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Hip-hop based interventions as pedagogy/therapy in STEM
A model from urban science education

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Abstract

Purpose – This paper aims to argue that providing youth of color with opportunities to explore content while reflecting on and sharing mental health concerns is an under-focused dimension of teaching and learning that has the potential to positively impact these students' academic achievement in science, technology, engineering and mathematics (STEM) disciplines

Design/methodology/approach – This paper used a qualitative study to interrogate a teaching/learning model through a hip-hop-based science program.

Findings – Because urban youth of color are traditionally most disengaged in STEM and also the ones who are the least likely to seek or be provided with mental health tools/services, it is suggested that there is a connection between their low academic achievement and the absence of opportunities for them to address emotions that impact their academic success. Furthermore, if these youths come from communities where mental health stressors are highly prevalent, and teaching is most restrictive, a model for teaching that considers practices that address both their academic and mental health needs becomes necessary.

Research limitations/implications – This work does not intend to devalue or undermine the role of school counselors or traditional teachers. It is believed that the role of the school counselor or social worker when youths identify themes that go beyond the scope of personal challenges is significant and that these professionals should be made available when engaging in this type of work. It is also believed that the educator who may not be privy to hip-hop can successfully engage in this type of activity with STEM students. Finally, the use of science as an exemplar for engaging in this work does not indicate that the other STEM disciplines cannot or should not explore this type of model.

Practical implications – The paper outlines a model that other educators/researchers may use and suggests ways that this brand of research may be implemented by scholars across the country.

Social implications – Through the implementation of the hip-hop-based science program as an intervention in science classrooms, students are provided the opportunity to bolster science content knowledge and knowledge of self. In addition, utilizing the hip-hop-based science program created an avenue for teachers to develop better understanding of students and their full socioemotional selves. This is especially necessary in STEM education where perceptions of students' decisions to not engage in the disciplines are directly related to our collective unwillingness to present the subject matter in a way that goes beyond the glorification of its stoic and "old white" history.

Originality/value – This paper suggests a new dimension of STEM research through an exploration of hip-hop culture and youth emotions.

Keywords STEM, Mental health, Equity

Paper type Research paper

Introduction

> I started feeling every single word that I was saying. I didn't mean to cry. I was trying hard not to, but it just got a hold of me and I broke out [crying]. I'm not mad that I cried because I felt like I was able to release everything I was feeling […]. I was able to show what I learned in science and release so many emotions that I was feeling and that were bottled up inside for so long".
> -Vicki, Compass High School

In the quote above, a high school student explains how performing a science-themed rap to an audience of strangers served as a powerful emotional outlet. While the power of this moment is vividly captured in the quote, what is novel about this emotional release is that it was not performed at a poetry slam or counseling session, but at an event that was part of a classroom project that involved the writing and performing of a hip-hop song about science. In this paper, we explore the power of classroom tasks/activities aimed at engaging in and with rigorous science content by providing urban youth from diverse backgrounds with powerful opportunities to discuss, reflect on and express emotions concurrently with learning science. More specifically, we argue that a hip-hop-based science program, when used as an intervention in classrooms where urban youth of color are disengaged, supports the creation of classroom spaces that make it easier for these youths to express their emotions and consequently be more prepared to engage in academic work. These arguments are based on the assertion that if the negative emotions that youths experience related to both their life experiences and their science, technology, engineering and mathematics (STEM) classes are unresolved (as they traditionally are), barriers to academic success get created. These emotions range from test anxiety to lack of confidence and self-doubt and have a deleterious effect on academic achievement. Consequently, we argue that if youths have negative emotions surrounding their ability to be successful in STEM, or have negative emotions about STEM assessments they have to take, they will not be as academically successful in these disciplines as they could be if these issues were addressed. In essence, young people who bring self-doubt about their abilities to engage in science to the classroom, or who are overwhelmed by anxiety about their academic performance in STEM disciplines, inevitably underperform in these disciplines. Furthermore, young people of color are most likely to experience these emotions because of biases about their intellectual ability and academic capability. Such biases negatively affect what Bandura (1977) referred to as self-efficacy, which is defined as one's ability to see oneself completing a task or set of tasks.

Hossain and Robinson's (2012) report that the USA is falling behind other countries in terms of student performance in both mathematics and science. Reports show that STEM occupations are projected to grow by 17 per cent from 2008 to 2018, compared to 9.8 per cent growth for non-STEM occupations (Langdon *et al.*, 2011; Olson and Riordan, 2012). Furthermore, African-American students' interest in STEM has decreased significantly and is now lower than for any other ethnic group and is expected to remain low during the coming years (Munce and Fraser, 2012). Much literature suggests that young people from urban environments are less likely to engage in STEM (Blustein *et al.*, 2013). These same young people are significantly less likely to be provided with mental health care or viable emotional outlets in comparison with White and more affluent youth (Holm-Hansen, 2006). Even when mental health care is provided, disparities are evident in terms of the quality and completion of those services (Holm-Hansen, 2006). Furthermore, researchers who study the impact of neighborhood on mental health find that urban neighborhoods are at a disadvantage when it comes to social and economic resources and are overrepresented when it comes to levels of

physical and social disorders (Sampson *et al.*, 1997). In addition, youths from urban neighborhoods are more likely to have their academic abilities measured solely by tests even though these students are more likely to experience anxiety around their test taking. These are the youths who are most victimized by the fact that "we live in a test-conscious, test-giving culture in which the lives of people are in part determined by their test performance (Sarason *et al.*, 1960, p. 26).

Stockdale *et al.* (2007) describe urban neighborhoods as having social structures that create stress and trigger stressors. These stressors often result in lower levels of trust and higher levels of social isolation (Dempsey, 2002; Ross *et al.* 2000). We argue that the effects of these stressors are brought into the classroom. STEM educators have identified lack of trust in teachers, and social isolation as attributes that are brought into the classroom and negatively impact the development of science identities and success in science (Emdin, 2010). In addition, the stress one encounters in urban neighborhoods has been linked to increases in the likelihood of depression, anxiety, and psychological distress (Latkin and Curry, 2003; Ross and Jang, 2000; Aneshensel and Sucoff, 1996), which inevitably affect academic performance (Andrews and Wilding, 2004).

Given that urban youths of color come from communities where mental health stressors are most prevalent and that these youths are less likely to receive adequate counseling/therapy services, it is imperative that we consider a model for teaching that considers practices/activities in classrooms that address both the academic and mental health needs/stressors of young people. We suggest that this type of pedagogy should reflect the culture of young people and give them an opportunity to give voice to their emotions. In particular, we suggest a focus on the use of a hip-hop-based science program in urban classrooms. We suggest that the academic needs of a population cannot be fully addressed if educators are not equipped to create spaces within classrooms where emotional needs are addressed. We argue that hip-hop provides such spaces because of the ways in which it captures the imaginations of a wide array of urban youths of color from diverse places of origin (Chang, 2007).

The science program that this paper is based on is rooted in an approach to teaching and learning called reality pedagogy (RP) that uses the realities of youth experiences and the concomitant emotions that accompany them as the anchor of instruction (Emdin, 2011; Adjapong and Emdin, 2015) In this paper, RP is merged with hip-hop and spoken word therapy (HHSWT; Levy, 2012). RP and HHSWT are both connected to hip-hop because of the immense potential it has to engage diverse groups that may be previously disconnected from each other into dialogue. RP uses hip-hop to engage youths in STEM, and HHSWT uses it to help them write poetry about issues that affect their lives. Merging these approaches supports these youths in addressing mental health issues that affect their STEM achievement. The combining of these two approaches is important because STEM subjects are most likely to elicit a bevy of negative emotions that range from fear to inadequacy (Humphrey and Hourcade, 2010; Tobias, 1978), and urban youths of color are less likely to be provided with mental health care/strategies to deal with negative emotions in comparison to students from other backgrounds (Holm-Hansen, 2006). If urban youths of color who are most likely to create and consume hip-hop can use it as a way of expressing their brilliance and releasing their frustrations about the world (Stovall, 2006; Morrell. and Duncan-Andrade, 2002), we argue that it can and should be a tool for STEM teaching and learning. Consequently,

this study applies hip-hop and its ability to engage youths of color with school to the goal of creating new educational spaces that engage youths in science.

RP emphasizes the significance of bringing youth realities into the classroom. In this study, it involved implementing teaching strategies that fostered exchanges between the teacher and the students around how the students felt about the classroom and created opportunities for youths to take the helm of classroom instruction by teaching science concepts to each other (Emdin, 2016). More specifically, RP involves teachers:

- engaging in conversations with youths about their challenges with their teachers' instruction;
- having students take the helm of classroom instruction even if they struggle with content;
- building a classroom community that fosters collaboration; and
- connecting the content being taught with students' everyday lives in their local neighborhoods.

When combined with HHSWT, the approach emphasizes giving youth opportunities to use hip-hop as the chief tool for sharing emotions and addressing emotional themes that emerge from RP, and that would otherwise go unaddressed (Levy, 2012).

Conceptual framework

In this paper, we use the concept of third space as a framework for making sense of what happens when RP and HHSWT come together in STEM classrooms. We see the spaces created when they converge as locations of transformation (Humphrey. and Hourcade, 2010; Bhabha, 1994). More specifically, we see the merging of the "first space" of traditional STEM education and the "second space" of mental health/counseling to create a third space where urban youths can release tensions that result from trauma they experience (Ross *et al.*, 2000). This coupling of spaces allows for a type of hybridity where students' emotions that are not traditionally addressed in the classroom become voiced, and science content that students may not engage in/with can be researched and studied. Students are at an increased likelihood of struggling academically when teachers find themselves unable to address student emotions effectively (Marzano *et al.*, 2003). Using hip-hop has been demonstrated to heighten emotional awareness (Perry, 2004). We see a hip-hop-based STEM class intervention as a trigger for what Bhabha (1994) describes as nonphysical locations where concepts converge to "initiate(s) new signs of identity, and innovative sites of collaboration" (Bhabha, 1994, p. 1).

Hip-hop becomes the facilitator for the creation of third spaces for youth embedded in the hip-hop culture and provides a space where the acquisition of academic content knowledge and the attainment of emotional well-being come together. Hip-hop represents politically silenced voices in contemporary America, and the process of writing/creating hip-hop music (rap) harnesses the voices of these populations to help them make sense of their everyday experiences and solve their own problems (Perry, 2004). Unbeknownst to youths who engage in hip-hop and struggle in STEM:

A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning (National Research Council, 1996, p. 9).

Hip-hop, in many ways, does the same things that science intends to do. Creating hybrid third spaces where hip-hop is allowed to fulfill its potential for education and mental health only serves to improve opportunities for engaging in STEM for urban youth of color.

Method

Science genius

In this study, a hip-hop-themed science program served as an intervention for disengaged youth in science classes through rap. The program involved writing and performing science content-themed raps and engaging in a competition/battle to showcase what was written. The program was implemented in ten urban public high schools and was launched in low-income communities in a densely populated northeastern city in the USA. Students who participated in the hip-hop-based science program were high school students of various ethnic backgrounds who were largely of Latino/a and African-American descent. All participating youths reported that they listened to, wrote or engaged in hip-hop music or one of its elements (e.g. b-boying, dj-ing, tagging/graffiti, MCing/rapping).

Participating schools were selected based on historical underperformance of students in science, lack of success with engaging students in STEM (specifically science), willingness to explore an innovative approach to addressing the aforementioned issues and low socioeconomic status of the student body. Each school had at least one dedicated science educator committed to implementing the program in their science classroom and in each participating school. The science teacher dedicated at least one science period per week to the program – allowing students to craft science-themed raps based on science content being taught by the teacher. Participating teachers were provided with a guide that outlined the elements of hip-hop and ways to include its five elements (graffiti art, MCing, breaking, dj-ing and knowledge of self) into the science classroom. Over the course of the academic semester, students were asked to write raps and/or spoken word poems around the science content that they were studying in their classes. In addition to providing a class period per week for students to work on their raps, teachers served as science content experts to students as they wrote their raps. Students were encouraged to make connections between the science raps they were writing and their lived experiences, and students were encouraged to continue working on their raps and poems even after they left the classroom.

The program concluded for all participants across schools at the end of the academic semester, with a culminating event where each participating school sent a student who was selected by their peers to represent their school in a rap competition/battle where they performed their rap, which was judged by working scientists and established rappers on its overall quality and science content. Students were assessed by the judges based on criteria that included connections to lived and emotional experiences, the song's ability to capture an audience and the depth/quality of the science content. Each student from the ten participating schools performed their rap/poem, and after all performances, judges selected a winner of the event.

During this time, students also sat for statewide science examinations in the sciences and used the raps that were created as an opportunity to study for topics that they needed additional help with. A few weeks after the examination, the competition/battle was hosted on a university campus and was well attended by an audience that included

STEM experts/professionals, students from participating schools, family members of performing students, educators, musicians and community members. After the event, the students shared their comfort with the exam, their confidence with the subject matter and their belief that they did well on the exam. This was a marked difference from the negative emotions expressed previously.

Participants. While participants in the larger program included students across ten urban public high schools, the three participants in this study were high school students who were selected by their peers to represent their schools in the final BATTLE/competition. Each student was enrolled in a science class as a part of their graduation sequence (e.g. biology, earth science, chemistry) and was selected based on their initial disinterest in the main activity and subsequent active participation which led to their being selected as representatives of their respective schools at the final competition.

Data collection
The primary data sources for this study were student one-on-one interviews and the lyrics from students' science-themed raps. Secondary sources included field notes and observations of students both prior to and after the competition. All student interviews and lyrics were transcribed in their entirety.

Interviews
High school students who participated in the hip-hop-based science program were interviewed about their academic and emotional experiences while participating in one science class weekly, and then also at the end of the competition. The goal of the interviews was to understand the impact that the hip-hop-based science program had on students' lives and science identities. Among the questions asked during the interviews, the following questions were particularly significant for this study:

- What analogies did you use in your rap?
- While you were writing and while you were on stage and interacting with the crowd, what emotions were you experiencing?
- Do you think the Science Genius Rap Program has changed your perception of science?

Science-themed raps
All students who participated in the hip-hop-based science program completed the task of writing and performing science-themed raps in school. Each rap focused on the science content that was being studied in their respective science classrooms during the duration of the program. In many cases, students had multiple versions of the same raps that they had reviewed and improved upon over time. All students' science-themed raps were collected as artifacts for this study and analyzed for students' connections between science content and their lived and emotional experiences. Students' science-themed raps were also analyzed and coded for recurring themes.

Data analysis
Different data analysis strategies were used to efficiently and effectively analyze data collected during this study. Interviews were transcribed, as were science-themed raps of

selected students. These data were then studied for exemplars of how students used the hip-hop-based science program as an emotional outlet and as a learning tool.

Qualitative coding techniques, including member checking and coding for recurring themes, were used to analyze all the data generated from this study (Creswell, 2013; Guba and Lincoln, 1989). All interview and science-themed rap data were entered into a Word document for word-by-word coding and grouping into initial categories. These categories included types of content covered in the raps and general science themes addressed. Once categories were identified, the data were entered into Nvivo to be organized and grouped into recurring themes. The three themes that emerged from data analysis were:

(1) students disclosed emotion through the hip-hop-based intervention;

(2) students acquired substantial knowledge of content through the hip-hop-based intervention as evidenced through the content of their raps; and

(3) students used emotion and science content to reframe their science identity/ perceptions of science through the hip-hop-based intervention.

As a result of the emergence of these themes, student lyrics that spoke to personal struggles, life experiences or were self-reflective in nature fell under the theme of *students disclosed emotion through hip-hop-based intervention*. Writing that explained scientific concepts, either by applying them to their own life experiences or by merely discussing the inner workings of scientific concepts themselves fell under the theme of *students acquired knowledge of content through hip-hop-based intervention*. Finally, lyrics that used scientific language to explain a life event and drew conclusions about their life or their role as scientists fit under the theme of *students used emotion and science content to reframe identity through hip-hop-based intervention*.

In the data analysis, we examined as many artifacts as were available from all students who were the focus of the larger study. Through coding and the analysis of the lyrics of the science-theme raps from the three students who are the focus of this particular study, we noticed that each of the students used their science-themed raps as a way to explore each of the three themes identified in the previous paragraph.

Vicki

In her science-themed rap, Vicki made an explicit comparison between the processes that food undergoes as it travels through the digestive system and teenage heartbreak. Through her science-themed rap, she showcased knowledge of content but also shared an inner conflict that she found overwhelming. Throughout the verse, she discussed themes like pride, love and loss but also the ways she dealt with these emotions. Particularly significant in Vicki's lyrics are her visceral reactions to the lyrics themselves and the emotion with which she delivers them. An example of her lyrics that had particular emotional value were:

> […] and so it remained till teenage curses and high school potions got a hold of me/and HE got a hold of me/that's when the battle took over me.

The lyrics above speak to the loss of control that Vicki felt in an unsuccessful relationship with a young man who attended her school. Through an analysis of these lyrics, Vicki showcased a high level of emotional awareness and in many ways was healing as she wrote and performed the lyrics. In her lyrics, Vicki spoke to "teenage

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curses and high school potions" and "HE" (her ex-boyfriend) gaining control over her. The "battle" that Vicki describes is for her pride and self-confidence and is the chief focus covered in this part of her rap. By having the space to express her emotions about this emotional battle, Vicki brought an aspect of her true self to the science classroom and then made connections between her personal battle and science content through her lyrics:

> My teeth and my tongue are partners in the battle/fighting armed with saliva and other special chemicals/Drenched in sweat because more pride meant more ammo.

In the lyrics above (that followed the first lyrics quoted in this section), Vicki took on the concept of digestion and discussed how scientific and emotional processes were similar. As she described the complex relationship between teeth and tongue as they battle food to activate digestion, she connected this to the relationship between "teenage crushes and high school potions" as they battle for her pride. She also described the way that teeth and tongue require saliva to break down food during the process of digestion. By mentioning how she was "fighting armed with saliva and other special chemicals" and "drenched in sweat because more pride meant more ammo", Vicki was comparing the major part saliva plays in digestion to the major part sweat plays in a physical battle/ activity. She described an emotional battle over one's sense of pride and then extended this theme to a conversation about the expression "swallowing your pride". She then used that expression to describe the processes of digestion:

> Pride vs small intestine/
>
> Pride versus Protease to finish off the protein/
>
> Pride vs Lipase devouring every last oil every last fat/
>
> Pride vs Maltase vs Sucrase eating up every form of sugar/
>
> A Pride that was almost dead stood up for every last bit of confidence.

In her lyrics, Vicki was able to "regain her pride" and confront feelings of being trapped, or lacking control. As she led toward "A Pride that was almost dead" that "stood up for every last bit of confidence", she described the various enzymes, which aid the process of digestion, and made a powerful connection between her lived experiences and science content. When she was interviewed about the analogies she used in her rap, she stated:

> […] pride versus protease of the protein because protease is the enzyme that breaks down protein and pride versus lipase devouring every last oil and every last fat because lipase breaks down oils and fats […]. I felt like that was a really good analogy to use because it shows how things break down in your body and what works on what in order to digest food, or in this case digest pride.

When Vicki decoded her science-themed rap, she explained that the enzymes that "break down" protein in the digestive system "devoured" her in the same ways they break down food. Lastly, in an interview with Vicki after she performed her rap in front of hundreds of people at the culminating event, she stated the following:

> When I performed, I actually end[ed] up crying at the end of my performance […]. I started feeling the emotions. I started feeling every single word that I was saying. I didn't mean to cry.

I was trying hard not to, but it just got a hold of me, and I broke out. I felt like I was able to release everything I was feeling because I don't cry often […]. I was able to release so many emotions that I was feeling and that were bottled up inside for so long.

As she explained how writing and performing her science-themed rap caused her to cry, and as she described that she "does not cry often", she alluded to the ways that the process served as a powerful emotional outlet. We argue that through this hip-hop-based intervention, Vicki was provided with a therapeutic outlet to release latent stress/trauma and "[…] so many emotions that […] were bottled up inside for so long" while acquiring science content knowledge. We argue that without first having the third space in the classroom to speak to a situation that was causing her stress, Vicki may not have been able to reach a more secure emotional state or develop such complex knowledge of the digestive system.

Erika

The second science-themed rap we discuss was written by a student named Erika who used the rap as an opportunity to share feelings of anger and confusion about being misunderstood and minimized by the world she is growing up in. Having been viewed as not having the academic ability to do well in science, she chose to create a science-themed rap that showcased her content knowledge while concurrently challenging the ways that she had been stereotyped. Erika rapped:

Why can't I be a rapper, also be a genius too/Don't know how this rumor started, what a misconception too.

Through these lyrics, Erika spoke not only to her own feelings of being confused about popular beliefs surrounding her capabilities, but also about what she described as "people not even thinking that rappers are smart". Through her lyrics, she challenged societal misperceptions of young people of color and as she discussed in her interview, gender stereotypes about a girl being a rapper. In these short lyrics, she uncovered a powerful dynamic in STEM education related to how young people see themselves based on how society sees them. As she asserted herself confidently in her rap, she boldly challenged the way that she was viewed as a female, a rapper and an intellectual. She expressed vulnerability as she rapped:

[…] worry that I might not make it/something that I contemplate/with all the odds against me.

In the quote above, she described the self-doubt that comes with being painted into a box by society. She concurrently addressed "all the odds" that are against her. However, these lines served as an anchor for a powerful pivot through which she shares lyrics that combat societal perceptions and also serve as a self-motivator:

I'd like to call myself, a talking multicellular/a complex organism, something mutant and irregular.

The lyric above begins to showcase Erika's use of the science rap as a tool for self-affirmation. She embraced her role as "irregular" yet "complex" and began to make connections to the science content that she was responsible for learning. In her biology class, the main themes of the first semester revolved around characteristics of various organisms and their cellular and genetic makeup. Rather than study or learn these topics through the traditional method of memorizing definitions, Erika embedded herself in the content and defined *herself* though the vocabulary words she was expected to know.

Rather than describing a multicellular organism as one that has many cells, she called herself one. She also does not define a mutation as an alteration of the nucleotide sequence of the genome of an organism, but makes a comparison between the nucleotide sequence and societal perceptions about her. In addition, she compared her presence as a rapper and scientist as a mutation to societal narratives. In her interview, when asked to explain her lyrics in more depth, Erika said:

> I like to call myself different because there's no one like me […]. So let me be different, and most of all don't try and change me because everything I do/did is all part of the path paved out, which some people will never understand.

Erika's participation in the project allowed her a unique opportunity to speak back against the very worries and fears that would have prevented her from being able to see herself as an intellectual and allowed her to gain complex science knowledge. When interviewed about her lyrics, she consistently elaborated on the nuances of the science in her lyrics and how they went beyond what the teacher wanted students to cover. Erika represents the many students who feel they are not offered an opportunity to fully explore their scientific selves and who then choose not to engage in STEM because they have been told for very long that it is outside of their intellectual reach. Through the hip-hop-based science program, Erika began to identify herself as a scientist and subsequently applied for and took a job working in a science museum after being a part of the program.

Jalib

Jalib, the last of the three students who are the focus of this paper, composed a track which covered his thoughts and feelings around overcoming obstacles and striving to meet his goals through an exploration of physics concepts related to kinematics. In particular, he explained the concepts of work, force, distance and energy and connected the equation for work (work = force × distance) to the ways that he was able to, or would like to, overcome his personal obstacles. He opened his song with the line:

> This concept is applied to all lives/
>
> We stride times distance; I'll let you be a witness to the prize/
>
> Be a man, understand you comprehending this is vital/
>
> Work = FD. The equation for survival.

In the quote above, Jalib made powerful connections between having to work (engage in physical activity) and the scientific concept of work and the formula that guides it. Furthermore, he connected the daily "stride" to the physics concept of force by comparing "stride times distance" to the formula, force times distance. He described work (in the sense of labor or physical activity) as being "the equation for survival" just as the scientific formula (force × distance) is necessary for understanding the concept of work in physics. As he described his "equation for survival" that could be "applied to all lives", he engaged in the same type of self-affirmation work and speaking for/to a larger population than Erika did in her raps. His rap spoke directly to an audience that he hoped would be " […] witness to the prize" of hard work. He then went on to suggest:

Your only rival is friction don't get caught up in the drag/

So you better prepare cuz obstacles fight back/

When you get knocked down though don't please don't cry/

[…] just get up and apply more force next time.

In these lyrics, Jalib continued to explore the connections between his lived experience and physics concepts. He compared the concept of friction to a competitor who wants to push one away from one's goals or stands as an obstacle and began to articulate more about what he identified as his "equation for survival". The lyrics Jalib wrote and performed indicated that he was keenly aware of an as-yet-unnamed fear that he was convincing himself he could overcome if he would "just get up and apply more force next time". As he continued with his rap, he named this fear or obstacle and offered profound insight into the psyche of young people in STEM classrooms. He wrote:

Force times distance, is work no debate/

I'll take that concept apply it to my mistakes/

[…] and now I'm progressing a natural Rap Genius/

[…] and I'ma get an A if I see this on the regents.

At this point, he named the Regents (a state-standardized examination and requirement for high school graduation) as the seemingly insurmountable obstacle that his equation was directed at overcoming. The rap then became a science content-driven song that served as a way to deal with the stress and emotion of the examination. He was writing the song to convince himself that he could be successful on the exam and in many ways used the assignment as a tool for exploring ways to overcome challenges. In his science-themed rap, Jalib outlined themes for marginalized youth that traditional STEM education research has failed to focus on – building a belief in self around challenging content areas, understanding that making mistakes is part of the process of learning, learning from mistakes and putting in effort to face challenges and visualizing success even before engaging in a challenging task. Following the lyrics where he stated, "I'll take that concept apply it to my mistakes" and "I'ma get an A if I see this on the regents", he concluded with a powerful example of mental health strategies that are facilitated through hip-hop and that concurrently helped him learn/explore the science content required for better understanding of physics. On this Regents exam, when he did take it, he scored higher than a large percentage of his peers and other students across the city. We argue that his success on the traditional assessment was partly because of his positive emotions surrounding the subject and the exam itself spurred on by the hip-hop-based practices implemented in the classroom.

Discussion
In this paper, we explore the importance of creating "third spaces" within STEM classrooms that allow for academic content to be covered while marginalized youth are concurrently provided with tools for giving voice to their emotions and facilitating their

own mental health. The study used RP and HHSWT through the assignment of a task that allowed youths to share their realities and use them to explore science content without sacrificing the level of rigor of the content or placing boundaries on the ways they chose to make connections to their real lives and emotions in the classroom. Through the analysis of students' lyrics and interviews, we saw improvement in each of the students in terms of their ability to:

- disclose emotion through the hip-hop-based intervention;
- acquire knowledge of STEM content through the hip-hop-based intervention; and
- use emotion and science content to reframe identity through the hip-hop-based intervention.

Through lyric writing, all students explored their own emotional experiences and provided coping strategies for themselves and others. The researchers identified various types of emotion through the science-themed raps and assessed the content knowledge of the students. For example, Vicki was able to detail the process of losing and regaining her pride while making distinct comparisons between her emotions and science content. By allowing Vicki to write a science-based rap, she was provided an outlet to express her emotions, which included anger and frustration. By having the space to disclose that emotional experience, Vicki was afforded an opportunity to merge the first space (science content acquired while in the classroom) and the second space (her emotional experience) to enter a third space where she could draw comparisons between the two. In addition, Erika explored her individuality/complexities through science content. She used her verse as a platform to discuss her frustration and confusion surrounding her ability to be successful in STEM compared to others' expectations about her academic ability. Jalib was also able to tackle emotional concepts in his science-themed rap. Specifically, he spoke of fighting through obstacles and mistakes by continuing to work hard to reach his goals. His lyrics looked in depth at the emotional struggle he went through when he tried to push through feelings of procrastination.

Through participating in this hip-hop-based intervention, students were in a position to acquire science content knowledge through non-traditional practices – science-themed rap. Vicki created a science-themed rap in which she coupled her emotional experience with the process and major biological players of the digestive system within the human body. For example, Vicki mentioned protease, lipase and maltase and was able to clearly articulate that these are enzymes that serve specific purposes within the digestive system. Similar to Vicki, Jalib explained the equation for the concept of work as it relates to physics. In addition, Jalib showed his understanding of the challenging concept of friction, which is a force resisting the relative motion of an object, as he related it to negative forces holding him back from succeeding and achieving his goals.

Interestingly, when these students used science-themed raps to explore emotional content, they were each able to come to new conclusions regarding their identity. Vicki used science and emotional lyric writing to explore emotions around her loss of pride and by using this outlet, she discovered a sense of empowerment necessary to regain that pride and sense of control. Erika, who struggled with the thoughts and feelings of being minimized and stereotyped, used this process to cultivate scientific identity among feelings of stress and uncertainty in relation to stereotypes. She used her verse as

a platform to showcase her intellect and skills as a rapper and to combat her feelings of being stereotyped, minimized and misunderstood. In a sense, this process allowed Erika to reconcile tensions that led to a negative emotional state and develop the confidence necessary to combat emotions that paralyzed her academically. Jalib used science and emotional lyric writing to help him overcome procrastination and work harder. He explored his self-doubt regarding his struggles with pushing himself to work hard, generating motivation to excel.

We understand the criticisms targeted at hip-hop and its supposed propensity for violence, misogyny and gross materialism. We argue that these are often misperceptions of the culture guided by corporate media-driven narratives that highlight a thin slice of a robust culture and makes the most problematic aspects of the culture hyper-visible (Emdin, 2010). In fact, we argue that negative perceptions about hip-hop are responsible for much work related to hip-hop not being named as hip-hop. For example, much spoken word-related research related to youths of color relies on hip-hop style and rhetoric. Spoken word, hip-hop-inspired free writes and student rap are each reflections of the hip-hop culture and have particular strengths in teaching urban youths of color. Oftentimes, spoken word projects are not named as hip-hop in academic journals. The effort to use hip-hop as a tool for creating powerful third spaces in classrooms, as outlined in this paper, focuses on rap, and does so to challenge negative stereotypes of an aspect of hip-hop culture most perceived as being in opposition to teaching and learning. Focusing on rap opens up new possibilities for educators who have missed opportunities to engage with youth simply because of biases about youth culture that go unchecked. The researchers by no means make the claim that science-themed raps will lead to self-actualization and increased STEM achievement for all youth. However, we do suggest that RP's focus on youth realities led to the choice to use hip-hop/rap, which is the chief cultural artifact produced and consumed by the urban youths of color who were the focus of this study. We also suggest that encouraging youths to make connections to their real lives creates a natural way for youths to engage in HHSWT and STEM success.

Limitations

Our work does not intend to devalue or undermine the role of school counselors or traditional teachers. We believe that the role of the school counselor or social worker when youth identify themes that go beyond the scope of personal challenges is significant and that these professionals should be made available when engaging in this type of work. We also believe that the educator who may not be privy to hip-hop can successfully engage in this type of activity with STEM students. Finally, our use of science as an exemplar for engaging in this work does not indicate that the other STEM disciplines cannot or should not explore this type of model. In fact, we suggest that the same negative emotions generated from/in science classrooms are consistent across STEM areas and are less likely to be present in non-STEM disciplines. This work then becomes a way to introduce a new dimension in STEM teaching for a diverse student population who are part of the hip-hop generation.

Conclusion

Through the implementation of the hip-hop-based science program as an intervention in science classrooms, students are provided the opportunity to bolster science content knowledge and knowledge of self. In addition, utilizing the hip-hop-based science

program created an avenue for teachers to develop better understanding of students and their full socioemotional selves. This is especially necessary in STEM education where perceptions of students' decisions to not engage in the disciplines are directly related to our collective unwillingness to present the subject matter in a way that goes beyond the glorification of its stoic and "old white" history. If we can better understand young people and the ways that their culture can be used to address the emotional baggage they bring to the classroom as we deliver STEM content, we can create powerful opportunities for them to both engage in and associate positive emotions to becoming academically successful in STEM.

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