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“A Tale of Two Classrooms”: Designing Culturally-Relevant Hip Hop Curriculum to Support STEM Identity of Underrepresented Students

Abstract

This article explores how educators can contribute to the development of STEM identity in historically marginalized groups by using critical frameworks and pedagogies like Funds of Knowledge and Critical Hip-Hop Pedagogy as a curricular tool to counter traditional teaching practices. The authors amplify the importance of cultural spaces that support educators in examining aspects of power, access, and cultural awareness in STEM classrooms to increase student participation and acquisition of STEM knowledge. This article provides a guided activity named “A tale of two citiez” as an example of how educators can act towards (re)conceptualizing and (re)imagining STEM classrooms.

Keywords

Funds of Knowledge, Critical Hip-Hop Pedagogies, STEM Identity Development, Teacher Education

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Introduction

Too often, identity development research on marginalized groups in science, technology, engineering and mathematics (STEM) fails to account for their lived experiences as students within the K-12 STEM classroom. Specifically, researchers often overlook the lack of support from teachers for marginalized students who are struggling to negotiate their positionality in K-12 STEM classrooms. This lack of support likely happens because STEM teachers receive little guidance during their teacher education process on how to support students' STEM identity development. When teachers teach science content in their classroom, they often fail to take into consideration the ways in which identity development for students from historically marginalized groups is shaped by the dominant school culture (Baszile, 2009).

Ignoring identity negatively impacts STEM students as teachers rarely consider the impact of acquisition of knowledge for students of color on their STEM identity development. Thus in practice systematically shifting students away from STEM courses, STEM majors in college, and ultimately high-paying STEM jobs that allow for social mobility and future adaptations. Students need opportunities to understand and learn STEM-related content in ways that are relevant to their lived experiences and academic needs. It is essential that classroom teachers have access to curricular tools that enable them to center and empower underrepresented students' STEM trajectories and promote healthy STEM identity development.

As educators, we must be willing to use a variety of critical pedagogies and frameworks that help us disrupt the historically white-Eurocentric norms of STEM classrooms. This shift requires teachers using innovative means to reconceptualize curriculum. By framing classroom experiences through a Funds of Knowledge (FOK) lens anchored in Critical Hip-Hop pedagogy, educators can capture how sociopolitical (e.g., power, race, and culture) contexts are understood in underrepresented communities and translate them into STEM classroom practices. In this article, we examine STEM identity development and critical pedagogies and offer curricular resources for teachers looking to support students of color to make sense of power dynamics in STEM classrooms. We hope to (re)vision and (re)conceptualize the movement of power from a different perspective, thus making it more possible for underrepresented students in STEM fields to understand the connection between their knowledge base and a healthy STEM identity.

STEM Identity Development

Children enter the STEM classroom holding a variety of identities. By defining identity as a construct variation, researchers have been able to better understand the nuanced and multifaceted ways in which identity is impacted by an external environment (Bishop, 2012; Simpson, 2018). Identity formation does not occur in silos but is co-constructed socially; as children enter classrooms their beliefs, use of skills and experiences can influence STEM identity development (Carlone & Johnson, 2007). Kim and her colleagues (2018) characterize STEM identity as socially based identity grounded in the extent to which individuals see themselves and are accepted as a member of a STEM discipline or field.

Other researchers have framed STEM identity development as a methodological tool, letting them analyze the construct from a perspective that includes classroom environments, learners' identification, and historical perspectives that challenge current understandings (Bishop, 2012; Carlone & Johnson, 2012; Kim et al., 2018) For instance, Carlone and Johnson (2007) described the construction of a STEM identity as recognizing oneself within the field as

well has having sufficient content knowledge and the ability to use proper tools relevant to the STEM field.

STEM identity development conducted in discipline-specific areas accounts for how learners' identities are shaped while encountering various educational topics important for students of color as it can positively impact participation and engagement in STEM learning environments. For example, in one case study (Conlin et al., n.d.), Estevan, an 8th grade student, began to better understand his STEM identity as a result of being in Ms. K's science classroom. Branded as "problematic" by other teachers he struggled with scientific content his peers more easily understood. Ms. K saw that Estevan had challenges in his classes and decided to change her approach with science content. She shored up his understanding of day and night through direct instruction by asking probing questions that required Estevan to make connections to phenomena. The questions that she asked probed Estevan to think more critically about content instead of trying to seek the correct answer. She recognized his epistemological beliefs and identity as useful for assisting him with unpacking science content. Ms. K created a classroom environment where Estevan's beliefs and experiences were considered important and valued. As a result, Estevan saw himself as a science learner and knower of science facts, which increased his engagement and participation in class. STEM identity is often overlooked in STEM courses and fostering a strong STEM identity is critical for success in STEM disciplines. This is especially true for students who look at the historical participants of STEM careers and do not see themselves reflected there.

By creating spaces for learners to bring cultural and linguistic knowledge into STEM learning environments, educators can assist students struggling to connect new science content to their existing background knowledge. In Bang and Medin (2010), researchers illustrated that when using epistemologies as cultural processes as a resource in the classroom, teachers can help with underrepresented students' sense making in science. In one example, a lesson on the ecosystem integrated both science knowledge and knowledge generated from the community. Prior to the study, students questioned their ecological knowledge on what it included in a forest? Students' knowledge was limited to using localized and cultural knowledge. Post-lesson, students were able to demonstrate more knowledge on the ecology within the forest to include specific trees, animals and plants. The findings from the study indicated that incorporating culturally and localized knowledge into classroom curriculum resulted in positive changes for students learning science. By reframing learning environments to integrate perspectives and views from a student's culture, teachers can create spaces that welcome non-dominant knowledge as a powerful tool to use for those who are struggling in science.

Meanwhile, other researchers have explored shifts in STEM identity development and how it is shaped and informed by race and gender (Archer et al., 2013; Carlone & Johnson, 2012; Godwin et al., 2016). These studies highlight the positionality associated with race and gender and how it can influence an individual's STEM identity. For example, Archer et al. (2013) concluded girls between 10-12 years of age saw science as masculine-centered and not valued as being feminine enough. These perspectives bound participants to strict gender norms that ultimately hindered their identity in the STEM classroom. Likewise, Collins (2018) uncovered the disparities that Black men and women scholars in STEM experience when trying to navigate spaces that shape their STEM identity development. Collins advocates for four essential components necessary to support in the development of a Black student STEM identity: reflective identity, competence/ability, value/interest, and assimilation.

In K-16 classrooms, the encouragement of STEM identity development for underrepresented groups has involved centering cultural beliefs and experiences. While there has been an increase in engagement and retention of scientific knowledge by students', constraints still exist in using appropriate resources that can align to both localized and cultural practices. To rectify tensions, science educators and teachers must be willing to use culturally centered pedagogies that counter oppressive views about STEM learners. We argue that these critical framework and pedagogies provide resources for science educators and teachers in encouraging STEM identity development for students of color.

Funds of Knowledge & Critical Hip-Hop Pedagogy

Funds of Knowledge (FOK) is a critical conceptual framework that was identified by Vélez-Ibáñez (1988) in his foundational text on the network and labor exchanges that occur within Latinx communities. Moll et al. (1990) defines FOK as historically accumulated and culturally developed bodies of knowledge and skills that are essential for household or individual functioning and well-being. This framework reminds us that children do not come *tabula rasa* to the classroom but carry with them values and cultural repertoires. Teachers can approach these in a positive frame to avoid enacting deficit-oriented instruction. In education settings, FOK methodologies have been used for instruction broadly (i.e., curriculum and pedagogy) as well as content-specific areas such as STEM (Civil, 2016; Kiyama, 2010; Llopart & Esteban-Guitart, 2017; Moje et al., 2004; Zipin, 2009). Llopart and Esteban-Guitart (2018) identified the successful application of FOK in educational settings as a way to: (a) improve the academic performance of students of color; (b) cultivate trust between teachers, students, and students' families; and (c) create curricular and instructional approaches that integrate a student's FOK into the classroom in such a way that empowers them and honors their lived experiences.

FOK, though, is not a panacea for helping students develop stronger STEM identities. Researchers have highlighted the tensions teachers experience when identifying and mobilizing students in classrooms (Carlone & Johnson, 2012; Rodriguez, 2013). For example, Subero et al. (2017) documented how, while educators see value in FOK as a culturally informed approach to teaching, they can struggle to create classroom spaces that support cultural practices. They also have a hard time using funds as an asset for marginalized students and not slipping into deficit and essentializing thinking about students' FOK.

Critical pedagogies such as FOK have been effective resource for classroom teachers to find connections between classroom content and students' beliefs and cultural values. While this practice can yield positive results there are external factors that impact teachers to include: (a) resistance in critical practices due to localized curricular alignment (i.e., district lesson plans); (b) teachers' assumption of a one-size-fits-all teaching approach for racial and cultural knowledge that can be applied across classroom content; and (c) lack of confidence in using multiple resources that implore sociohistorical perspectives and challenge students' current beliefs (Neri et al., 2019). It should be noted in using these approaches there is a possibility of "othering" students from non-traditional backgrounds that are struggling to develop a positive and inclusive STEM identity. Therefore, the use of these pedagogies draws strength in understanding and connecting with students' individual ways of knowing and intersectional identities, so a one size fits all is not appropriate context in using these pedagogies. Therefore, we must create adaptable roadmaps that use multiple critical practices in order for teachers to diversify curriculum and increase their confidence in using this practice for discipline-specific content areas such as

STEM. We argue using Critical Hip-Hop pedagogies along with Funds of Knowledge could facilitate a shift that integrates underrepresented learners' ways of knowing and increases their participation and communication in classroom spaces.

Hip-Hop is an expressive art as it uses forms such as rapping, cipher battles, dance, graffiti, and DJ-ing to authentically describe stories of struggle to triumph. As a culture, Hip-Hop is a genre that reflects the social and political plight of communities that are disenfranchised and underrepresented. Studies in using Hip-Hop education have focused on the creation of curricular tools that assist in making cultural connections to content for students (Akom, 2009; Hill & Petchauer, 2013; Rodríguez, 2009; Seiler, 2013). In extending the work, Critical Hip-Hop pedagogies (CHHP) are transformative in nature as they enable teachers to help learners challenge dominant and essentializing views of the stories of communities of color. Akom (2009) defines Critical Hip-Hop pedagogies (CHHP) differs compared to Hip-Hop education to include a focus of social justice to empower student to use their knowledge to address race, racism, and other intersectional forms of oppressions.

CHHP can be used as a powerful extension of Culturally Relevant Pedagogy (Ladson-Billings, 1992) and Culturally Responsive Teaching (Gay, 1975, 1980), two frameworks that have gone a long way to infuse cultural awareness into curriculum and more explicitly meet the needs of diverse student populations. One of the challenges teachers encounter when using these culturally relevant educational approaches is the difficulty in addressing sociopolitical issues and power dynamics (Neri et al., 2019). The CHHP framework centers on engaging students in critical dialogue around connections between power and class. In doing this, it provides an underpinning for dialogue on students' perspectives of social, economic and political influence on overall society (Kelly, 2013; Rodríguez, 2009; Williams, 2009).

Other studies have highlighted the ways CHHP can capture how oppression and power are shaped in underrepresented communities and perpetuated unknowingly by STEM teachers' practices (Emdin, 2010; Emdin & Adjapong, 2015). Certain aspects of CHHP have been integrated into STEM curriculum as a way to increase student engagement. For example, Emdin and Adjapong (2015) documented how embedding Hip-Hop in the curriculum increased students' engagement and understanding of the content. The practice they embedded positioned students as co-teachers, with their instructor acting as the MC (master of ceremonies). They used call and response as means to assist others in understanding the content. Students reported feeling more empowered and could more easily explain how the content connected to their own lives. We built on Adjapong and Emdin's work to design the activity described in this article and argue that using Hip-Hop as a culturally informed teaching strategy for understanding science can support students in the process of critiquing power dynamics and making powerful connections between science content and their funds of knowledge. When educators use culturally centered frameworks to inform their teaching practice, students can make connections beyond superficial understandings of topic specific content.

Creating Cultural Spaces for STEM

Capital theories expose how white students are privileged as the preferred curators of knowledge, devaluing and excluding marginalized communities in the process (Apple & King, 1977; Rios-Aguilar et al., 2011). This has been observed in STEM classroom spaces where teachers access curriculum that promote hegemonic narratives that privileges knowledge from white and affluent student populations. Too often lack of Black and Brown students' funds of knowledge are not

recognized or valued in the same way as the capital of their white peers, thus leading to STEM classroom spaces that do not support Black and Brown students and contribute to their development of an internally oppressive mindset about their ability to understand and learn STEM content.

When educators do not understand the diverse STEM identities and forms of participation of minoritized students, they fail to recognize students' funds of knowledge as a resource to curriculum knowledge. Lacking a healthy STEM identity development can have damaging effects on students of color. It's imperative that we find tools that help to reconcile how power is mediated in institutionalized spaces (i.e. STEM spaces) and afford students of color strategies and practices to counter these power dynamics in their academic matriculation. We believe that teachers need curricular tools that attend to marginalized communities' understandings of how to mobilize their funds of knowledge to leverage power within science classrooms. These tools can be infused into the classroom to develop cultural spaces of hope that empower students' development of a healthy STEM identity. It is imperative that we create spaces where students can express themselves and learn to mobilize their funds of knowledge to promote their learning and persistence in STEM environments.

When navigating oppressive institutions, like schools, minoritized students can struggle to identify and activate their FOK in ways that support the advancement of their academic trajectories. To support students in this process, educators need to (re)imagine the types of resources that can be used to foster agency and voice of their minoritized students. In the creation of educational spaces that honor and integrate students' FOK, teachers need resources to design and implement teaching and learning that centers the voices of students that have historically been silenced. We argue that the creation of curricular tools should contain artifacts that students can easily identify from within their cultural repositories. Such tools can be created by using critical hip-hop pedagogy to activate and mobilize students' FOK for STEM learning, allowing students to leverage their FOK as part of discursive practice within the classroom. In doing this, it could address disparities and shift from a culture of deficit thinking to social change that values the FOK of underrepresented groups. The development of such STEM counter spaces can lead to future research that enhances sociocultural understandings and supports more robust STEM identity development for students.

Example Guided Activity: “A Tale of 2 Citiez”

Designing FOK and CHHP-informed curriculum for the STEM classroom that supports the development of students' positive STEM identity is a process shaped by localized practices, knowledge, and culture. The example activity described below, based on the song “A Tale of 2 Citiez,” was designed for a classroom teacher to understand students' interests and FOK. More specifically, a teacher would use Aldridge's (2005) notion of “imaging,” which invokes the use of symbols, images, events, and people to enact past lived experiences that could assist with present ideas.

1. “A Tale of 2 Citiez” is an identity artifact that uses the rhythmic flow similar to hip hop cipher. In the introduction of the artifact, the teacher explains the connection between the activity and the science content goals, so students understand the purpose behind using this culturally informed tool.

2. The teacher begins with a definition of the construct of power and the ways in which it is mediated and used in different spaces (e.g., individuals, families, and communities). Then, the teacher asks students to define power and give examples of it in their own lives. In small groups, students discuss why having “power” is important in certain communities. Then as a whole class, students discuss the impact of power on those who do not possess it.
3. Next, the teacher uses an excerpt of lyrics from J. Cole's “A Tale of 2 Citiez” to show how words can express power through a different lens. By doing this, it affirms for students that Hip-Hop is a genre of music that lyrically tells the story of those who are typically silenced or overlooked. The teacher provides the following explanation to students: “The artist J. Cole tells a story within the song from the other side of the track and the tension associated with trying to choose the correct path but having to deal being poor.” (Note: J. Cole’s song is used due to the vivid narration throughout. The teacher can use hip-hop from other decades such as Public Enemy’s “Fight the Power,” “Rhapsody,” or “Power”.)
4. The teacher leads students through direct instruction on how to do research on scientific topics and give students time to research similar topics where power is mediated and used within educational contexts, particularly in science (e.g., eugenics in America, environmental injustice). The goal reflects the concept of power and how it's been perpetuated within society and in science. The teachers asks questions concerning who had the power and the impact globally. How were different communities influenced by power/society?
5. Allow students to find hip-hop lyrics they identify with and that contain experiences of power. Finally, ask students to share these lyrics within a cipher format and provide an explanation for their choice. During this portion of using the curricular tool, the teacher asks students if they could relate their songs to experiences of power in STEM classrooms. Many students understand that hip-hop is a genre of music that is lyrical, which supports them in finding their voice and telling their own authentic story.

Discussion

Schooling in America has typically been framed by white Western European perspectives, and this thinking has been (re)produced by institutions like schools as the normative standard. Education systems need alternatives that embrace culturally enriched knowledge as the standard. This shift can only occur if the funds of knowledge of minoritized students are honored and integrated into curriculum and pedagogy. Here, teachers and educators need strategies and tools to build trust and respect with students and develop learning spaces in which students can feel empowered to mobilize their funds of knowledge to make connections with content and address sociopolitical issues. In STEM classrooms, the use of the curricular tool “A Tale of 2 Citiez” can support teachers in the process of integrating student's local knowledge and practices to drive the content-specific instruction. We recognize that dependent on factors of context, teachers might lack the confidence and knowhow needed to use the curricular tool effectively. Therefore, professional development should be coupled with the tool to provide support for educators attempting to implement these practices in their classrooms.

STEM identity development is fluid and requires educators to critically reflect upon and design ways to address the misalignment between the STEM identity development of students of

color and the traditional western-style STEM curriculum. The “A Tale of 2 Citiez” tool could support teachers’ efforts to decolonize STEM curriculum and identify, over time, the instances in which students’ of color STEM identity construction take shape. Educators need to be able to identify accurately where identity development around STEM content happens in order to support students in the process of developing a more healthy STEM identity and connecting their funds of knowledge to STEM content. Further research on the implementation affordances and challenges of using this tool will be needed to improve its design and support educators in using it as a way to gather students’ FOK, support students’ in making connections between their worlds and STEM content, and measure the growth in students’ STEM identity development.

The mere use of a lone activity that incorporates students’ FOK into STEM learning does not by default constitute a transformation of power and positive STEM identity formation. Rios Aguilar et al. (2011) reminds us of the levels of power within institutional spaces; just because we expose students to tools that could assist them in STEM spaces does not always mean students will know how to activate their FOK to connect to STEM content or to address issues facing their lives and communities. As the rate of exchange for the cultural knowledge and practices of students of color changes, so will their value. As educators, we must create spaces where students feel empowered, confident, and valued enough to recognize and confront power dynamics that they encounter along their STEM trajectories.

Conclusion

As educational systems look for ways to engage and retain underrepresented communities in STEM majors, we must think carefully about how young people form their understanding of who does science or who is allowed to study the world around them. By doing activities like the one described here, teachers can use critical pedagogies and frameworks to reveal intersections of power within STEM classrooms towards supporting the STEM identity development of historically marginalized students. The tool presented in this paper, “A Tale of 2 Citiez”—grounded in FOK and CHHP frameworks—is just a start. It is hopeful that teachers and administrators will use this tool as both a curricular and pedagogical support in STEM classrooms, but also use it to design new critical tools and strategies for integrating the FOK of students of color in STEM content. Students deserve learning spaces shaped by the work of practitioners and researchers who think critically about how culturally relevant pedagogy can support STEM learning and identity development. Finally, activities like “A Tale of 2 Citiez” can aid in the creation of new narratives that will help the field of teacher education develop a new perspective on what it means for all students to have a positive STEM identity.

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