

Fostering Spaces for Black Joy in STEM-Rich Making and Beyond
Ti'Era Worsley, University of North Carolina at Greensboro, tdworsle@uncg.edu
ReAnna S. Roby, Vanderbilt University

Abstract. What does it mean to express Black joy and loving blackness through STEM-rich making? What does it mean for Black youth in community-based, youth-focused makerspaces to express Black joy and loving blackness? We look at how Black youth alongside their facilitators co-create spaces of Black joy through making. These makerspaces are located at two local Boys and Girls Clubs in the US Midwest and the Southeast. Makerspaces are informal sites where youth are encouraged to work collaboratively while building digital and physical artifacts. As two Black female STEM educators working with Black youth we frame our work in critical race theory. Specifically we draw on the tenets of whiteness as property and counter-narratives. Using critical ethnographic methods, we explore the ways in which Black youth produce counter-narratives that disrupt whiteness as property through STEM-rich making. Data sources include fieldnotes; artifacts, such as youth work; interviews; and video recordings. The first vignette highlights how two Black girls navigate choosing and creating characters using Scratch. The second vignette focuses on a brother and sister duo who center their making on family and their shared maker identity. We then discuss the freedoms afforded to youth with flexible co-designed curriculum with facilitators and how we foster open spaces. We address this special issue's driving question by asking, How do we, as STEM facilitators, counter anti-blackness in/through STEM by fostering space for Black joy with youth in making?

Keywords: Black joy, informal, makerspace, STEM

Historically, STEM (science, technology, engineering, and mathematics) has been depicted as a bland, white space with little to no spice, pizzaz, or energy. Similarly, innovations within these domains have been enriched and made more appealing with the centering of Black thought and joy, for example, Black Twitter and Tik Tok (Dates & Ramirez, 2018). The same can be said about maker education that centers Black joy and love within such spaces. This article highlights expressions of Black joy and loving Blackness through STEM-rich making: "STEM-rich making refers to making projects and experiences that support makers in deepening and applying science and engineering knowledge and practice, in conjunction with other powerful forms of knowledge and practice" (Calabrese Barton & Tan, 2018, p. 3). Specifically, this piece is designed for science education researchers who speak to the development of curriculum and policy that directly and indirectly impacts science learning. As such, we see the work of calling attention to anti-blackness in STEM and ideally creating environments for Black joy as a circular conversation. As two Black women with co-conspirators (Love, 2019), we have co-created a community that celebrates and enacts Black joy through relationships with students, families, and staff within two Boys and Girls Clubs (BGC). In these making-based clubs, youth have fostered a community where they have strong bonds and sense of ownership (Calabrese Barton & Tan, 2018; Roby & Calabrese

Barton, 2019). We support youth in having significant agency over what they make and how and why they want to make, especially in ways that challenge the settled boundaries of making. We employ the following Critical Race Theory (CRT) tenets, whiteness as property (Harris, 1993) and counter-narrative (Stefancic & Delgado, 2000), as means of highlighting the liberatory praxes made possible through making while also reimagining participation and epistemologies by/with minoritized youth.

Our work in community-making counters Black suffering while keenly focusing on Black joy and brilliance (Bullock et al., 2012; Dumas, 2014). Black suffering within the context of STEM is a silenced discussion, though central to many of the practices implemented in PK-20 in formal and informal learning contexts, especially in STEM (Bastile & Lopez, 2015; McGee, 2020). For example, STEM curriculum diminishes how race was employed as a variable to define humanness, not only with regard to education but also history (Nelson, 2016). Additionally, leaning into color-evasive ideologies (Annamma et al., 2017) to advance science teaching and program development not only works to erase the experiences of Black learners but to rationalize whiteness as a form of objectivity that is above critique (Habig et al., 2021). Together these factors insinuate STEM is not “a place” for Black youth (Roby & Calabrese, 2019; Vakil & Ayers, 2019). We focus on the joy fostered throughout the making process from learning new skills to completing community-needed projects. The *makers* from and with whom we have the privilege of learning exude Black joy and brilliance in a variety of ways. As such, answering the research question, How do we, as STEM facilitators, counter anti-blackness in/through STEM, by fostering space for Black joy with youth in making?, is in service of radically imagining making that celebrates and honors Black youth.

Literature Review

Making, as an extension for STEM, generally takes place in informal science settings, such as community centers, museums, and science centers. Within the context of makerspaces and other informal science spaces, Black youth are presented with the opportunity to leverage their community cultural wealth (Yosso, 2005) and engage in STEM through its multiple entry points (Calabrese Barton & Tan, 2010; Dawson, 2017). Yosso (2005) defines community cultural wealth as an array of knowledge, skills, abilities, and contacts possessed and utilized by communities of color to survive and resist macro- and micro-forms of oppression (p. 77). While making serves as a site of possibilities, it still remains dominated by white, heteronormative, male, and middle-class adults (Halverson & Sheridan, 2014) and remains largely inaccessible by Black and brown communities. As such, the dominant maker culture exudes whiteness as property by legitimizing their discourses, practices, and tools in making (Keenan-Lechel, 2019). Critical maker educators aim to broaden what counts as making and who is or can be a maker (Pepler et al., 2016) by challenging dominant discourses and practices (Barajas-López & Bang, 2018; Gollihue, 2019). Within the last decade, minoritized youth, who have been the focus of a wide range of maker intervention programs, and yet have been positioned as novice/outsider in need of being *mentored into* making through deficit lens and lack of acknowledgment of their cultural wealth. It is

important to acknowledge how minoritized communities have always been engaged in making in ways that matter to them, their families, and communities (Vossoughi et al., 2016). However, not all opportunities to make in maker programs acknowledge these histories or support such meaningful making. To the contrary, making has been presented as elitist and perpetuates anti-blackness in subtle, yet still harmful ways. The structural inequities and forms of oppression that limit opportunities to make in ways that matter include the powered relationalities that inform life in makerspaces (Gollihue, 2019).

There are current models of informal science that look to embrace the totality of blackness specifically while countering its elitism and anti-Black values. King and Pringle (2018) present a summer program called I AM STEM. I AM STEM is a community-based, non-residential summer program for Black girls in grades 4–8 that focuses on how informal experiences transfer into the classroom. One of the main principles of I AM STEM is to tend to the whole child (mind, body, and spirit) and maintain “culturally healthy” students. The participants were co-constructors of knowledge and worked alongside researchers. The focus of this study was for Black girls to share their counter-narratives about their experiences in STEM. Three themes that emerged were field trips and authentic STEM experiences, continuation of STEM activities, and the role of race in their formal STEM experiences. The participants shared that field trips were a key factor for them to engage in STEM learning and expanded their knowledge. Participants also began to look for STEM opportunities outside of I AM STEM that included formal and informal settings. When participants reflected on their formal experiences, they felt racialized in their science classroom as they noticed their teacher treated white girls better (King & Pringle, 2018).

Critical and political studies of maker learning over the past several years have offered a more robust, heterogeneous view of what maker culture can be. For example, Barajas-López and Bang (2018) describe how maker programs centered on clay making within Indigenous communities cultivate a culture built around socially and ecologically just nature-culture relations, where “knowing, being, and doing are simultaneously unfolding and are essential/defining elements in the practice of material storytelling” (p. 17). Studies that have followed youth through makerspaces to inform iterative makerspace design have also contributed to expanded understandings of what maker practices are possible and could be more explicitly acknowledged, supported, and centralized (Martin et al., 2018). For these reasons, we employ Critical Race Theory (CRT) as a tool to combat the anti-black nature of making, while providing a counter-narrative of Black joy.

Conceptual Framework

Given the centrality of Black joy within the context of this study, we employ CRT as a conceptual framework. CRT within the context of education and research has a history reaching back to its roots in Critical Legal Studies and Critical Theory (Bell, 1987). Applying CRT in education makes it possible to analyze practices and ideologies through a race-conscious lens, which can help to frame critical questions

addressing the traumas that directly affect communities of color (McGee & Stovall, 2015).

For the purpose of this study, we focus primarily on the tenets of whiteness as property and counter-narrative. Whiteness as property (Harris, 1993) can be understood as a means to call attention to the danger and pervasive nature of whiteness within the context of science, making, and knowing. Within the context of science and science education and by extension making, the dominant discourses of whiteness serve to disenfranchise while also withholding or limiting participation and access for minoritized youth (Mensah & Jackson, 2018; Miles, 2019; Wright & Riley, 2021). We trouble this practice by centering narratives of Black youth co-opting science and making it their own. CRT operationalizes counter-narrative in three different ways: 1) lifts the voices of people of color so that race and racism are seen from an alternative lens; 2) pushes against ethnocentrism and one-world views to construct a new reality; and 3) works against silencing oppressed individuals and provides legitimated space for the “counter” perspective/narrative to be heard (Solórzano & Yosso, 2002; Stefancic & Delgado, 2000; Tate, 1994). The valuing of stories and experiences acknowledges that “...those who lack material wealth or political power still have access to thought and language, and their development of those tools...differs from that of the most privileged” (Matsuda, 1987, p. 65).

The practice of centering counter-narrative serves as a way to locate Black joy within the context of making while also pushing back on anti-blackness within the dominant epistemological understandings and practices of science, which suggest Black youth are in some ways sub-human and, as such, unable to feel or express emotion (Coles, 2019; Haynes et al., 2016).

Positionality Statement

As scholars deeply invested in equity and justice in science and science education by way of informal science, this study is a testament to the power of love and joy we experience with youth as we engage in this work. As such, we are invested in not only calling out anti-blackness within the context of science education, extension, and maker education but, more importantly, highlighting the active resistance to such in the form of Black joy as a means of disruption, resistance, and liberation. The authors of this paper identify as first-generation, cisgendered, Black women from the rural South who have not only witnessed Black joy within the context of making with youth but have lived and experienced such as a result of our ontological experiences with science and making in unorthodox ways from girlhood.

Author 1 — Ti’Era Worsley

I identify as a Black woman and a tinkerer. As a child, my greatest joy was to take things apart to understand how they worked and then put them back together. My family always encouraged and supported my interests and skills. I enrolled in an engineering program at a PWI located in the Southeast, and this experience showed me the harm that can be done when others feel that you do not “fit” in. As a Black woman who works with Black youth, I make it my personal goal to encourage them

in all ways possible. It can be easy for someone to point out all of the ways that you do not match rather than to focus on the brilliance (Leonard & Martin, 2013) of what you can contribute.

Author 2 — ReAnna S. Roby

I identify as a cisgender Black woman from the deep rural south. My love for science stemmed from the intimate familial relationship with my grandparents and their engagement with informal science (farming and gardening) in addition to numerous hours spent in the beauty salon on Saturday mornings. This love for informal science was enriched with a passion for mathematics that prompted a love for Chemistry. As an undergraduate at my HBCU, I was nurtured and supported in my chemistry engagement. However, upon graduation and matriculation to graduate school, I quickly noticed the overrepresentation of whiteness in the field. This motivated me to start a new line of inquiry that critically assessed participation in science fields in addition to the history of science. My ontological experiences coupled with my training as a scientist and social scientist equip me with a unique lens to ideally reimagine science differently.

Our cross-generation, multi-racial/ethnic research team across sites consists of scholars ranging from undergrads to graduate students to full professors. We are situated in the US Midwest and Southeast. Within the context of this work, we see ourselves as co-learners and co-authors within the makerspaces with youth makers and youth authored-knowledge.

Methods

This study is grounded in two STEM-rich makerspaces housed at Boys and Girls Clubs within the Midwest and Southeast regions over the course of a year. Because our study aims to highlight Black joy by critiquing what it means to *make*, we employ critical ethnographic approaches. Critical ethnography starts with an ethical responsibility to call out injustices within the communities in which we work (Madison, 2011). As Black women and critical ethnographers in this space, we are hyper aware of how power, as it relates to race and gender, are operationalized in/within STEM, making, and larger society (Evans-Winters, 2019). As authors deeply entrenched in the makerspaces, spending an average of 15-20 hours per week (2017–present) during the academic year and summer with the youth, we acknowledge our roles as integral members of the community. Data sources included fieldnotes; artifacts, such as student work; interviews; and video recordings and vlogs. Fieldnotes were taken after programming sessions. Artifacts included projects made by youth as well as scaffolding resources to aid in the development of projects. Artifact interviews were conducted over the span of project development while vlogs (video logs) were recorded at the end of meeting sessions. Data were analyzed using a grounded theory approach (Glaser, 1992) that sought to identify critical episodes where youth were supported and revealed in Black joy. The criteria for these episodes were youth's challenge of dominant views to prompt counter-narratives of making and joy for Black youth. In concert with grounded theory, the moments described within this text were not sought after but,

instead, surfaced as we considered the functioning of joy in direct opposition to anti-blackness.

Mid-West Green Club

The Mid-West Green Club has functioned for over more than a decade within the community providing youth with STEM-rich making experiences and more. The Mid-West Green Club offered programming and events for youth grades three and up focused on STEM-rich making, coding, robotics, and forensics. During the signature program of the Mid-West Green Club, which centered making for middle school youth, participants would identify issues pertinent to them and develop ways to address them. The socially just community that makes up the Mid-West Green Club is a collective of youth, research practitioners, and their families. The Mid-West Green club is centrally located to the community and within walking distance for some of the participants. Each session was hosted twice a week and started with refreshments and orienting discussions before diving-into making.

Southeast Green Club

Within the Southeast Green Club, Worsley had dual roles as a researcher and facilitator. Southeast Green Club meets once weekly, and the theme of programming at the time of the vignette was coding. Southeast Green Club consisted of about 12 youth participants (in sixth and seventh grade), who were predominately Black. In Southeast Green Club, youth have fostered a community where they have a strong bond and sense of ownership. Youth have significant agency over their work and space (such as moving freely in the room, visiting other friends to look at their work) and a lot of input with how weekly programming goes. Youth are also provided a place where they can share and vent about their daily lives, which heavily revolve around school. There is no set *curriculum* for the program that directs youth in a linear, step by step process. For example, when youth are learning a new coding concept, facilitators provide a general overview of how the different codes work. Youth are then able to take that direction and explore what they can produce with it. The facilitators usually go in depth about how to do something when it is requested by the youth or they are presenting a new concept/feature. This is referred to as just-in-time teaching (Calabrese Barton & Tan, 2018).

Vignettes

Can we become the characters in our Scratch? — Felicia and Kia

The focus of the Southeast Green Club at the time (2018–2019) was coding with the use of Scratch and ozobots. Ozobots are tiny robots that use a color-coding system on paper by using a combination of colors (red, blue, green, and black) and can also be used with a block-based coding program online (ozoblockly.com). Scratch is an online block-based coding program created by Massachusetts Institute of Technology (MIT) where users can create games and share them with an online community. The project that youth were working on was to create a storyboard

with 12 scenes. The themes of these stories came from the responses from their community ethnography. Youth were tasked with interviewing BGC staff and other youth about what they appreciated about their community and something that they wished for their community. Youth paired up, were given an iPad to record, and practiced their interviewee questions. Youth practiced their interviews in pairs to develop their interview etiquette, such as starting with, Hello, how are you? and Do you have a moment to do a quick interview with us? They then practiced probing questions, such as, Can you tell me more? or Can you give me an example? Once youth felt ready, they left the room to find interviewees.

When youth returned they used the responses they collected to fill out their storyboards. Some of the findings included that staff liked working there because of the kids, liked that the programs taught kids new stuff, and, based on one staff member's response, felt that youth were her kids. Some youth responses included activities, such as sports, games, friends, help with homework, and helping people. Once their storyboards were completed, youth began coding.

Two makers, Felicia and Kia, had interviewed a few staff members about what they liked most about working at BGC. As mentioned above, a common response among the staff was that they enjoyed working at BGC because of the kids. Felicia and Kia incorporated this data into their Scratch. As they were thinking about how they wanted to design their Scratch, they knew they wanted to include kids. They started to look through the pre-loaded Scratch characters to find ones that looked like kids. As they searched through the characters, they found one that they wanted to add. They raised their hand, and Worsley walked over to assist. They explained their dilemma saying that they had located a character that they felt was representative of a kid, but they wanted to alter the character to be more reflective of a *Black* kid. They asked if there was a way that they could paint the characters. To clarify, I asked Felicia and Kia what they meant by paint the character. They responded by saying they wanted to paint the skin on the character to make it look darker.

Scratch has an editing feature (costumes) where you can edit characters. Users have many options to alter characters such as add shapes, flip the image, fill the background, and many others. First, together we looked at the colors, which were presented on a color wheel. The colors immediately presented are red, yellow, green blue, purple, pink, and back to red. To create different shades of these colors, the user must adjust the color by saturation and brightness. Felicia and Kia were looking for shades of brown, and brown is not a pre-selected color in the color wheel. To create brown, Felicia and Kia had to select the red color and then adjust the saturation and brightness until they created the desired shade of brown. After selecting the right shade of brown, Felicia and Kia used the paintbrush tool to find the right size. The size of the paintbrush can be changed on a scale of 1–100 (1 being extremely thin strokes and 100 being extremely thick strokes). Felicia and Kia decided to use a thinner size so they could carefully apply the brown color on top of the character. This required Felicia and Kia to zoom in on the character and paint small sections at a time. This process was tedious to the girls as they had to constantly zoom in and out on the character and while staying in the lines.

After, Worsley showed them what they would need to do, Felicia and Kia continued to work. Because of the long and tedious process of painting the kid character, Felicia and Kia stopped painting the character. They then asked one of the other facilitators if they could take pictures of themselves and make the images a character instead. The facilitator said that they could do that, and together they left the room to find a location to take their photo. Felicia and Kia decided to take their photo in a doorway that led to one of the work rooms, with an apartment building in the background. When Felicia and Kia returned back to the room, they were all smiles as they waited to see how their photo would transfer from the cell phone to Scratch. The facilitator emailed the picture and then downloaded the attachment to the computer. Once on the computer, the facilitator selected the upload scratch option for adding characters and then the images appeared in their Scratch. Felicia and Kia had to adjust the size of their characters so that they could fit within the frame boundary of Scratch. Felicia and Kia decided to make their pictures the same size and placed Kia to the left (Figure 1) and Felicia to the right. Felicia and Kia instantly began to smile when they saw themselves as characters in their Scratch.

Figure 1

Kia as a character in her Scratch



Analysis

By engaging in the process of STEM-rich making, we see Felicia and Kia provide a counternarrative of who can participate in STEM. For two Black girls, the lack of representation within STEM by not seeing themselves as pre-loaded characters could have led them to settle for a character that they did not want to include. However, we see them offer a counter-narrative by disrupting whiteness within the context of Scratch and reauthoring who is making for and for what purpose. Together they leverage the support of their facilitators and utilize them as resources to learn the skills needed to create Black girl characters. Felicia and Kia had the option to upload any character that they wanted into their Scratch. They could have searched the internet for other characters that were Black girls, but with much enthusiasm, they chose to use images of themselves, thereby decentering whiteness. Usually, when the facilitators take pictures of the girls specifically they tend to cover their faces, shy away from the camera, or immediately demand to see the picture. Choosing to be seen on the Scratch they were creating was a powerful statement that challenged notions of whiteness as property that pushed back on who has the right to be represented as characters in games while also countering dominant discourses of how Black youth experience and embody joy.

To support Felicia and Kia's vision of their Scratch, we see the facilitators being allies and playing an integral role to support their vision. When Felicia and Kia first asked if they could "paint" the character's skin, Worsley did not deter them from their idea because of the additional work involved. She took the time to show Felicia and Kia the skill of how to alter characters using the costumes tool. When Felicia and Kia decided that painting the skin of the character would be a tedious task, *they* decided to use images of themselves. Again we see the facilitator support their vision by showing Felicia and Kia how to download and upload images as characters into Scratch. The facilitators provided skills that Felicia and Kia would continue to draw on for the remainder of the year.

Making with Family in Mind

At Mid-West Green Club, Roby had the honor of working as a research practitioner and also as a liaison between the Mid-West Green Club and the university. Our facility, which had its own space dedicated to the Mid-West Green Club as well as teenage members, was a thriving environment full of energy. Tasked with bridging the Mid-West Green Club for middle schoolers and teens prompted a peculiar tension, but one Roby leaned into with grace, that is, she was ready for the challenge and the odds it may have presented. The joy in making and beyond described below is reflective of my relationship with a group of siblings who were between the makerspace in the Teen Zone.

"Why your knees look like Raspusha[1]?" Suzanne asked, as I held the door to open to the maker space. Taken a back, but not knocked down completely, I responded "Because that's how God made me."

Suzanne was a popular Black girl at the club, but not for all of the “right” reasons. As a result, she would sometimes be reprimanded and have her “Mid-West Green Club” privileges revoked by club staff above my pay grade. Her big, bold spirit was endearing, and during one-on-ones, her tenderness was made plain or evident, as exhibited during the process of creating a board that featured her name.

As a Black girl from the deep South, Suzanne’s name plate connected her to her former home and the family there as well as her immediate family. During the development of her name board, Suzanne was intentional about not only naming herself but also creating a board reflective of the things that brought her joy and brought her family into a space that some may or may not occupy. As such, Suzanne selected colors that made her board pop and that also represented her brothers, her mom, and other relatives. Each letter on the name board used specific rubber band colors to designate certain family members—her mom, her oldest brother, her other brother, and more. This was a work Suzanne was proud of and used to not only express her love of her family but also the joy of making which invited them into the space—directly and indirectly. While Suzanne was intentional about making for herself, the selflessness reflected in her board also included others and brought them into the space. Within the context of each letter and each color featured on Suzanne’s board, there was a narrative that connected to others and served as an example of how her making was not just for her but was a message conveyed to her by her brother Mac.

Mac, Suzanne’s brother, was a member of Mid-West Green Club , long before Suzanne. During his time as a middle school maker, he led making and design efforts to support his peers with the community in mind. When he and another maker designed the Timmy, a timberland boot with a heating core to support wearers in the brutal mid-west winter, it was with the message that making is not a self-serving endeavor and, as such, helping others is one way to bring about community and joy.

Figure 2

Suzanne and an iteration of her name board



Figure 3

Mac starting his own name board after an impromptu visit to Mid-West Green Club



Analysis

While Suzanne and Mac's experience in the Mid-West Green Club is one example of family sharing in making, it is also one that seeks to disrupt antiblack narratives of representation and feelings/shared emotions. Historically, Black people, to include Black youth, have been framed as a group of people with limited *ability* feel or to actually have family (Coates, 2015; Hoffman et al., 2016). This discourse was used not only to rationalize the inhumane treatment of enslaved people in the US but also to further subjugate Black people (Haynes et al., 2016). Suzanne and Mac's engagement within the makerspace exhibits how their making together serves as a site to consider the generational knowledge shared among siblings and well as a countering of dominant discourses with the joy and love shared through the process. While Suzanne was proud of her work and would oftentimes share it throughout the club, it also brought her joy to be supported in tinkering and navigating the makerspace as an extension of her older brother. By getting Mac back into the makerspace, both siblings were able to engage in the joy of making and bonding simultaneously. In a world where Black youth are often demonized for their creativity, and not provided safe spaces for such, it was important for the Mid-West Green Club to be something they could claim as their own and as a space for them to explore with support and care.

Additionally, leaning into their identities as scientists and makers, Suzanne and Mac counter who can be a scientist and who science and making are for. Their makerspace, which was located in a community center, already troubled the class and racialized privilege of making. Their participation, though, went another level by troubling who making is for and to what ends making could be used as a space to tell and amplify stories, not centered in struggle, but in speaking truth to power—in this case, the power of Black joy.

Discussion

Much of informal science learning tends to further minoritize Black thoughts, and access is limited by location and cost. In the vignette of Felicia and Kia, we see them enact their freedom practice through their determination to authentically represent the Black kids at their BGC by bringing their vision to reality. The pre-loaded characters were not sufficient for the imagined way that they saw their game being represented. However, without the role of the facilitators, this could have become a missed opportunity. The facilitators supported Felicia and Kia's choice of adding images of themselves into their game. In addition, this provided an opportunity for Felicia and Kia to develop their Scratch expertise by learning new skills. Without the allyship of their facilitators, Felicia and Kia could have chosen to not continue further with their Scratch. This shows the importance of facilitators working alongside youth to engage in possibilities that challenge historically who gets to make and what making has been.

In the vignette centering the brother-sister duo, Mac and Suzanne, we see the siblings engage Black joy in part by being together and focusing on the development of their maker projects. Creating maker projects that centered their names and how they wanted to show up in the world is deeply connected to Black familial practices that extend throughout the diaspora. This can be reflected in how Suzanne developed a naming board that brought family in the space, both physically and abstractly. Additionally, it builds on the historical practice Black people within the United States have leveraged to combat white supremacist practice that disregard them and their names (Martin, 1991; Ortiz et al. 2019). As research practitioners and facilitators, it is not enough to provide material resources, but also to call upon and include family in the making process. This practice is one way to expand who making is for and what participation in making could look like. The ability to engage making as a freedom practice with family provides unique opportunities for creativity and a love ethic.

This work seeks to address a void in maker education literature by specifically considering how Black joy can foster spaces of pride, creativity, and ownership for and by Black youth. Countering anti-blackness by defining, creating, designing and naming one's own worlds, characters, and realities is in essence a form of resistance as well as Black joy. Implications for STEM educators seek to explore how access and the choice to innovate on one's own terms is a freedom practice (Love, 2019; Wright & Riley, 2021). To consider STEM learning as a freedom space that actively counters anti-blackness requires moving from trauma-centered narratives to imagining from perspectives that are not limited to the confines of STEM and making as defined by the dominant culture.

Conclusion

We have argued for the freedoms afforded to youth when facilitators are flexible and open in their curriculum and co-design alongside youth (as detailed in the vignettes). By co-designing, the learning environment opens for youth and makes room for their voices to be acknowledged and heard. Freedom as a construct has

been limited because of whiteness as property. Our work acknowledges that our own fullness and capacity to embrace freedom but also to embrace the liberatory praxis that comes with making is not only an act but, in part, a celebration of joy through making. To be able to do this within an informal makerspace is reminiscent of the making that we as practitioners have engaged in through our own experiences with making.

However, we acknowledge this work is not easy and having the support of our ontological experiences as well as that of other research practitioners makes it doable for the youth we have the honor to collaborate with. It is for those reasons we explore and uplift the unique and telling ways Black youth resist deficit narratives which would suggest that making, and by extension STEM, is not for them and neither is joy. Seeing how the youth take on projects that decenter whiteness while centering blackness in all of its complexities is one way in which we as practitioners can better engage in developing curriculum that actively combats anti-blackness.

Looking forward, it is important to consider how we as facilitators can create spaces where Black youth feel that they can bring their brilliance. As facilitators we must engage in critical reflection of our praxis and ask where we are supporting the youth's freedom to explore that brilliance. Additionally acknowledging the power that Black youth possess and seeing it as an opportunity and not a nuisance requires a level of vulnerability necessary to further intergenerational models and practices of radically imagining something different. This is necessary, as the historical and current conditions of STEM in formal contexts and informal contexts, were not necessarily created with Black youth in mind as creators, authors, and knowledge producers. Thus, the counter-narratives presented within the context of this work are necessary in fully embracing the abundance of blackness and the joy that we witness as Black women research practitioners.

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Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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