., Cortez, A., Lizárraga, J. R., Rivero, E., Villegas, K., & Yin, P. (2019). Youth as historical actors in the production of possible futures. *Mind, Culture, and Activity*, 26(4), 291–308. <https://doi.org/10.1080/10749039.2019.1652327>
- Gutierrez, R. (2016). Nesting in Nepantla: The importance of maintaining tensions in our work. In N. M. Joseph, C. Haynes, & F. Cobb (Eds.), *Interrogating whiteness and relinquishing power: White faculty's commitment to racial consciousness in STEM classrooms* (pp. 253–282). Peter Lang.
- Harris, A., & Leonardo, Z. (2018). Intersectionality, race-gender subordination, and education. *Review of Research in Education*, 42(1), 1–27. <https://doi.org/10.3102/0091732X18759071>
- Herrera, F., Hurtado, S., Garcia, G. A., & Gasiewski, J. (2012). A model for redefining STEM identity for talented STEM graduate students. In J. C. Garibay (Chair), *Talent and Identity Development Across the STEM Pathway [Symposium]*. American Educational Research Association Annual Meeting, Vancouver, Canada.
- Herrera, F., & Kovats Sánchez, G. (2022). Curando la comunidad [healing the community]: Community-centered STEM identity. *Journal of Hispanic Higher Education*, 21(2), 135–150. <https://doi.org/10.1177/15381927211069543>
- Hispanic Association of Colleges and Universities. (2021). *2021 Hispanic and Higher Education and HSI Facts*. https://www.hacu.net/hacu/HSI_Fact_Sheet.asp
- Holland, D., Lachicotte, W., Jr., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Harvard University Press.
- Ibourk, A., Hughes, R., & Mathis, C. (2022). “It is what it is”: Using storied-identity and intersectionality lenses to understand the trajectory of a young Black woman's science and math identities. *Journal of Research in Science Teaching*, 59(7), 1099–1133. <https://doi.org/10.1002/tea.21753>
- Jimenez, R. M. (2020). Community cultural wealth pedagogies: Cultivating autoethnographic counternarratives and migration capital. *American Educational Research Journal*. <https://doi.org/10.3102/0002831219866148>

- Johnson, A., Brown, J., Carlone, H., & Cuevas, A. K. (2011). Authoring identity amidst the treacherous terrain of science: A multiracial feminist examination of the journeys of three women of color in science. *Journal of Research in Science Teaching*, 48(4), 339–366. <https://doi.org/10.1002/tea.20411>
- Kang, H., Calabrese Barton, A., Tan, E., Simpkins, S. D., Rhee, R. H., & Turner, C. (2019). How do middle school girls of color develop STEM identities? Middle school girls' participation in science activities and identification with STEM careers. *Science Education*, 103(2), 418–439. <https://doi.org/10.1002/sce.21492>
- King, N. S., & Pringle, R. M. (2019). Black girls speak STEM: Counterstories of informal and formal learning experiences. *Journal of Research in Science Teaching*, 56(5), 539–569. <https://doi.org/10.1002/tea.21513>
- Ladson-Billings, G. (2006). From the achievement gap to the education debt: Understanding achievement in U.S. Schools. *Educational Researcher*, 35(7), 3–12. <https://doi.org/10.3102/0013189x035007003>
- Lave, J., & Wenger, E. (1991). Situated learning: legitimate peripheral participation. In J. Lave & E. Wenger (Eds.), *Learning in doing: Social, cognitive and computational perspectives*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511815355>
- Le, P. T., & Matias, C. E. (2019). Towards a truer multicultural science education: How whiteness impacts science education. *Cultural Studies of Science Education*, 14(1), 15–31. <https://doi.org/10.1007/s11422-017-9854-9>
- López, E. J., Basile, V., Landa-Posas, M., Ortega, K., & Ramirez, A. (2019). Latinx students' sense of familismo in undergraduate science and engineering. *Review of Higher Education*, 43(1), 85–111. <https://doi.org/10.1353/rhe.2019.0091>
- Malcom, S. M., Quick, P., Janet, H., & Brown, W. (1976). The double bind: The price of being a minority woman in science. In *Report of a Conference of Minority Women Scientists* (Vol. 76). American Association for the Advancement of Science. <https://www.aaas.org/sites/default/files/migrate/uploads/1975-Double-Bind.pdf>
- McGee, E., & Bentley, L. (2017). The equity ethic: Black and Latinx college students reengineering their STEM careers toward justice. *American Journal of Education*, 124(1), 1–36. <https://doi.org/10.1086/693954>
- Mensah, F. M., & Jackson, I. (2018). Whiteness as property in science teacher education. *Teachers College Record: The Voice of Scholarship in Education*, 120(1), 1–38. <https://doi.org/10.1177/016146811812000108>
- Morales-Doyle, D., Childress Price, T., & Chappell, M. J. (2019). Chemicals are contaminants too: Teaching appreciation and critique of science in the era of next generation science standards (NGSS). *Science Education*, 103(6), 1347–1366. <https://doi.org/10.1002/sce.21546>
- Nasir, N. S., Rosebery, A. S., Warren, B., & Lee, C. D. (2014). Learning as a cultural process. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed., pp. 686–706). Cambridge University Press.
- National Science Foundation. (2017). Women, minorities, and persons with disabilities in science and engineering: 2017. In *Special Report NSF 17-310*.
- Neubauer, B. E., Witkop, C. T., & Varpio, L. (2019). How phenomenology can help us learn from the experiences of others. *Perspectives on Medical Education*, 8(2), 90–97. <https://doi.org/10.1007/s40037-019-0509-2>
- Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race, and science. *Social Problems*, 52(4), 593–617. <https://doi.org/10.1525/sp.2005.52.4.593>
- Ong, M., Wright, C., Espinosa, L. L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Education Review*, 81(2), 172–209.
- Owens, T. J., Robinson, D. T., & Smith-Lovin, L. (2010). Three faces of identity. *Annual Review of Sociology*, 36, 477–499. <https://doi.org/10.1146/annurev.soc.34.040507.134725>
- Oyserman, D., Elmore, K., & Smith, G. (2011). Self, self-concept and identity. In M. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (2nd ed., pp. 69–104). Guilford Publications.
- Polman, J. L. (2006). Mastery and appropriation as means to understand the interplay of history learning and identity trajectories. *Journal of the Learning Sciences*, 15(2), 221–259. https://doi.org/10.1207/s15327809jls1502_3
- Polman, J. L., & Miller, D. (2010). Changing stories: Trajectories of identification among African American youth in a science outreach apprenticeship. *American Educational Research Journal*, 47(4), 879–918. <https://doi.org/10.3102/0002831210367513>
- Rendon, L. I., Nora, A., & Kanagala, V. (2014). *Ventajas/assets y conocimientos/knowledge: leveraging Latin@ strengths to foster student success*. http://education.utsa.edu/center_research_policy_education

- Rincón, B. E., & Rodriguez, S. (2021). Latinx students charting their own STEM pathways: How community cultural wealth informs their STEM identities. *Journal of Hispanic Higher Education*, 20(2), 149–163. <https://doi.org/10.1177/1538192720968276>
- Robinson, C. J., & Kelley, R. D. G. (2000). *Black Marxism: The making of the black radical tradition*. The University of North Carolina Press.
- Rodriguez, S., Cunningham, K., & Jordan, A. (2019). STEM identity development for Latinas: The role of self- and outside recognition. *Journal of Hispanic Higher Education*, 18(3), 254–272. <https://doi.org/10.1177/1538192717739958>
- Rodriguez, S., Pilcher, A., & Garcia-Tellez, N. (2021). The influence of familismo on Latina student STEM identity development. *Journal of Latinos and Education*, 20(2), 177–189. <https://doi.org/10.1080/15348431.2019.1588734>
- Salinas, C. (2020). The complexity of the “x” in Latinx: How Latinx/a/o students relate to, identify with, and understand the term Latinx. *Journal of Hispanic Higher Education*, 19(2), 149–168. <https://doi.org/10.1177/1538192719900382>
- Salinas, C., & Lozano, A. (2021). The history and evolution of the term Latinx. In E. G. Murillo Jr., D. Delgado Bernal, S. Morales, L. Urrieta Jr., E. Ruiz Bybee, J. S. Muñoz, V. B. Saenz, D. Villanueva, M. Machado-Casas, & K. Espinoza (Eds.), *Handbook of latinos and education: Theory, research, and practice* (2nd ed., pp. 249–263). Routledge. <https://doi.org/10.4324/9780429292026-24>
- Santiago, M., de los Ríos, C. V., & Gutiérrez, K. D. (2021). Historicizing latinx civic agency and contemporary lived civics. In C. D. Lee, G. White, & D. Dong (Eds.), *Educating for civic reasoning and discourse* (pp. 49–58). National Academy of Education.
- Sengupta-Irving, T., & Vossoughi, S. (2019). Not in their name: Re-interpreting discourses of STEM learning through the subjective experiences of minoritized girls. *Race Ethnicity and Education*, 22(4), 479–501. <https://doi.org/10.1080/13613324.2019.1592835>
- 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. <https://doi.org/10.3102/0013189X034004014>
- Solorzano, D. G., & Yosso, T. J. (2001). Critical race and LatCrit theory and method: Counter-storytelling? *International Journal of Qualitative Studies in Education*, 14(4), 471–495. <https://doi.org/10.1080/09518390110063365>
- Sparks, D. M., Przymus, S. D., Silveus, A., de La Fuente, Y., Cartmill, C., De, Y., Fuente, L., & Cartmill, C. (2021). Navigating the intersectionality of race/ethnicity, culture, and gender identity as an aspiring Latina STEM student. *Journal of Latinos and Education*. <https://doi.org/10.1080/15348431.2021.1958332>
- Stets, J. E., & Burke, P. J. (2000). Identity theory and social identity theory. *Social Psychology Quarterly*, 63(3), 224–237.
- Stevenson, A. D., Gallard Martínez, A. J., Brkich, K. L., Flores, B. B., Claeys, L., & Pitts, W. (2019). Latinas’ heritage language as a source of resiliency: Impact on academic achievement in STEM fields. *Cultural Studies of Science Education*, 14(1), 1–13. <https://doi.org/10.1007/s11422-016-9789-6>
- Tan, E., Calabrese Barton, A., Kang, H., & O’Neill, T. (2013). Desiring a career in STEM-related fields: How middle school girls articulate and negotiate identities-in-practice in science. *Journal of Research in Science Teaching*, 50(10), 1143–1179. <https://doi.org/10.1002/tea.21123>
- Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A., & Varpio, L. (2015). Choosing a qualitative research approach. *Journal of Graduate Medical Education*, 7(4), 669–670. <https://doi.org/10.4300/JGME-D-15-00414.1>
- Tuan, Y. (1977). *Space and place: The perspective of experience*. University of Minnesota Press.
- Varelas, M. (2018). Dialectical relationships and how they shape (in)equitable science learning spaces and places. In L. Bryan & K. G. Tobin (Eds.), *13 Questions: Reframing education’s conversation: Science* (pp. 183–191). Peter Lang.
- Varelas, M., Kane, J. M., & Wylie, C. D. (2011). Young African American children’s representations of self, science, and school: Making sense of difference. *Science Education*, 95(5), 824–851. <https://doi.org/10.1002/sce.20447>
- Varelas, M., Martin, D. B., & Kane, J. M. (2013). Content learning and identity construction: A framework to strengthen African American Students’ mathematics and science learning in Urban Elementary Schools. *Human Development*, 55(5?6), 319–339. <https://doi.org/10.1159/000345324>
- Varelas, M., Menig, E., Wilson, A., & Kane, J. (2020). Intermingling of identities: A black student in a middle-school science class. *Cultural Studies of Science Education*, 15(3), 695–722. <https://doi.org/10.1007/s11422-019-09966-3>

- Varelas, M., Segura, D., Bernal-Munera, M., & Mitchener, C. (2022). Embracing equity and excellence while constructing science teacher identities in urban schools: Voices of new teachers of Color. *Journal of Research in Science Teaching*. <https://doi.org/10.1002/tea.21795>
- Varelas, M., Settlage, J., & Mensah, F. M. (2015). Explorations of the structure-agency dialectic as a tool for framing equity in science education. *Journal of Research in Science Teaching*, 52(4), 439–447. <https://doi.org/10.1002/tea.21230>
- Visintainer, T. (2020). ?I think at first glance people would not expect me to be interested in science?: Exploring the racialized science experiences of high school students of color. *Journal of Research in Science Teaching*, 57(3), 393–422. <https://doi.org/10.1002/tea.21597>
- Ye, L., Varelas, M., & Guajardo, R. (2011). Subject-matter experts in urban schools: Journeys of enacted identities in science and mathematics classrooms. *Urban Education*, 46(4), 845–879. <https://doi.org/10.1177/0042085911399930>
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education*, 8(1), 69–91. <https://doi.org/10.1080/1361332052000341006>

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