



## OPEN ACCESS

## EDITED BY

Bryan Dewsbury,  
Florida International University, United States

## REVIEWED BY

I-Chien Chen,  
Michigan State University, United States  
T. Peele-Eady,  
University of New Mexico, United States

## \*CORRESPONDENCE

Ambar Hernandez Negrete  
✉ ambhernandez@ucdavis.edu

RECEIVED 01 March 2023

ACCEPTED 08 June 2023

PUBLISHED 29 June 2023

## CITATION

Hernandez Negrete A, Mouavangsou KN and Caporale N (2023) Toward asset-based LatCrit pedagogies in STEM: centering Latine students' strengths to reimagine STEM teaching and practice.

*Front. Educ.* 8:1176913.

doi: 10.3389/feduc.2023.1176913

## COPYRIGHT

© 2023 Hernandez Negrete, Mouavangsou and Caporale. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# Toward asset-based LatCrit pedagogies in STEM: centering Latine students' strengths to reimagine STEM teaching and practice

Ambar Hernandez Negrete<sup>1\*</sup>, Kaozong N. Mouavangsou<sup>2</sup> and Natalia Caporale<sup>1</sup>

<sup>1</sup>Department of Neurobiology, Physiology, and Behavior, University of California, Davis, Davis, CA, United States, <sup>2</sup>Department of History and Critical Race and Ethnic Studies, University of California, Merced, Merced, CA, United States

Latine students continue to persist in science, technology, engineering and mathematics (STEM) fields despite the numerous obstacles in place that stifle their academic potential and contributions. Instead of fostering the strengths Latine students possess that help them succeed despite these obstacles, the field of STEM education has traditionally examined these students' experiences and challenges through a deficit lens. Deficit perspectives posit that any existing disparities in educational outcomes in STEM for Latine students are a product of the students' lack of interest in STEM fields, poor academic preparation and/or motivation, among other 'faults.' In this manner, this deficit approach absolves educators, educational institutions, administrators, and researchers from any responsibility in mediating the disparate outcomes and negates the roles that outdated pedagogical practices, structural racism, discrimination and disciplinary bias have in limiting Latine students' success in STEM. These deficit-understandings of these inequities are pervasive in all aspects of STEM education, guiding curricular choices, pedagogical approaches, assessment designs, interventions and even how STEM fields define knowledge and success. To counter these harmful constructions, this article discusses how STEM educators can draw on Latino Critical Race Theory (LatCrit) and Community Cultural Wealth (CCW) epistemologies to foster learning ecologies that draw on Latine students' cultural strengths rather than deficits. To this end, this article introduces LatCrit and CCW frameworks in the context of STEM education, and combines them to propose an *asset-based LatCrit pedagogical approach* to STEM curriculum design and teaching. It also contributes guiding questions and application examples STEM educators can reference to advance *asset-based LatCrit pedagogical approaches* that promote justice and equity within STEM classrooms and beyond. Contributing to this underdeveloped line of scholarship in the field of STEM, we apply these critical frames to help educators (re)imagine postsecondary STEM pedagogies and reforms around the wealth of skills, dispositions, and cultural practices that Latine students possess.

## KEYWORDS

STEM – science technology engineering mathematics, LatCrit, community cultural wealth, Latine students, asset-based pedagogy, higher education, diversity

## Introduction

Latine<sup>1</sup> individuals comprise 20% of the United States population, yet according to the [National Science Board \(2019\)](#) they only make up 14% of Science, Technology, Engineering and Mathematics (STEM) bachelor's degree recipients and 8% of this workforce ([Lara, 2017](#)). Existing scholarship sheds light into the discriminatory structures taking place within the field of STEM that rectify social hierarchies and further justify the accumulation of racial disadvantage ([Bullock and Meiners, 2019](#)). The construction of racial disadvantage among Latine students in STEM has been documented in the overrepresentation of Latine students in under-resourced K-12 schools and limited access to the following: rigorous math and science courses and activities; qualified math and science teachers; role models in sciences and academic services; and financial support to pursue costly STEM degrees ([Museus et al., 2011](#); [Peralta et al., 2013](#); [Rodríguez, 2015](#); [Rincón et al., 2020](#)). These structural opportunity gaps are exacerbated by the hostile experiences of discrimination, microaggressions, feelings of inadequacy ('imposter syndrome'), and general presumptions of incompetence that have been identified within the literature as further marginalizing Latine students in STEM ([Sorge et al., 2000](#); [Carlone and Johnson, 2007](#); [Crisp and Nora, 2012](#); [George-Jackson et al., 2012](#); [Hazari et al., 2013](#); [Rincón et al., 2020](#); [Rincón and Rodríguez, 2021](#); [Flores et al., 2022](#)).

This pervasive structural disadvantaging of Latine students in STEM not only hinders innovation and discovery (as diverse workgroups have been shown to promote novel thinking and adaptability, which are key to innovation; [Hewlett et al., 2013](#)), but also hampers the social mobility and opportunities available to this population. Unfortunately, over the last few decades, most well-intentioned efforts to address these structural inequities have been informed by deficit theories that can reproduce injustice ([Coronella, 2018](#)). Deficit approaches center the responsibility for any observed educational gaps in course outcomes and graduation rates on the STEM students themselves, while ignoring the critical role of pedagogical and institutional practices in establishing and sustaining these inequities. That is to say, instead of asking: '*What may be the pedagogical and institutional practices that are preventing the success of these students in STEM?*,' educators and universities are implicitly asking: '*What is wrong with these Latine students and how can we change them so they become more similar to the kinds of students that our university was originally designed to serve?*'

Efforts aimed at achieving long-term, sustainable increases in the number of Latine STEM graduates are doomed to fail unless there is a significant paradigm shift within STEM educators<sup>2</sup> (given their role as key powerbrokers in institutions of Higher Education). We focus on STEM educators given the power they hold in shaping curriculum design, student advising, departmental hiring practices, in addition to other key activities that dictate Latine students' access to STEM

educational opportunities. While this approach focuses on STEM educators, we believe it can also be a useful blueprint for other university stakeholders and powerbrokers, such as major advisors, administrators, teaching assistants, or staff, who can adapt it to their specific positions. It is necessary that STEM educators start examining and reflecting about their current pedagogical and institutional practices that are alienating Latine students, and recognize that they are discouraging Latine students from pursuing their STEM major. STEM educators must begin to use asset-based pedagogies informed by critical perspectives that utilize the unique experiences and strengths of Latine populations to guide pedagogical, structural, and policy decisions that can transform all aspects of STEM education. In this article, we merge two critical frameworks—Latino Critical Race Theory (LatCrit) ([Valdes and Bender, 2021](#)) and Community Cultural Wealth (CCW) ([Yosso, 2005](#))—to propose an *asset-based LatCrit pedagogical approach* to STEM education as a necessary and timely alternative to deficit-based pedagogies. This approach leverages [Yosso's \(2005\)](#) six CCW capitals and reframes them in the context of Latine student experiences, as informed by LatCrit.

There are numerous frameworks that provide guidance on pedagogies and strategies for improving the educational experiences of racially diverse student groups (e.g., culturally relevant pedagogy, culturally sustainable pedagogies, and anti-deficit research frameworks), yet there are limited concrete resources for how STEM educators can better serve the rapidly growing Latine student population. Given the increasing Hispanic-Serving Institution (HSI) designations requiring educators and universities to better serve Latine students ([Cuellar et al., 2017](#)), and the growing demands to diversify the STEM pipeline, this *asset-based LatCrit pedagogical approach* is tailored specifically to Latine students. With this context in mind, in the following sections we describe and compare a deficit-based lens versus an asset-based lens in the context of STEM, introduce critical frameworks (i.e., LatCrit and CCW), and apply these frameworks to STEM. We then describe the *asset-based LatCrit pedagogical approach* derived from these frameworks and provide guiding questions as well as concrete application examples of what engaging Latine students through an asset-based lens could look like in the classrooms.

## Deficit-based lens vs. asset-based lens in STEM

Deficit theories have been (and continue to be) widely used to explain and justify disparities and gaps in educational outcomes and opportunities, including the underrepresentation of Latine students in STEM ([Bruton and Robles-Piña, 2009](#); [Harper, 2010](#); [Caushi, 2022](#)). [Valencia \(1997\)](#) explains that deficit perspectives propose that students who fail in school do so because of internal deficits or deficiencies often associated with their culture, rather than institutional malfunctions. According to this perspective, students' perceived cultural deficits are often seen as a reflection of cognitive deprivation, ignorance, and low aspirations among communities of color ([Riojas-Cortéz, 2000](#)). This emphasis on perceived cultural inferiorities and deficiencies has evolved from earlier eugenicist theories that justified existing disparities based on the genetic deficits of communities of color ([Castro, 2014](#)). Despite deficit-based understandings' connection to earlier eugenicist theories, they continue to shape ideological

1 Throughout this paper, we use the term 'Latine' to be gender-inclusive and more culturally responsive to our population of focus. We chose this term because it adapts better to the Spanish language than the commonly used term 'Latinx.'

2 When we use the term 'STEM educator', we are referring to not only STEM faculty but also STEM lecturers, researchers, and classroom coordinators.

interpretations held by educators and other university powerbrokers that structure the learning environment and the distribution of resources and opportunities in Higher Education institutions (Bruton and Robles-Piña, 2009; Castro, 2014).

Within the STEM classroom, these deficit perspectives underpin traditional pedagogies that promote highly competitive 'survival of the fittest' mentalities that see education as a tool to weed out the 'weak' (Caushi, 2022). These perspectives disadvantage Latine students within this competitive culture because they perpetuate racialized messages that construe Latine students as 'failing,' 'weak,' 'in need of help,' and 'deficient,' while their White or more privileged peers are viewed as 'successful,' 'strong,' and 'capable.' With this lens, the focus is on 'fixing' the 'deficient' Latine student rather than addressing oppressive and white-serving educational paradigms, pedagogies, practices and structures in STEM. By concentrating on 'fixing' the 'deficient' Latine student, we fail to establish just, equitable, and inclusive learning environments.

These narrow and misconstrued framings of Latine students have tangible consequences as they inform pedagogical practices, assessment designs, research, and how we define knowledge and success in STEM (Peck, 2021). Educators' deficit-based expectations and dispositions toward students of color have been documented quantitatively and qualitatively as negatively affecting students' academic performance and motivations to learn (Berlak, 2001; Bruton and Robles-Piña, 2009). Within the research, deficit-based theories are pervasively used to explain Latine students' challenges and experiences in STEM (Caushi, 2022). For example, one study attributed the disparate academic outcomes in calculus between White and Asian students and the lower scores of students of color to a lack of motivation, under-preparation, and lack of familial support (Treisman, 1992; Adiredja et al., 2020). Without critical examination of the traditional ideologies, perspectives and biases that have shaped STEM pedagogies and practices, STEM educators can unknowingly employ and reproduce deficit-based interactions (lowered expectations, microaggressions) when working with Latine students (Caushi, 2022).

Deficit perspectives limit our ability to address educational inequities between Latine students and their more privileged peers by perpetuating racialized beliefs that create, sustain, and uphold unjust pedagogies and institutional practices in STEM. As Castro (2014) stated, these deficit ideologies cannot provide a pathway toward equity because of their investment in pathology; students of color will always be constructed as problems to be fixed, and institutions will always have to 'assist' them in being successful. To upend these harmful pedagogies, we must shift away from 'fixing' Latine students and instead focus on creating learning environments that are conducive to their success and progression in STEM. Educators must alter their dispositions and replace this limited paradigm with one that sees Latine students as possessing the attributes not only to succeed but also to thrive in STEM.

The need for asset-based pedagogies is even more critical in view of the hierarchical manner in which STEM topics are traditionally taught, which discourages students from questioning and where most of the knowledge is presented as immutable facts (Alberts, 2012), even though the scientific process is meant to encourage exploration, asking questions, and challenging existing ideas (Vale, 2013). This contradiction between the teaching and practice in STEM has been highlighted repeatedly (Alberts, 2012; Committee on a Conceptual Framework for New K-12 Science

Education Standards, 2012; Vale, 2013). Yet, most STEM Higher Education courses are still taught following the traditional model, despite K-12 enacting the Next Generation Science Standards in 2013 to address this contradiction (National Research Council, 2013).

As we will discuss in the following sections, asset-based pedagogies that are informed by critical perspectives can counter these contradictions and offer a more equitable alternative to deficit-based strategies. These approaches recognize and leverage Latine students' worlds, positionings, and authored selves in ways that are consequential, empowering, and supportive of their STEM journeys (Rahm and Moore, 2016). In contrast to deficit-based approaches, practices that situate academic knowledge within the lived experiences of students are associated with creating more meaningful, appealing, and learnable educational environments (Gay, 2018). While asset-based approaches that are informed by critical perspectives can benefit all students, they offer a unique opportunity to serve Latine students, whose knowledge and strengths have traditionally been overlooked, neglected, and undervalued in STEM (Adiredja et al., 2020).

## Introducing LatCrit and CCW in STEM

LatCrit and CCW are two critical perspectives that can help STEM educators challenge deficit-based pedagogies (including teaching, interacting, and mentoring) when working with Latine students. In this section, we introduce LatCrit and CCW as inspirations for our epistemological orientations for the *asset-based LatCrit pedagogical approach* we propose. Since LatCrit and CCW are both rooted in Critical Race Theory (CRT), we begin with a brief discussion of CRT before fleshing out LatCrit and CCW (see Table 1 for a summary of their common and distinguishing features). Throughout this section we also outline why bridging the epistemologies offered by LatCrit and CCW is useful for disrupting deficit-based pedagogies and interactions in STEM classrooms.

CRT emerged in the legal field in the mid-1970s and offered a new theory to understand the persisting disparities experienced by people of color across almost every measure of prosperity (i.e., class, health, education, social, political). In other words, it provided a framework to understand race and racism in the United States (Pettigrew, 2004). This theory pushed back on ideologies (underlying deficit-based theories) that explained post-slavery racial disparities as a product of the individual capacities and pathological lifestyles of people of color (Delgado and Stefancic, 2017). Instead, CRT highlighted the institutional and systemic discriminatory practices that create and uphold persisting inequities (Haney-Lopez, 1994). CRT challenged these post-slavery ideologies by shedding light on the ongoing, yet more subtle and covert, racism taking place in a post-slavery society in the United States.

CRT promotes and encourages examination based on the following guiding tenets:

1. Racism is endemic to society in the United States
2. Whiteness functions as property
3. Critiquing liberalism is necessary to promote sweeping changes
4. Experiential knowledge and counter-storytelling must be centered
5. Interdisciplinary analyses are necessary

TABLE 1 Common and distinguishing features across CRT, LatCrit, and CCW.

Common features (commonality across CRT, LatCrit, and CCW)			
Common features	Build on CRT tenets and foundations.		
	Acknowledge existing racial disparities as engendered from within the “context of a legacy of racism” and other systems of oppression (Yosso, 2005, p. 82).		
	Promote critical assessment of the status quo in relation to race, power, and privilege.		
	Encourage “contextualized analysis of the cultural, political, and/or economic dimensions of white supremacy” (Iglesias, 1996-1997, p. 23).		
	Center lived experiences of communities of color.		
	Committed to advancing a social justice agenda.		
Distinguishing features (differences across CRT, LatCrit, and CCW)			
	Critical race theory (CRT)	Latino critical race theory (LatCrit)	Community cultural wealth (CCW)
Focus	Examines and unveils persisting racial disparities in the United States as a “logical and predictable result of a racialized society in which discussions of race and racism continue to be muted and marginalized” (Delgado and Stefancic, 2017, p. 2).	Unpacks the complexities of how racism uniquely affects Latine individuals in the United States. LatCrit also emphasizes “Latin[e] identities, lived experiences, and policy concerns, without essentializing this variegated and multifaceted identity that embraces race, color, ethnicity, language, sexual orientation, gender identity, immigration status, [and] national origin” (Valdes and Bender, 2021, p. ix).	Encourages shift “away from a deficit view of Communities of Color as places full of cultural poverty disadvantages, and instead focuses on and learns from the array of cultural knowledge, skills, abilities and contacts possessed by socially marginalized groups that often go unrecognized and unacknowledged” (Yosso, 2005, p. 82).
Population of interest	People of color	Latine individuals	Students of color and people of color
Guiding themes	Five abridged tenets: 1. Racism is endemic 2. Whiteness as property 3. Critiques of liberalism 4. Centering experiential knowledge and counter-storytelling 5. Interdisciplinary analyses *While the guiding CRT tenets have been adopted, modified, and extended across numerous fields (see Ladson-Billings and Tate, 1995; Solórzano and Yosso, 2002), most CRT scholars operate under the above considerations.	Shared antisubordination agenda: While LatCrit is structured by a shared antisubordination agenda that includes numerous commitments, guideposts, hallmarks, and postulates, it does not employ hierarchical star-system principles given that it purposefully seeks to promote democratic, dynamic, responsive, and relevant knowledge production processes regarding Latine communities (Valdes and Bender, 2021).	Six cultural capitals: 1. Resistant Capital 2. Familial Capital 3. Linguistic Capital 4. Navigational Capital 5. Aspirational Capital *While the guiding CCW capitals have been adopted, modified, and extended (see Rendón et al., 2014), the ones presented above are the original ones offered by Yosso (2005).
Limitations in the context of the Latine population	Centers a Black/White binary understanding of racism. Does not focus on Latine communities’ distinct experiences with racism based on their unique identities and dimensions. Does not provide a conceptual blueprint for how educators can channel understanding of racism in the United States to disrupt deficit-based understandings of people of color, let alone Latine communities.	Does not provide a conceptual blueprint for how educators can channel understanding of the racism Latine individuals experience in the United States to disrupt deficit-based understandings of Latine students.	Does not solely focus on Latine students’ unique lived experiences. Does not provide a conceptual blueprint for how educators can weave this new understanding of Latine students’ cultural capitals to inform classroom structures, learning, and dynamics.
Usefulness to STEM	Can help STEM educators and stakeholders <i>interrogate</i> post-racial understandings of communities of color and the continuing racial disparities in the United States and in STEM.	Can help STEM educators <i>interrogate</i> and <i>expand</i> what is known and understood about Latine students and their communities in general and in STEM.	Can help STEM educators <i>change</i> how they think about and engage Latine students in STEM from a deficit approach to one that centers their strengths and assets.



While the guiding CRT tenets have been adopted, modified, and extended across numerous fields (see [Ladson-Billings and Tate, 1995](#); [Solórzano and Yosso, 2002](#)), most CRT scholars operate under the above tenets.

Although CRT can provide STEM educators with a broad understanding of the shared racial discrimination experienced by people of color in the United States, it is less helpful for unpacking the complexities of Latine subordination, particularly those related to Latine student experiences, identities, and needs. This limitation is often attributed to the Black/White binary emphasis of CRT where examinations or understandings of racism are often based on an analysis of the racism Black people experience from White individuals ([Espinoza and Harris, 1997](#)). As [Stefancic \(1997\)](#) argued, this Black/White binary focus of CRT constrains our understanding of the unique experiences of Latine with racism, arguing that “conventional, and even critical, approaches to race and civil rights ignore the problems and special situations of Latino people” (p. 424). This Black/White focus omits the dimensions associated with Latine communities (e.g., bilingualism, immigration status, gender, etc.) that are subject to different forms of oppression often inapplicable to Blacks in the United States and invisible in CRT ([Valdes and Bender, 2021](#)). Given this shortcoming, we only reference CRT within this article to honor the epistemological foundations of LatCrit and CCW.

Acknowledging these limitations, we contend CRT’s cousin, LatCrit, offers additional expansive and contextualized understandings of the social justice struggles specific to Latine individuals that STEM educators can use to disrupt mainstream deficit-based perceptions of Latine students and their communities. Unlike CRT, LatCrit does not offer guiding tenets STEM educators can reference to understand Latine history, experiences, and challenges. Instead, it is driven by a broad antisubordination agenda supported by numerous open-ended hallmarks, commitments, guideposts, and postulates that promote democratic, dynamic, responsive, and relevant knowledge production processes and understandings of Latine communities ([Valdes and Bender, 2021](#)). Notably, LatCrit is not antagonistic, incompatible, or competitive with CRT, but rather supplementary and complementary ([Valdes, 1996](#)).

Existing since the late 1980s, LatCrit’s antisubordination agenda highlighted the continued oppression of people of color in the United States, while also revealing the distinct forms of oppression that Latine individuals experience ([Aoki and Johnson, 2008](#)). Paying attention to the distinct forms of discrimination Latine communities experience can help STEM educators shift away from viewing “color discrimination as the sole essence of racial discrimination” when working with Latine students and instead recognize how other dimensions, such as “language and culture are often as important as skin color in separating privileged [student] groups from oppressed ones” ([Peralta et al., 2013](#), p. 909). With this additional Latine consciousness, educators can be more aware and sensitive to how their Latine students may be experiencing additional challenges and discrimination based on other identity domains besides race when navigating the STEM educational pipeline.

LatCrit provides a more tailored insight into Latine experiences, creating opportunities for STEM educators to recognize and value the vast diversity that exists among the Latine students they serve. Even though these students share ethnicity, they may vary across national origin, immigration status, language, culture, identity, gender, and sexuality ([Iglesias, 1996-1997](#)). For instance, STEM educators could

be serving a mix of Mexican, Puerto Rican, Cuban, Dominican, Nicaraguan, Salvadoran, and Colombian students, among others, each with their unique backgrounds, histories, and experiences.

The multilayered background, histories, and experiences within Latine subgroups are reflected in the numerous topics explored within LatCrit scholarship. [Stefancic \(1997\)](#) outlined these commonly explored areas in the Latine experience as the following: (1) migration histories, as well as challenges based on citizenship status ([Steinberg, 2004](#); [Pérez Huber, 2010](#); [Chang and Aoki, 2012](#); [Martinez, 2012](#)); (2) colonization of Latin America ([Walsh, 1992](#)); (3) gender roles and discrimination across transnational socio-historical contexts ([Anzaldúa, 1987](#)); (4) educational inequities for the broader Latine group as well as for ethnic subgroups ([Gandara and Contreras, 2009](#); [Gandara et al., 2010](#); [Cammarota and Aguilera, 2012](#)); and (5) tensions created through one-size-fits-all civil rights policies between Black and Brown individuals ([Martinez, 1993](#)). These numerous areas underscore the need for STEM educators to embrace dynamic, varied, and holistic perceptions and understandings of Latine students and their communities, rather than rigid, bounded, and stereotypical ones.

Even though LatCrit provides an expanded view of Latine experiences that CRT does not fully offer, it does not necessarily translate into non-deficit understandings of Latine students within the classroom. Both CRT and LatCrit share this shortcoming. Even with increased awareness of the histories, experiences, and challenges of communities of color, including those unique to Latine communities, a well-intentioned STEM educator might still be unable to identify or recognize the unique strengths, knowledge, and capacities that Latine students possess. As we outlined in the section above, in failing to alter how Latine students are perceived, one can inadvertently position them as passive ‘victims’ in need of fixing. This misguided framing, rather than helpful, recreates the racialized perceptions underlying deficit-oriented reforms that construe Latine students as lacking the qualities to be successful in STEM when compared to their more privileged White peers.

Given these limitations, we find [Yosso’s \(2005\)](#) CCW framework useful because it offers a conceptual roadmap STEM educators can use to position Latine students as possessing the aptitudes, capacities, and skills necessary to succeed and excel in STEM. Also born out of CRT epistemologies in the early 2000s, CCW sought to challenge dominating paradigms, such as Bourdieu’s Cultural Capital Theory, which justified lower social and academic outcomes for students and communities of color ([Bourdieu and Passeron, 1977](#)). Informed by deficit assumptions, Bourdieu’s paradigm inadvertently positioned White middle and upper-class communities as possessing the valuable knowledge necessary to succeed in our hierarchical society. Given the history of economic and racial inequality and the lack of access to enter middle- and upper-middle classes, communities of color were consequently positioned as lacking essential knowledge, social skills, abilities, and cultural capital. To counter this deficit-informed theory, CCW can help STEM educators shift away from viewing “communities of color as places full of cultural poverty disadvantages, and instead focuses on and learns from the array of cultural knowledge, skills, abilities, and contacts possessed by socially marginalized groups that often go unrecognized and unacknowledged” ([Yosso, 2005](#), p. 82). CCW encourages moving beyond mainstream, stereotypical understandings and perceptions of students and communities of color, arguing that such a mindset keeps us from delving deeper into understanding the aptitudes, capacities, and skill

sets present within communities of color when measuring them based on White mainstream cultural practices, norms, and values.

To facilitate the identification of the aptitudes of students of color, Yosso (2005) conceptualized and outlined this concept of CCW as six capitals that reflect the cultural wealth present within these communities. These six capitals are resistant, familial, linguistic, navigational, aspirational, and social capital (see Table 2 for brief definitions). While other scholars have adopted, modified, and extended these capitals, the ones previously mentioned are the original ones offered by Yosso (2005). Focusing on affirming these capitals can help steer STEM educators away from deficit-laden reforms and pedagogical practices that “[place] value judgments on communities that often do not have access to White, middle-or upper-class resources” (Yosso, 2005, p. 82). Adopting this paradigm can enable STEM educators at institutions of Higher Education to transform existing educational structures and practices around the assets abundant in Latine communities. Furthermore, this framework can help ground efforts by STEM educators and practitioners aimed at redressing existing racial disparities by centering Latine strengths rather than weaknesses or deficits.

While CCW provides a conceptual blueprint for educators to shift away from deficit-based pedagogies and interactions with students of color, there are two limitations left unresolved by this framework. The first is that CCW does not address the unique racialized subjugation experienced by Latine students and communities, which LatCrit can fulfill (Yosso, 2005, 2006). Thus, it is crucial that STEM educators also adopt a LatCrit consciousness when working with Latine youth in order to attend to and honor their unique needs, backgrounds, and histories. The second limitation, also shared by LatCrit, is that even though folks have often merged LatCrit and CCW together, they are often used to understand and analyze the unique histories, experiences, and needs of Latine students from an asset-based perspective, but rarely used to offer more concrete pedagogical strategies for how STEM educators can apply these new understandings to (re)shape classroom structures, learning, and dynamics. In other words, LatCrit and CCW provide limited guidance on how to weave and engage a Latine consciousness that centers Latine students’ cultural wealth within STEM classrooms and

beyond. To address these limitations, we developed an *asset-based LatCrit pedagogical approach* that strives to bridge theory and practice by providing STEM educators guidance and suggestions around weaving Latine students’ cultural wealth within classroom ecologies. To this end, we have dedicated the following section to unpack this approach, which includes explaining in detail each of Yosso’s (2005) six cultural capitals in the context of Latine experiences, as informed by LatCrit scholarship.

## Toward an asset-based LatCrit pedagogical approach in STEM

In this section, we outline the six cultural capitals that Latine students bring into the classroom which serves as the foundation for an *asset-based LatCrit pedagogical approach*. These six cultural capitals, inspired by CCW and focused on Latine students, are: *Latine resistant capital*, *Latine familial capital*, *Latine linguistic capital*, *Latine navigational capital*, *Latine aspirational capital*, and *Latine social capital*. Similar to CCW, these capitals are not mutually exclusive or static; rather, they are dynamic processes that build on one another (Yosso, 2005).

In addition to describing each capital in the context of Latine experiences, we hereby offer guiding questions and application examples STEM educators can use to engage these assets within their practice (see Table 3 for details). Given the multipronged and dynamic nature of these capitals, the guiding questions and application examples are not intended to: (1) be all-encompassing; (2) address all the layers within a capital; (3) be singular definitive ways of affirming and leveraging Latine students’ assets. We do not envision a rigid utilization of this approach, but rather imagine educators embracing this pedagogy similar to what Love (2016) describes as a “way of life, a way of seeing the world, and a way of taking action against injustice” (p. 167). With this vision, we encourage STEM educators to view this approach as a paradigm shift, and consider the guiding questions and applications as entry points for how Latine students’ assets can be used as a learning resource inside and outside of the STEM classroom.

TABLE 2 Yosso’s (2005) six cultural capitals.

Capital name	Definition
Resistant capital	Students of color have acquired and possess intergenerational wisdom, knowledge, and information for resisting systems of oppression in numerous ways.
Familial capital	Students of color receive indispensable strength, knowledge, and support from their <i>familias</i> .
Linguistic capital	The social and intellectual skills that students of color use to communicate with others in multiple languages or communication styles.
Navigational capital	The information, knowledge, and resources students of color leverage to navigate institutions.
Aspirational capital	Students of color’s ability to hope and dream, despite the challenges and barriers they face.
Social capital	The social networks and community connections that students of color rely on for support.

### Latine resistant capital

Latine resistant capital refers to the wisdom, knowledge, and information Latine students have that helps them combat systems of oppression (Yosso, 2005, 2006). Deficit approaches assume Latine students do not possess this knowledge of resistance to challenge inequality. This capital takes a non-deficit approach by highlighting the intergenerational wisdom passed onto Latine students from their families to resist the status quo (Yosso, 2005, 2006). That is, the ways in which Latine students learned to challenge racialized messages that devalue, criminalize, or subordinate them and their communities (Yosso, 2006). An example from Yosso (2006) that illustrates Latine resistant capital is one in which a Latine mother teaches her daughter through both verbal and non-verbal lessons to assert herself as intelligent, capable, beautiful, and worthy of respect to counter the racist, sexist, classist, and materialistic messages she may be receiving from society telling her otherwise. This capital acknowledges the

TABLE 3 Asset-based LatCrit pedagogical guiding questions and application examples.

Capital	Guiding questions	Application example
Latine resistant capital	<ul style="list-style-type: none"> <li>• How can I leverage Latine students' unique insights of how to combat oppression and the status quo to inform discussions about innovative advances in and within STEM?</li> <li>• How can I adjust my curriculum in ways that connect classroom discussions to lessons that interrogate the structural nature of racism and oppression within STEM?</li> </ul>	Discuss the value of Latine students leveraging their unique insights and experiences to challenge the status quo for advances in STEM. Identify examples relevant to your course where failure to challenge the status quo limited STEM advances and insights. Encourage Latine students to try to identify such examples themselves.
Latine familial capital	<ul style="list-style-type: none"> <li>• What pedagogical modifications can I make in my class to connect Latine students and their families' knowledge and experiences to the STEM course concepts, assignments, and class discussions?</li> <li>• What opportunities can I create to encourage Latine students to leverage the lessons and values their families have taught them as relevant to their STEM education?</li> </ul>	Invite Latine parents to a panel where they can share: (1) their experiences and/or knowledge related to STEM fields, and (2) their advice or wisdom for persisting in their area of work despite challenges.
Latine linguistic capital	<ul style="list-style-type: none"> <li>• How can I design a classroom ecology where Spanish (as well as indigenous Latine dialects) languages and communication styles are used, appreciated, and encouraged in my class?</li> <li>• What connections can I make between my class, the field, and the profession to Latine students' language and communication skills that can support their development as culturally competent STEM professionals?</li> </ul>	Create a snapshot of the Latine population within your respective city/state in order to highlight the desire and need for Latine students to maintain and cultivate their language and communication skills. Design assignments for Latine students to work with STEM clinics/organizations/businesses serving Latine populations where they can use and apply their language and communication skills.
Latine navigational capital	<ul style="list-style-type: none"> <li>• What are the ways in which I can draw on Latine students' maneuvering creatively and ingeniously across numerous environments (and social contexts) to reimagine classroom curriculum, assignments, and assessments?</li> <li>• Understanding that STEM education can be a hostile and unsupportive space for Latine students, how can I change the culture of my class, department, and field to reduce these institutional barriers?</li> </ul>	Design a survey to be distributed at the beginning of class to inquire about Latine students' learning styles and potential challenges they foresee that might impact how they do in your class. Draw on their knowledge navigating Higher Education institutions to design your course to best support their learning and reduce the challenges they may encounter.
Latine aspirational capital	<ul style="list-style-type: none"> <li>• Recognizing that Latine students possess the ability to dream/hope despite barriers, how can I connect that skill as important for working through and solving challenging STEM related homework/assignment problems in my class, and the field?</li> <li>• Using the motivations that Latine students' receive from their parents and families, how can I connect that source of strength to nourish and ignite their development, growth, and future in STEM?</li> </ul>	Conduct a survey to identify Latine students' long term goals that can inform modification of STEM class lectures, assignments, readings, and labs. Use this information to connect Latine students' learning to their goals and/or how they can apply what they learned to support their communities.
Latine social capital	<ul style="list-style-type: none"> <li>• What activities can I create to brainstorm with Latine students around the community resources they can tap into for additional opportunities, information, resources, and guidance?</li> <li>• Knowing that Latine students possess an array of networks, what opportunities can I create in class to grow and cultivate their peer network?</li> </ul>	Create a workshop with Latine student organizations (e.g., M.E.Ch.A.) to lean into the wealth of social capital present within Latine communities. During this workshop, advanced Latine students and professionals can share the information, strategies, and lessons (e.g., Latine student study halls, retreats, and centers) they accessed to progress in their STEM education and profession.

many ways Latine students resist systems of oppression. Their resistance can range from what Solórzano and Delgado-Bernal (2001) outline as oppositional behavior (self-destructive behavior) to transformational resistance (actions that seek to transform inequitable structures and systems). An *asset-based LatCrit pedagogical approach* draws on this capital to leverage students' skills to challenge systems of oppression as valuable tools for

STEM. Engaging this capital within STEM requires educators to acknowledge Latine students are equipped with a unique and indispensable understanding of marginalization that can inform efforts within the field of STEM to be more just and equitable. We provide guiding questions and an application example that STEM educators can use to begin affirming this capital and applying it within their classroom (see Table 3 for details).

## Latine familial capital

Latine familial capital refers to the indispensable source of strength, knowledge, and support Latine students receive from their *familias* (Yosso, 2005, 2006). Deficit approaches in classrooms often carry racial, class, and heterosexual assumptions of family that signal to students that they must adopt White middle class familial practices and roles in order to be successful (Valenzuela, 1999; Yosso, 2005). Contrary to deficit perspectives that often position Latine families as disinvested in their children's education (Valencia, 1997), this capital recognizes the multiple ways that often go unrecognized through which Latine parents contribute to their children's educational journeys. For example, while a Latine parent may be unable to help their children with their physics homework (because of language barriers) or pay for a tutor (because of financial barriers), they are able to teach them the concepts of hard work, responsibility, and integrity by taking their children to work in the fields with them (Yosso, 2005). Through this act, parents encourage their children to *eharle ganas a sus estudios* (give their best effort to their studies) so that they can access better paying and less physically demanding jobs. As part of these lessons, Rendón et al. (2014) note that Latine parents offer role modeling, validation, and *consejos* that helps students overcome the barriers and systems of oppression that would otherwise discourage students from persisting in their educational journeys. An *asset-based LatCrit pedagogical approach* draws on this capital to strengthen students' connection with their families, rather than weaken them. This capital honors the many ways that Latine parents can engage in STEM by sharing wisdom from their everyday lives and/or occupation, which challenges deficit perspectives that Latine parents have no knowledge and/or experience useful to this field. When applying this capital, STEM educators are committing to affirming the critical roles that Latine families play in their children's education. To support STEM educators in this effort, we provide guiding questions and an application that they can use as a resource (see Table 3 for details).

## Latine linguistic capital

Latine linguistic capital refers to the intellectual and social skills Latine students draw on to build relationships and communicate with others using more than one language or communication style (Yosso, 2005, 2006). This capital counters deficit perspectives that position Latine youth's multilingual repertoires as an 'obstacle' or barrier to their academic success. The research on these deficit perspectives are reflected in the racialization of language, English only local policies, and banning of bilingual education in the United States (Gutiérrez et al., 2002; Rosa, 2016; García and Kleifgen, 2018; García and Solorza, 2020). Countering these destructive perspectives, this cultural capital recognizes the significant role students' native language or distinct communication styles play in students' development of a strong sense of identity and their long-term academic success (Gandara et al., 2010). As well, linguistic capital acknowledges the additional social tools Latine students possess and have developed based on their ability to navigate numerous contexts that require additional capacities associated to their linguistic capital (i.e., vocabulary, social awareness, real world literacy skills, metalinguistic awareness, etc.). An *asset-based LatCrit pedagogical approach* draws on this capital to leverage students' native language and communication styles as valuable tools

for learning. When focusing on Latine students, this capital highlights the ways in which Latine students navigate native and non-native languages and communication styles, which will prepare them to become more culturally competent STEM professionals in the future. In fact, STEM educators should encourage linguistic pluralism in their classrooms, as our society would benefit from more linguistically and culturally competent doctors, nurses, and engineers that can support our increasingly diverse populations. To affirm this capital, we provide STEM educators with guiding questions and an application example that they can draw on as a resource (see Table 3 for details).

## Latine navigational capital

Latine navigational capital refers to the skills, dispositions, and information Latine students draw upon to navigate social institutions that have historically catered to White, heterosexual, upper middle-class students (Yosso, 2005). Deficit approaches assume Latine students do not possess the skills to persist and excel in Higher Education. In highlighting Latine students' strengths, this capital challenges deficit approaches by recognizing that students have "agency even though their decisions and actions take place within constraints" (Yosso, 2006, p. 44). That is, Latine students continue to find creative and ingenious ways to persist despite navigating hostile, challenging, and unjust institutions that were not made with them in mind. Applying this capital to Higher Education, Rendón et al. (2014) explain that this capital enables Latine students to skillfully operate across distinct worlds, contexts, and expectations (e.g., countries, peers, family, schools, society) they encounter once in college. To navigate these numerous environments, Latine students draw on their repertoire of mental scripts, language codes, and intellectual and behavioral conventions that each of these contexts requires of them (Rendón et al., 2014). Using an *asset-based LatCrit pedagogical approach* means leaning into Latine students' knowledge and skills to navigate Higher Education institutions as valuable tools for reducing STEM inequity. However, STEM educators must also take the responsibility to reduce STEM barriers within their classroom, the university, and the field. As a way to affirm and leverage this capital, we provide guiding questions and an application that STEM educators could utilize (see Table 3 for details).

## Latine aspirational capital

Latine aspirational capital highlights Latine students' aspirations which could be toward their personal, familial, and/or community goals (Rendón et al., 2014). In particular, this capital operates in three parts which are: (1) Latine students' ability to dream and hope despite the challenges they face, (2) Latine students setting high expectations for themselves, and (3) Latine parents and families inspiring and validating Latine students' hopes and dreams by providing advice and testimonies of how they have overcome hardships (Yosso, 2005; Rendón et al., 2014). Woven together, these parts shape and fuel Latine students' goals such as attending college, entering professional careers, or making a difference within their communities. Deficit approaches position Latine students as low achieving students not able to dream beyond their means. This capital acknowledges Latine students' ability to reach for possibilities beyond their present



circumstances in order to improve both their family's and their own quality of life. This *asset-based LatCrit pedagogical approach* challenges deficit perspectives about Latine students and instead affirms and leverages this capital as valuable to incorporate into the classroom. The integration of this capital would enhance the teaching and learning of STEM courses by connecting course materials to Latine's students' aspirational abilities, their high expectations, and their families who continue to be part of their journey. We provide guiding questions and an application to support STEM educators in honoring and using capital in their class (see [Table 3](#) for details).

## Latine social capital

Latine social capital recognizes Latine students' multitude of social networks and community resources that support their educational pursuits (Yosso, 2006). Deficit approaches operate from the assumption that Latine students lack access to networks and community resources (i.e., social capital) essential for their academic progression (Yosso, 2006). These deficit approaches fail to consider how discriminatory practices have limited Latine communities' access to social networks and resources often obtainable for White middle class communities. Nonetheless, this capital validates how despite these restrictions, Latine students and their network exchange information, resources, and guidance to support one another. Due to this extensive network of support, students learn about scholarship opportunities, internships, and other critical information despite the racialized access to opportunities in the United States (Rendón et al., 2014). An *asset-based LatCrit pedagogical approach* centers this often-overlooked capital that Latine students bring into the classroom. We provide STEM educators with guiding questions to affirm and utilize this capital (see [Table 3](#) for details). Additionally, we also want to acknowledge that STEM educators possess power and influence outside their class too. Thus, we intentionally created an application example that can be utilized outside the classroom that affirms and leverages this capital (see [Table 3](#) for details).

## Discussion and considerations for applying an asset-based LatCrit pedagogical approach

As we described above, an *asset-based LatCrit pedagogical approach* pushes against deficit theories that are used to explain and justify the underrepresentation of Latine students in STEM (Bruton and Robles-Piña, 2009; Caushi, 2022). The integration of this approach by STEM educators supports efforts to counter the "culture of attrition" in STEM that prevents cultivating the "scientist" in Latine students (Bensimon et al., 2019, p. 1691). Incorporating and recognizing these capitals is critical considering Latine students are often viewed as not possessing the "stereotypical features that gain them recognition as an aspiring scientist" (Bensimon et al., 2019, p. 1692). Thus, affirming these capitals can support Latine students to navigate the incongruencies of a field that fails to consider how race shapes constructions of who is granted access and found to be meritorious in STEM. In addition, this framework can help ground efforts by STEM educators to "integrate and reward" Latine students for the "cultural capitals they introduce into everyday" classroom

learning experiences, rather than "penalize them for the differences they represent" (Peralta et al., 2013, p. 915). This approach will allow STEM educators to notice and leverage the untapped aptitudes, brilliance, and ingenuity Latine students can contribute to the field of STEM.

While we invite STEM educators to start their journey toward disrupting deficit assumptions about Latine students and embark on applying an *asset-based LatCrit pedagogical approach*, we also recognize that changing instructional practices is notoriously difficult (Henderson et al., 2011; Brownell and Tanner, 2012; Wieman and Gilbert, 2015). There may be push back in applying our proposed pedagogical approach due to the lack of time to undertake a course transformation, lack of training on how to implement effective changes to teaching, lack of departmental and institutional support that promote and value such changes, lack of recognition at the time of merit and promotions, lack of a community also interested in similar changes, and more. While there is little literature specifically on the attitudes of STEM educators toward implementing asset-based pedagogies such as ours in their classrooms, STEM educators have been shown to struggle addressing issues of racism in their classroom (King et al., 2023), with many educators highlighting their lack of preparation for addressing such social issues. Thus, it is not surprising that many STEM educators feel lost as to how to start applying an *asset-based LatCrit pedagogical approach* in their courses.

At the same time, we also recognize that STEM educators might have questions and concerns on how this pedagogical approach designed for Latine students in mind *can be carried out* in practice when they might also have students who are not Latine. We acknowledge these questions and concerns, but at the same time note that there already exist pedagogical approaches that encompass a racially diverse student population that educators can implement within their classroom (e.g., culturally relevant pedagogy, culturally sustaining pedagogy). However, there is limited scholarship around more concrete pedagogical practices that pertain particularly to the Latine population, especially in STEM. We focus our scholarship on this scholarly gap, which aims to center, affirm, and support Latine students in STEM. Although this pedagogical approach is specific to Latine students, we do not see it as *only* applicable and beneficial to Latine students. On the contrary, this approach is applicable and beneficial to all students, such as being helpful for other non-Latine students to challenge deficit perspectives about Latine students and their communities, learn new innovative insights from their Latine peers, and grow as future culturally component STEM professionals.

Given the above concerns that STEM educators might have, the next sections outline recommended steps that can guide STEM educators when preparing to implement an *asset-based LatCrit pedagogical approach*. These sections provide context for [Table 3](#). Specifically, we describe a teaching-learning cycle consisting of: STEM educator reflection; implementation plan and assessment and feedback. Finally, we discuss the importance of institutional support and the contributions and limitations of this work.

## STEM educator reflection

As with any pedagogical change, STEM educators should *engage in deep reflection* (Brookfield, 1995; Machost and Stains, 2023) prior

to, during and after the implementation of *asset-based LatCrit pedagogies*. Educators need to reflect on their own positionality and biases regarding race in STEM, particularly in the context of Latine students. We recognize that this reflection can be challenging because it requires STEM educators to examine themselves, identify their own biases and beliefs, and most importantly, to unlearn the harmful biases and beliefs that *shape their perceptions* of Latine students and *how they teach* Latine students. The unlearning part will be an ongoing process that requires STEM educators to pay “careful attention to their own and others’ racialized and cultural systems of coming to know, knowing, and experiencing the world” (Milner, 2007, p. 388). This recognition will support STEM educators to also begin thinking about their reasons for wanting to implement the change, how the pedagogical change aligns with their teaching philosophies, and how this pedagogical change connects to their course curriculum. From there, educators can participate in a paradigm shift to challenge deficit perspectives about Latine students in STEM. To further support STEM educators in this effort, we included 10 LatCrit and CCW articles that educators can reference (see Table 4) to continue expanding their racial awareness, cultural awareness, and reflexivity, which have been identified as critical for disrupting racial harm (Milner, 2007; Pearson et al., 2022). Once STEM educators have done the important work of deep reflection they can begin to incorporate the guiding questions and applications we provided earlier (see Table 3 for details).

## Implementation plan for the STEM classroom

The second step is utilizing what has been learned from these reflections as well as relevant examples of similar course transformations in the literature to *develop an implementation plan*. An implementation plan includes the strategies, processes, and actions that STEM educators can use when preparing to apply an *asset-based LatCrit pedagogical approach*. This implementation plan requires STEM educators to intentionally and purposefully consider the necessary steps to effectively incorporate this pedagogical approach, such as identifying their learning goals and what content students need to know before introducing an assignment and assessment. As part of this preparation process, STEM educators should consider these steps in the specific context of the capitals and assets that Latine students are bringing to the classroom. While implementation may take place in racially diverse classrooms, for the purpose of this section we center Latine students, but see this implementation plan as applicable to all students as well. A possible implementation plan within this context can be the following:

1. Learning about the Latine students in the class such as their lives, communities, interests, and career goals in order to better align the topics of the course and the activities to this population (through a survey, for example).
2. Selecting (initially) one or two activities to incorporate into the course (see Table 3 for application/activities examples).
3. Identifying the best format and place in the curriculum for the planned activity/task. For example, the activity could be part of the lecture, a class assignment, a case study, a homework assignment, a blog, etc.
4. Defining the learning goals for the activity. These learning goals should be two-part. On the one hand, identify learning goals that are relevant to course content or skills that Latine students are expected to master in STEM. On the other hand, there should be learning goals for how Latine students can relate the course material being taught to their communities and lives.
5. Introducing the goal of the activity and developing the trust necessary to carry it out in a meaningful, impactful, and transformative way for Latine students in STEM. To create this learning environment, STEM educators should encourage the co-creation of community norms at the beginning of the course before engaging the previously identified activity (Woods and Roig-Torres, 2018; Bowen et al., 2022; Bridges et al., 2023).

We want to strongly discourage educators from implementing an *asset-based LatCrit pedagogical approach* activity that works as a ‘one off’ that has little to do with the rest of the course and that is not actively discussed in class. Latine students need to feel and understand the value of the activity in order to engage in it in a meaningful manner, and it is critical that they see how the activity is relevant to their course as well as their own personal long-term goals for it to be effective (Ovid et al., 2023).

## Assessment and feedback

Prior to implementing the pedagogical changes, STEM educators should consider how they will evaluate the outcome of the activity and whether it met their learning objectives. If the activity and outcome are part of the course summative assessment, we recommend that this is made explicit within the classroom. In addition, STEM educators should develop a plan for collecting feedback about the activity (e.g., reflections, surveys, etc.) in order to incorporate these insights into future iterations of this activity and/or to inform the educators’ teaching.

If STEM educators are interested in aligning this activity with other institutional goals, they could consider including instruments on sense of belonging (Pak, 2018), science identity (Robnett et al., 2015), self-efficacy (Bandura, 1977), and commitment to science (Chemers et al., 2011) in a pre-course and end of the course survey so as to gain insight into whether the pedagogical innovation is associated with changes in any of these retention-related constructs. This would also be advantageous for those STEM educators who may be interested in publishing about their pedagogical innovation.

## Institutional support

While we consider STEM educators as active agents in challenging deficit pedagogical practices, we also acknowledge the competing institutional demands and expectations that discourage educators from pursuing this path. For these reasons, we recognize the pursuit of equitable asset-based STEM ecologies, as a collective endeavor, not just one that STEM educators should bear alone. Committed to this collective endeavor, STEM stakeholders, and powerbrokers can support educators in their pursuit of *asset-based LatCrit pedagogical approach* and non-deficit educational reforms (Oliver and Hyun, 2011; Brownell and Tanner, 2012). This support can include (but need not be limited

TABLE 4 Additional suggested reading on LatCrit and CCW.

LatCrit: additional recommended articles/books	CCW: additional recommended articles/books
Aoki, K., and Johnson, K. R. (2008). An assessment of LatCrit theory ten years after. <i>Indiana Law J.</i> 83, 1151–1196.	Peralta, C., Caspary, M., and Boothe, D. (2013). Success factors impacting Latina/o persistence in Higher Education leading to STEM opportunities. <i>Cult. Stud. Sci. Educ.</i> 8, 905–918. doi: 10.1007/s11422-013-9,520-9.
LatCrit Inc. (2001). LatCrit Primer: A Selection of Articles from the Annual LatCrit Symposia and Related Materials. Gainesville, FL: <a href="http://LatCrit.org">LatCrit.org</a>	Rendón, L. I., Nora, A., and Kanagala, V. (2014). <i>Ventajas/Assets y Conocimiento/Knowledge: Leveraging Latin@ Strengths to Foster Student success</i> . San Antonio, TX: Center for Research and Policy in Education.
Stefancic, J. (1997). Latino and Latina critical theory: an annotated bibliography. <i>Calif. Law Rev.</i> 85, 1509–1584.	Rincón, B. E., Fernández, É., and Dueñas, M. C. (2020). Anchoring comunidad: how first-and continuing-generation Latinx students in STEM engage community cultural wealth. <i>Int. J. Qual. Stud. Educ.</i> 33, 840–854. doi: 10.1080/09518398.2020.1735567.
Valdes, F. (1996). Foreword: Latina/o ethnicities, critical race theory, and post-identity politics in postmodern legal culture: From practices to possibilities*. <i>Berkeley La Raza L.J.</i> 9, 1–32.	Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. <i>Race Ethn. Educ.</i> 8, 69–91. doi: 10.1080/1361332052000341006.
Valdes, F., and Bender, S. W. (2021). <i>From Critical Legal Theory to Academic Activism</i> . New York, NY: University Press.	Yosso, T. J. (2006). <i>Critical Race Counterstories along the Chicana/Chicano Educational Pipeline</i> . New York, NY: Routledge.

to): (1) channeling institutional resources to support training, workshops, and lectures that can equip STEM educators with the necessary information, knowledge, and tools for transforming their classes; (2) increasing the recognition and valuation of pursuing pedagogical transformation during merits and promotions; (3) providing faculty with incentives to engage in this re-evaluation of their teaching and course redesign (either in the form of research funds, commitment of teaching assistants to aid in newly redesigned courses, a reduction in teaching workload for the year in which the course was re-designed, etc.) (Nagashima and Hrach, 2021); (4) creating or helping organize communities of practice that create cohorts of peers supporting each other through the process of pedagogical re-design (Tinnell et al., 2019). These examples provide a glimpse of how expansive and deeply rooted institutional support can be if institutions are truly committed to support STEM educators in integrating an *asset-based LatCrit pedagogical approach* and in increasing the interest, enrollment, graduation, and retention of Latine students in STEM.

## Contributions and limitations

While we believe in the potential of implementing an *asset-based LatCrit pedagogical approach*, we acknowledge the limitations of our work, such as the lack of empirical data demonstrating the student outcomes resulting from this approach in STEM courses. Nonetheless, existing research on similar student-centered strategies suggests the potential impact of engaging alternative STEM pedagogical approaches. For example, student-centered pedagogies that promote active learning (Freeman et al., 2014), course-based undergraduate research experiences (Banger and Brownell, 2014), and problem-based learning (Wood, 2003) have been shown to improve student learning, promote retention, and increase graduation rates in STEM. These strategies center the voices of marginalized groups, challenge bias, and promote inclusive environments (Saunders and Wong, 2020). Similarly, strategies that encourage examination of how things are and how they could be different have been found to motivate students to become co-creators of knowledge and contest dominant narratives (Freire, 1970; Giroux, 2010). Therefore,

student-centered pedagogies, such as *asset-based LatCrit pedagogies*, hold promise to create even more significant changes in student learning and retention in STEM, especially for Latine students.

Despite this limitation, the *asset-based LatCrit pedagogical approach* presented here contributes to this literature on alternative student-centered strategies while also expanding the scholarship on the importance of incorporating Latine students' capitals to improve their educational and learning experiences. This approach seeks to expand the use and leveraging of Latine students' cultural capitals given the existing research that documents the ways aspirational, familial, and linguistic capital are critical for overcoming the racial stereotypes, hostile environments, and discouragement many Latine students experience when navigating the STEM pipeline (Peralta et al., 2013). Latine students' cultural capitals have also been found to positively influence students' 'scientific' identities, academic success, and emotional well-being when pursuing a STEM degree (Rodriguez et al., 2019; Contreras Aguirre et al., 2020; Gonzalez et al., 2022).

Despite the increased attention to alternate student-centered strategies and the components that contribute to Latine students' persistence in STEM, tangible tools and resources that can help STEM educators incorporate these strategies within their classrooms remain limited. Therefore, the *asset-based LatCrit pedagogical approach* presented in this article contributes to this growing literature. We encourage further research documenting the benefits of this approach, its limitations, its implementations, and information on the modifications that would strengthen the guiding questions and application examples presented in this article. We invite, welcome, and challenge STEM educators to partake in furthering efforts in increasing and supporting Latine students in STEM through utilizing the approach presented in this paper and documenting and sharing their efforts and findings.

## Conclusion

In conclusion, STEM educators hold a significant responsibility in promoting equity and disrupting inequitable STEM pipelines for Latine students. This requires a shift away from a deficit-based

perception of Latine students to a paradigm that recognizes and affirms their experiences, ingenuity, and cultural backgrounds as assets that can contribute to the field of STEM. To achieve this, educators can adopt an *asset-based LatCrit pedagogical approach* that can promote more equitable and inclusive STEM environments. This approach focuses on identifying and utilizing the strengths and experiences of Latine students to enhance their learning and promote their success in STEM fields. By implementing this approach, educators can foster a more inclusive and diverse STEM environment that encourages innovation and creativity and promote the retention and success of Latine STEM students. Furthermore, it is important to recognize that the impact of this paradigm shift is not limited to the classroom but extends to the larger societal structures that also shape STEM education and disciplines. By adopting an *asset-based LatCrit pedagogical approach*, educators will be better equipped to support changing STEM from a tool for creating and upholding injustice to one that facilitates liberation, empowerment, and transformation.

## Author contributions

AHN, KM, and NC contributed to the conception, planning and outline of this article. AHN and NC conducted the literature search. AHN and KM conceptualized and developed the principles of the asset-based LatCrit pedagogy described in the article. AHN took the lead in writing the manuscript. KM and NC contributed to the manuscript by aiding in the design, drafting and revision of important intellectual content. All authors were involved in the final editing of the manuscript and approved the submitted version.

## References

- Adiredja, A. P., Bélanger-Rioux, R., and Zandieh, M. (2020). Everyday examples about bias from students: an anti-deficit approach in the classroom. *Primus* 30, 520–538. doi: 10.1080/10511970.2019.1608609
- Alberts, B. (2012). Failure of skin-deep learning. *Science* 338:1263. doi: 10.1126/science.1233422
- Anzaldúa, G. (1987). *Borderlands/La Frontera: The new Mestiza*. San Francisco, CA: Aunt Lute Books.
- Aoki, K., and Johnson, K. R. (2008). An assessment of Lat Crit theory ten years after. *Indiana Law J.* 83, 1151–1196.
- Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychol. Rev.* 84, 191–215. doi: 10.1037/0033-295X.84.2.191
- Bangera, G., and Brownell, S. E. (2014). Course-based undergraduate research experiences can make scientific research more inclusive. *CBE Life Sci. Educ.* 13, 602–606. doi: 10.1187/cbe.14-06-0099
- Bensimon, E. M., Dowd, A. C., Stanton-Salazar, R., and Dávila, B. A. (2019). The role of institutional agents in providing institutional support to Latinx students in STEM. *Rev. High. Educ.* 42, 1689–1721. doi: 10.1353/rhe.2019.0080
- Berlak, H. (2001). Race and the achievement gap. *Urban Educ.* 15, 10–14.
- Bourdieu, P., and Passeron, J. (1977). *Reproduction in education, society and culture*. London, UK: Sage Publications.
- Bowen, C. L., Hudson, H., Austin, S. J., Landaiche, C., Peters, A. M. K., Salom, M. F. C., et al. (2022). The development and implementation of “class community norms” to facilitate learning in a social justice-oriented classroom. *J. Electr. Electron. Eng.* 1–9. doi: 10.1109/FIE56618.2022.9962392
- Bridges, M. W., DiPietro, M., Lovett, M., Norman, M. K., and Ambrose, S. A. (2023). *How learning works: Eight research-based principles for smart teaching*. Hoboken, NJ: Jossey-Bass.
- Brookfield, S. (1995). *Becoming a critically reflective teacher*. San Francisco, CA: Jossey-Bass.
- Brownell, S. E., and Tanner, K. D. (2012). Barriers to faculty pedagogical change: lack of training, time, incentives, and ... tensions with professional identity? *CBE Life Sci. Educ.* 11, 339–346. doi: 10.1187/cbe.12-09-0163
- Bruton, A., and Robles-Piña, R. A. (2009). Deficit thinking and Hispanic student achievement: scientific information resources. *Probl. Educ. 21st Century.* 15, 41–48.
- Bullock, E. C., and Meiners, E. R. (2019). Abolition by the numbers: mathematics as a tool to dismantle the carceral state (and build alternatives). *Theory Pract.* 58, 338–346. doi: 10.1080/00405841.2019.1626614
- Cammarota, J., and Aguilera, M. (2012). ‘By the time I get to Arizona’: race, language, and education in America’s racist state. *Race Ethn. Educ.* 15, 485–500. doi: 10.1080/13613324.2012.674025
- Carlone, H. B., and Johnson, A. (2007). Understanding the science experiences of successful women of color: science identity as an analytic lens. *J. Res. Sci. Teach.* 44, 1187–1218. doi: 10.1002/tea.20237
- Castro, E. L. (2014). “Underprepared” and “at-risk”: disrupting deficit discourses in undergraduate STEM recruitment and retention programming. *J. Student Aff. Res. Pract.* 51, 407–419. doi: 10.1515/jsarp-2014-0041
- Caushi, K. (2022). *Development, implementation, and investigation of an asset-based approach to supporting general chemistry students*. PhD thesis, Boston, MA: University of Massachusetts Boston.
- Chang, R. S., and Aoki, K. (2012). Centering the immigrant in the inter/national imagination. *Calif. L. Rev.* 85, 1395–1448. doi: 10.2307/3481063
- Chemers, M. M., Zurbriggen, E. L., Syed, M., Goza, B. K., and Bearman, S. (2011). The role of efficacy and identity in science career commitment among underrepresented minority students. *J. Soc. Issues* 67, 469–491. doi: 10.1111/j.1540-4560.2011.01710.x
- Committee on a Conceptual Framework for New K-12 Science Education Standards. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: National Academies Press.
- Contreras Aguirre, H. C., Gonzalez, E., and Banda, R. M. (2020). Latina college students’ experiences in STEM at hispanic-serving institutions: framed within Latino critical race theory. *Int. J. Qual. Stud. Educ.* 33, 810–823. doi: 10.1080/09518398.2020.1751894
- Coronella, T. (2018). Transforming academic advising: implementing validating advising experiences with first-generation Latina engineering students. *J. Educ. Found. Soc. Justice Educ.* 4, 57–71.

## Funding

This work received support from an NSF BCSEI IID grant (#1937778, PI: NC) and the Sloan Equity and Inclusion in STEM Introductory Courses (SEISMIC) project ([seismicproject.org](http://seismicproject.org)) funded by the Alfred P. Sloan Foundation and participating institutions.

## Acknowledgments

The authors want to thank Natalia Deeb-Sossa and Nita Kedharnath for their valuable feedback on the drafts of this article.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.



- Crisp, G., and Nora, A. (2012). *Future research on Hispanic students: What have we yet to learn? And what new and diverse perspectives are needed to examine Latino success in higher education?* Washington, DC: Hispanic Association of Colleges and Universities.
- Cuellar, M. G., Segundo, V., and Muñoz, Y. (2017). Answering the call: Hispanic-serving institutions as leaders in the quest for access, excellence, and equity in American higher education. *Assoc. Mex. Am. Educ. J.* 11, 84–108.
- Delgado, R., and Stefancic, J. (2017). *Critical race theory: An introduction*. New York, NY: New York University Press.
- Espinoza, L., and Harris, A. P. (1997). Afterword: embracing the tar-baby-Lat Crit theory and the sticky mess of race. *La Raza LJ*, 10, 499–560.
- Flores, Y. G., Grindstaff, L., and Brazil-Cruz, L. (2022). “Making visible the invisible: studying Latina STEM scholars” in *Uprooting Bias in the academy: Lessons from the field*. eds. L. F. Bisson, L. Grindstaff, L. Brazil-Cruz and S. J. Barbu (Cham, CH: Springer)
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., et al. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci.* 111, 8410–8415. doi: 10.1073/pnas.1319030111
- Freire, P. (1970). *Education for critical consciousness*. New York, NY: Continuum Publishing Company.
- Gandara, P. C., and Contreras, F. (2009). *The Latino education crisis: the consequences of failed social policies*. Cambridge, MA: Harvard University Press.
- Gandara, P. C., Lossen, D., August, D., Uriarte, M., Gomez, M. C., and Hopkins, M. (2010). “Forbidden language: a brief history of US language policy” in *Forbidden language: English learners and restrictive language policies*. eds. P. Gandara and M. Hopkins (New York, NY: Teachers College Press)
- García, O., and Kleifgen, J. A. (2018). *Educating emergent bilinguals: policies, programs, and practices for English learners*. New York, NY: Teachers College Press.
- García, O., and Solorza, C. R. (2020). Academic language and the minoritization of U.S. bilingual Latinx students. *Lang. Educ.* 35, 505–521. doi: 10.1080/09500782.2020.1825476
- Gay, G. (2018). *Culturally responsive teaching: theory, research, and practice*. New York, NY: Teachers College.
- George-Jackson, C. E., Rincon, B., and Martinez, M. G. (2012). Low income students in engineering: considering financial aid and differential tuition. *J. Stud. Financ. Aid.* 42, 4–24. doi: 10.55504/0884-9153.1009
- Giroux, S. S. (2010). *Between race and reason: Violence, intellectual responsibility, and the university to come*. Stanford, CA: Stanford University Press.
- Gonzalez, E., Aguirre, C. C., and Myers, J. (2022). Persistence of Latinas in STEM at an R1 higher education institution in Texas. *J. Hisp. High. Educ.* 21, 151–164. doi: 10.1177/1538192720918369
- Gutiérrez, K. D., Asato, J., Santos, M., and Gotanda, N. (2002). Backlash pedagogy: language and culture and the politics of reform. *Rev. Educ. Pedagogy Cult. Stud.* 24, 335–351. doi: 10.1080/10714410214744
- Haney-Lopez, I. F. (1994). The social construction of race: some observations on illusion, fabrication, and choice. *Harv. C.R.-C.L. L* 29, 1–62.
- Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Dir. Inst. Res.* 2010, 63–74. doi: 10.1002/ir.362
- Hazari, Z., Sadler, P. M., and Sonnert, G. (2013). The science identity of college students: A gender and race/ethnicity comparison. *J. Coll. Sci. Teach.* 42, 82–91.
- Henderson, C., Beach, A., and Finkelstein, N. (2011). Facilitating change in undergraduate STEM instructional practices: an analytic review of the literature. *J. Res. Sci. Teach.* 48, 952–984. doi: 10.1002/tea.20439
- Hewlett, S. A., Marshall, M., and Sherbin, L. (2013). How diversity can drive innovation. *Harv. Bus. Rev.* 91:30.
- Iglesias, E. M. (1996–1997). International law, human rights, and Lat Crit theory. *U. Miami Inter-Am. L. Rev.* 28, 22–47.
- King, G. P., Russo-Tait, T., and Andrews, T. C. (2023). Evading race: STEM faculty struggle to acknowledge racialized classroom events. *CBE Life Sci. Educ.* 22, 1–16. doi: 10.1187/cbe.22-06-0104
- Ladson-Billings, G., and Tate, W. F. (1995). Toward a critical race theory of education. *Teach. Coll. Rec.* 97, 47–68. doi: 10.1177/016146819509700104
- Lara, H. (2017). *Latinx students in STEM education research: A CRT and Lat Crit analysis of NSF funded projects*. Lincoln, NE: University of Nebraska Digital Commons.
- Love, B. (2016). *We want to do more than survive: Abolitionist teaching and the pursuit of educational freedom*. Boston, MA: Beacon Press.
- Machost, H., and Stains, M. (2023). Reflective practices in education: A primer for practitioners. *CBE Life Sci. Educ.* 22, 1–11. doi: 10.1187/cbe.22-07-0148
- Martinez, G. A. (1993). Legal indeterminacy, judicial discretion and the Mexican-American litigation experience: 1930–1980. *U.C. Davis Law Rev.* 27, 555–618.
- Martinez, G. A. (2012). Arizona, immigration, and latinos: the epistemology of whiteness, the geography of race, interest convergence, and the view from the perspective of critical theory. *Ariz. State Law J.* 44, 175–212.
- Milner, H. R. IV (2007). Race, culture, and researcher positionality: working through dangers seen, unseen, and unforeseen. *Educ. Res.* 36, 388–400. doi: 10.3102/0013189X07309471
- Museus, S. D., Palmer, R. T., Davis, R. J., and Maramba, D. C. (2011). Racial and ethnic minority students’ success in STEM education. *ASHE High. Educ. Rep.* 36, 1–140.
- Nagashima, T., and Hrach, S. (2021). Motivating factors among university faculty for adopting open educational resources: incentives matter. *J. Interact. Media Educ.* 2021, 1–10. doi: 10.5334/jime.678
- National Research Council. (2013). *NGSS Lead states. Next generation science standards: For states, by states*. Washington, DC: The National Academies Press.
- National Science Board (2019). *Higher education in science and engineering*. Alexandria, VA: National Science Board.
- Oliver, S. L., and Hyun, E. (2011). Comprehensive curriculum reform in higher education: collaborative engagement of faculty and administrators. *J. Case Stud. Educ.* 2, 1–20.
- Ovid, D., Abrams, L., Carlson, T., Dieter, M., Flores, P., Frischer, D., et al. (2023). Scientist Spotlights in Secondary Schools: Student Shifts in Multiple Measures Related to Science Identity after Receiving Written Assignments. *CBE—Life Sci. Educ.* 22:ar22. doi: 10.1187/cbe.22-07-0149
- Pak, C. S. (2018). Linking service-learning with sense of belonging: a culturally relevant pedagogy for heritage students of Spanish. *J. Hisp. High. Educ.* 17, 76–95. doi: 10.1177/1538192716630028
- Pearson, M. I., Castle, S. D., Matz, R. L., Benjamin, K. P., and Byrd, W. C. (2022). Integrating critical approaches into quantitative STEM equity work. *CBE Life Sci. Educ.* 21, 1–10. doi: 10.1187/cbe.21-06-0158
- Peck, F. (2021). Towards anti-deficit education in undergraduate mathematics education: how deficit perspectives work to structure inequality and what can be done about it. *Primus* 31, 940–961. doi: 10.1080/10511970.2020.1781721
- Peralta, C., Caspary, M., and Boothe, D. (2013). Success factors impacting Latina/o persistence in higher education leading to STEM opportunities. *Cult. Stud. Sci. Educ.* 8, 905–918. doi: 10.1007/s11422-013-9520-9
- Pérez Huber, L. (2010). Using Latina/o critical race theory (Lat Crit) and racist nativism to explore intersectionality in the educational experiences of undocumented Chicana college students. *Educ. Foundations.* 24, 77–96.
- Pettigrew, T. F. (2004). Justice deferred a half century after Brown v Board education. *Am. Psychol.* 59, 521–529.
- Rahm, J., and Moore, C. J. (2016). A case study of long-term engagement and identity-in-practice: insights into the STEM pathways of four underrepresented youths. *J. Res. Sci. Teach.* 53, 768–801. doi: 10.1002/tea.21268
- Rendón, L. I., Nora, A., and Kanagala, V. (2014). *Ventajas/assets y Conocimiento/knowledge: Leveraging Latin@ strengths to Foster student success*. San Antonio, TX: Center for Research and Policy in Education.
- Rincón, B. E., Fernández, É., and Dueñas, M. C. (2020). Anchoring comunidad: how first-and continuing-generation Latinx students in STEM engage community cultural wealth. *Int. J. Qual. Stud. Educ.* 33, 840–854. doi: 10.1080/09518398.2020.1735567
- Rincón, B. E., and Rodriguez, S. L. (2021). Latinx students charting their own STEM pathways: how community cultural wealth informs their STEM identities. *J. Hisp. High. Educ.* 20, 149–163. doi: 10.1177/1538192720968276
- Riojas-Cortéz, M. (2000). Mexican American preschoolers create stories: Sociodramatic play in a dual language classroom. *Biling. Res. J.* 24, 295–307. doi: 10.1080/15235882.2000.10162767
- Robnett, R. D., Chemers, M. M., and Zurbriggen, E. L. (2015). Longitudinal associations among undergraduates’ research experience, self-efficacy, and identity. *J. Res. Sci. Teach.* 52, 847–867. doi: 10.1002/tea.21221
- Rodriguez, S. L. (2015). *Las Mujeres in the STEM pipeline: How Latina college students who persist in STEM majors develop and sustain their science identities*. PhD thesis, Austin, TX: University of Texas, Austin.
- Rodriguez, S., Pilcher, A., and Garcia-Tellez, N. (2019). The influence of familismo on Latina student STEM identity development. *J. Lat. Educ.* 20, 177–189. doi: 10.1080/15348431.2019.1588734
- Rosa, J. D. (2016). Standardization, racialization, languagelessness: Raciolinguistic ideologies across communicative contexts. *J. Linguist. Anthropol.* 26, 162–183. doi: 10.1111/jola.12116
- Saunders, L., and Wong, M. A. (2020). Critical pedagogy: challenging bias and creating inclusive classrooms, In *Instruction in libraries and information centers*, L. Saunders, and Wong, A. M. Champaign, IL: Windsor and Downs Press
- Solórzano, D. G., and Delgado-Bernal, D. (2001). Examining transformational resistance through a critical race and LatCrit theory framework: Chicana and Chicano students in an urban context. *Urban Educ.* 36, 308–342. doi: 10.1177/0042085901363002
- Solórzano, D. G., and Yosso, T. (2002). Critical race methodology: counter-storytelling as an analytical framework for education research. *Urban Educ.* 36, 308–342.
- Sorge, C., Newsom, H. E., and Hagerty, J. J. (2000). Fun is not enough: attitudes of Hispanic middle school students toward science and scientists. *Hisp. J. Behav. Sci.* 22, 332–345. doi: 10.1177/0739986300223004

- Stefancic, J. (1997). Latino and Latina critical theory: an annotated bibliography. *Calif. Law Rev.* 85, 1509–1584. doi: 10.2307/3481065
- Steinberg, S. L. (2004). Undocumented immigrants or illegal aliens? Southwestern media portrayals of Latino immigrants. *Humboldt J. Soc. Relat.* 28, 109–133.
- Tinnell, T. L., Ralston, P. A. S., Tretter, T. R., and Mills, M. E. (2019). Sustaining pedagogical change via faculty learning community. *Int. J. STEM Educ.* 6, 1–26. doi: 10.1186/s40594-019-0180-5
- Treisman, U. (1992). Studying students studying calculus: a look at the lives of minority mathematics students in college. *Coll. Math. J.* 23, 362–372. doi: 10.1080/07468342.1992.11973486
- Valdes, F. (1996). Foreword: Latina/o ethnicities, critical race theory, and post-identity politics in postmodern legal culture: from practices to possibilities\*. *Berkeley La Raza L.J.* 9, 1–32.
- Valdes, F., and Bender, S. W. (2021). *From critical legal theory to academic activism*. New York, NY: University Press
- Vale, R. D. (2013). The value of asking questions. *Mol. Biol. Cell* 24, 680–682. doi: 10.1091/mbc.e12-09-0660
- Valencia, R. R. (1997). *The evolution of deficit thinking educational thought and practice*. London, EN: Routledge.
- Valenzuela, A. (1999). *Subtractive schooling, caring relations, and social Capital in the Schooling of US-Mexican youth*. New York, NY: State University of New York Press.
- Walsh, C. E. (1992). Pedagogy and the struggle for voice: issues of language, power, and schooling for Puerto Ricans. *Am. J. Sociol.* 98, 433–435. doi: 10.1086/230037
- Wieman, C., and Gilbert, S. (2015). Taking a scientific approach to science education, part II—changing teaching: challenges remain before universities more widely adopt research-based approaches, despite their many benefits over lecture-based teaching. *Microbe Mag.* 10, 203–207. doi: 10.1128/microbe.10.203.1
- Wood, D. F. (2003). ABC of learning and teaching in medicine: problem based learning. *BMJ* 326, 328–330. doi: 10.1136/bmj.326.7384.328
- Woods, A., and Roig-Torres, T. (2018). Classroom norms: A strategy to connect with students. *J. Res. Pract. Coll. Teach.* 3, 126–131.
- Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethn. Educ.* 8, 69–91. doi: 10.1080/1361332052000341006
- Yosso, T. J. (2006). *Critical race Counterstories along the Chicana/Chicano educational pipeline*. New York, NY: Routledge.