# THE BLACK CODE: EMPLOYING CULTURALLY RESPONSIVE COMPUTING TO HELP BLACK MALES THRIVE IN STEM CAREERS

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## ABSTRACT

*Research suggests there are at least three challenges to Black male interest and success in STEM careers: increasing access to STEM resources and curriculum, increasing Black and male inclusiveness in STEM initiatives, and increasing cultural and technical competency in STEM fields. African American schools typically do not have equitable STEM resources or instruction. In addition, there is limited research on supporting Black males' success in STEM in the culturally responsive computing (CRC) literature. Most STEM initiatives prioritize increasing the number of girls in STEM fields. STEM field employers are not active recruiters of Black male hires and have little experience with diversity and cultural inclusiveness. Research also suggests that Black students may not be interested working in White corporate America that undervalues their unique cultural perspectives and are more concerned with schooling that improves their communities. This chapter utilized CRC as a lens to examine the complexity of engaging Black males in STEM. As a result, the authors suggest adopting an equity ethic to help teachers help Black males connect themselves and their communities to STEM technology by utilizing smartphones and smartphone technology to engage Black males who may not have access to computers. We end with an example of CRC called barbershop computing, which combines computing,*

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*engineering, and innovation as a method to attract and retain Black males in STEM classes and help them persist in STEM careers.*

**Keywords**: Black males; STEM; education; culturally responsiveness; equity; smartphones; computing

> Everyone has all different experiences in school. I just know that throughout my life, at no time did any teacher ever point to me and say, hey. He'll go far!
>
> –Neil deGrasse Tyson

# INTRODUCTION

On June 18th, 2020, in a Zoom meeting to discuss diversity, Wells Fargo CEO Charles Scharf said that "While it might sound like an excuse, the unfortunate reality is that there is a very limited pool of Black talent to recruit from" (Charles Scharf in McEvoy, 2020). The resulting outcry from Black Wells Fargo employees was so strong that Scharf later apologized for his insensitive comment and personal unconscious bias by stating,

> I've worked in the financial services industry for many years, and it's clear to me that, across the industry, we have not done enough to improve diversity, especially at [the] senior leadership level. (Charles Scharf in McEvoy, 2020)

Scharf's comments go beyond being insensitive and highlight that Black professionals are almost invisible when it comes to top-level careers. Additionally, recruiters who mean well do not even know where to find Black professionals to hire.

In May 2015, Google debuted its Google Photo service to store images and share images on its cloud system. However, Google's AI tagged Blacks as gorillas on their platform. Flickr, another online photo management service with advanced recognition, also tagged Black people as apes and animals (Copia Institute, 2020).

Large companies that use STEM technology like Wells Fargo and Flickr and tech companies like Google are not the only companies that lack racial sensitivity and critical objectivity. Unfortunately, even when people of color are hired in companies, unconscious biases, racial barriers, and microaggressions still persist. For example, an action as simple as washing one's hands can become a headache for people of color working in a professional organization (Fussell, 2017). Soap dispensers typically use an optic sensor to detect a hand underneath. However, the darker a person's skin tone, the less likely it is that a sensor will recognize the hand placed in front of it. The same is true for automatic paper dispensers. The difficulty machines have recognizing darker skin tones has been documented in the medical field as well as by wearable fitness trackers and heart rate monitors (Hailu, 2019).

Suppose tech companies were aware of where to find a diverse, highly capable intellectual hiring pool. In that case, egregious mistakes like associating animals with Black people and miscalculation of medical devices would not happen. What is more insensitive is that Google has reduced its diversity initiatives because they did not want to seem anticonservative and were fearful of claims by right-wing White employees even though Google acknowledges and is aware they need to hire more people of color (Glaser, 2005).

There may be systemic reasons why tech companies may find it challenging to find Black STEM employees. Milgrom-Elcott's (2020) 2018 study asserts that high schools with the highest percentage of Black and Latino students in the United States do not even offer Algebra II, a required course for higher-level STEM courses and success in STEM fields. Teachers in the poorest elementary schools lack the resources to adequately teach mathematics (Education Commission of the United States, 2021). Additionally, 90% of US school districts report they have difficulty recruiting and retaining qualified as well as certified STEM teachers (Milgrom-Elcott, 2020).

Furthermore, when Black students are offered STEM classes, the curriculum highlights the knowledge and accomplishments of White men over the knowledge and achievements of people of color (Milgrom-Elcott, 2020).

Gender and race are important factors concerning Black males having access to STEM courses. For example, Black male students assert they may have a lack of a sense of belonging in STEM classes and careers (Strayhorn, 2015). It is not surprising that Black males find themselves out of place in hard sciences like algebra, computer science (CS), and material engineering when their numbers are in the single digits (Strayhorn, 2015).

Being prepared for advanced classes like Algebra 2 requires methodical planning and consistently offered mathematics classes being available and accessible in the correct sequence to succeed in STEM (Schmidt & McKnight, 2012). Unfortunately, Black males are half as likely to be in Advance Placement (AP) classes and consequently less likely to pursue STEM careers than White males and Black females, where they are outnumbered two to one (Hathaway, 2020). Black males are also less likely to receive rigorous instruction in the classes that are available to them (Bonner, 2000; Ransaw et al., 2020).

## OVERVIEW

The authors in this chapter argue that issues related to supporting Black males in STEM classes and careers can be improved by (1) increasing access to STEM resources and curriculum, (2) increasing Black male inclusiveness in STEM initiatives, and (3) increasing cultural and technical competency in STEM fields. African American schools typically do not have equitable STEM resources or instruction. To highlight issues related to Black male involvement in STEM classes and careers, the remaining portion of the volume will be organized into personal bias statements, the literature review, the theoretical framework, the discussion/recommendations section and the conclusion. The authors felt that personal bias statements were necessary as two of the authors are Black males who have had both positive and negative experiences with STEM, and one of the authors is a White male who has had positive experiences delivering STEM content to Black males.

The individual and collective experiences of the authors are blended into a cohesive and comprehensive whole. However, it may help the reader to differentiate a Black male experience with lack of access to STEM classes and opportunities, a Black male experience dealing with race who has a successful career in a STEM field, and a White male experience of how he successfully engaged Black males in the classroom. The subsequent literature review will provide the background for the chapter, and the following theoretical framework will serve to inform the discussion/recommendations section.

## PERSONAL BIAS STATEMENTS *Theodore Ransaw*

I attended junior high school at St. Charles Borromeo in Albuquerque, New Mexico. While at St. Charles, I was in the St. Charles Aeronautics Team (SCAT). SCAT was a model rocket club that also included basic electronics training. I loved it. I also participated in the Afro American Studies National Technical Association's Summer After School Academy at the University of New Mexico. Students in the summer program visited Sandia National Laboratories, the tech company DIGITAL, and helped to test the Tandy/RadioShack TRS-80.

Sandia National Laboratories was (and still is) one of the top research facilities in the United States. Our tour of Sandia included learning about Light Amplification by Stimulated Emissions of Radiation (LASER) technology, and how seismographs measure earthquakes. DIGITAL was an innovator in microcomputers in the 1960s but was eventually bought by Compaq and then later purchased by Hewlett-Packard. Digital had a robot that delivered the mail to employees at their desks! The TRS-80 was the first personal computer, (yes, I am that old). The TRS-80 was one of the first mass-produced home computers. Clearly, I was on track for a STEM career.

However, my family moved from New Mexico to a state that did not have a world-class scientific research facility or emphasize STEM curriculum. The point that I am trying to make is that I was interested in science and engineering as a child. Still, I did not have access or opportunity to take STEM classes in the schools that I attended. Black male students are not likely to be interested or successful in STEM careers if STEM classes and curriculum are not offered.

### *Kevin Green*

I had some surreal cultural and impactful (positive and negative) moments attending graduate engineering classes where, in some instances, I was the only person of color and even sometimes the only American. All of my educational experiences enabled me to better cope with my fears and insecurities during the period of time that I was a full-time student. They helped broaden my cultural experiences by meeting and studying with Asians, Africans, Europeans, and other international engineering students. During this time, I discovered how the cultural ethos of rugged individualism versus collectivism has its pros and cons. For example, when I was working on my master's in electrical engineering, I learned about the power of study groups after observing how many international students studied together versus how American students did not. Once I started studying more regularly in groups, I immediately witnessed a sharp increase in my grades. On the other hand, international students attending American graduate engineering schools had to learn that it is not okay to turn in the same software code as their individual assignment, but it is okay to study in groups and collectively discuss solutions for an engineering assignment.

The most powerful realization that I received from interacting with international students was realizing how much internalized negative self-doubt and fear I had about my academic abilities. And, because of this realization, my fears and self-doubts about my academic skills began to dissipate. Unfortunately, most engineering professors had low expectations for student success, had very little instruction in good teaching practices, and saw teaching undergraduate students as a distraction from their research interests. Nevertheless, I finished my graduate career with a clear understanding of what it takes to become an A student.

After graduating with a master's and a PhD degree in electrical engineering, I accepted a position at Sandia National Laboratories in Albuquerque, New Mexico. My research scientist position at Sandia was a very fulfilling experience because of the varied research activities. I had not realized how exciting technical careers could be for people interested in mathematics and science.

However, my worst experience was when I transferred to another research center to work with a highly respected and brilliant engineering manager. Unfortunately, the engineering manager had decided to leave to work for another department soon after I had transferred to his department. The new manager they brought in invited me to have lunch with him. During the lunch, he self-disclosed that he used to be a "former racist." I was in utter shock and dismay. I ended up quitting that job and left Sandia feeling bewildered and full of shame. It was (and still) is the worst job experience that I have ever had.

So, I decided to become a full-time high school mathematics teacher for almost three years in the Washington, DC Metro area. Additionally, I taught part-time to adult learners at the University of Phoenix and community college students at Montgomery College. It was truly an enjoyable and rewarding experience for me. In my role as a teacher, I found that I, too, was a student learning the best ways to transmit the knowledge. As a result, I unexpectedly deepened and broadened my mathematics and CS skills much more than I had ever anticipated.

After regaining my confidence and increasing my self-esteem, I went back into the engineering field. Just as I had learned, the number one deterrent to becoming a confident and competent mathematics student, no matter your age, is fear. I attribute the ability to overcome fear as the principle in helping me become a successful engineering professional.

*Mike Lachney*

While I grew up in a relatively secular, White middle class liberal household, the town where I lived in West Michigan was and continues to be a hotbed for the White Christian right. The intimacy between Christianity, homophobia, racism, and sexism that I witnessed among children and adults in my hometown turned me away from my faith and toward a materialist worldview shaped by the ideals and ideas of science. In my teenage years, popular figures such as Carl Sagan provided images of "truth" that were said to be free of culture, politics, and the messy reality of our social worlds. But this celebratory stance was short-lived as I started to tune into the ways that politics and cultural assumptions shaped the structures and content of science itself. Structurally, science seemed to work in favor of nationalism and corporate profiteering; the range of science appeared to reproduce individualism (Dawkins's "selfish gene"), Marxism (Levins's and Lewontin's "dialectical biologist"), or other political stances. These combined experiences led me to pursue a PhD in science and technology studies, where I learned how science and technology don't just shape society, but I also learned how society shapes science and technology. With an explicit focus on STEM education, I studied how the narratives that we tell ourselves about STEM and the disciplines themselves tended to be White and Eurocentric.

False narratives present a major challenge for broadening the participation of communities of color in STEM fields. For it was not that communities of color who needed to change but instead the very structure and shape of STEM itself need to be changed to create a multiracial democracy truly.

## LITERATURE REVIEW

STEM was originally called SMET, science, mathematics, engineering, and technology in the 1990s. The term STEM was not created until 2001. Both acronyms were created by the National Science Foundation (Catterall, 2017). STEM became an essential topic after the Program for International Student Assessment (PISA) was created. PISA compared achievements between 15 year-olds in 65 countries and found that America performs toward the middle internationally. Then, as now, the low performance of US schools is attributed to inequitable school funding (Catterall, 2017).

For example, children who attend elementary school in neighborhoods with low Social Economic Status (SES) are less likely to have teachers with the resources they need to teach mathematics, and their students are less likely to experience hands-on science activities (Education Commission of the States, 2021). Fourth graders in low SES schools have less access to science and lab materials, and high school students from low SES schools have the least access to CS (Education Commission of the States, 2021).

If there was any part of the STEM conversation that rang true and continues to do so today, it is that there were not and there are still not equitable opportunities to engage in STEM classes across our school systems. All students are not given equal opportunities to experience STEM subjects during their school years.

Moreover, students who want to pursue higher learning in STEM fields encounter deep institutional bias (Catterall, 2017). For example, according to Schmidt and McKnight (2012), schools reproduce inequalities, especially in mathematical instruction and curriculum.

Mathematics is known as the language of STEM because it is necessary to have a strong background in mathematics to be successful in STEM. In fact, taking algebra I by eighth grade is an indicator of success in college and STEM because the earlier a student takes algebra, the more time that student will have to take the higher levels of mathematics like geometry, algebra II, pre-calculus, and calculus before they start college (U.S. Department of Education, 2020). However, only 30% of school districts in the United States offer algebra I in eighth grade (U.S. Department of Education, 2020). Only 12% of Black students enrolled in algebra in 2016 compared to 24% of White students and 34% of Asian students (U.S. Department of Education, 2020). In sum, a good foundation in algebra sets the tone for success in higher mathematics to prepare students to understand algorithms and is considered the gateway to higher level mathematical courses (National Mathematics Advisory Panel, 2008).

Facilitating more people of color, especially Black males, into STEM classes and careers is crucial to achieving equity in the United States. Yet the goal of designing technologies to be free of values, culture, and biases is increasingly recognized as unreasonable: technologies always shape and are shaped by our social worlds (Benjamin, 2019; Leydens & Lucena, 2017; Noble, 2018; Winner, 1980). What is more, there is always a risk, when assuming that technologies are racially neutral, of reproducing colorblindness – the assertion that race is no longer an organizing social mechanism, and thus racism is no longer a social problem (Bonilla-Silva, 2006).

Therefore, while challenging racist biases in technologies is key to creating a more socially just world, it is not enough in and of itself to end racism. Instead of just treating race as unwanted noise to be silenced, positive racial representations can be incorporated into technology design and implementation (Eglash et al., 2020). Unfortunately, students who attend elementary schools with high poverty rates, which many Black male students do, are less likely to be offered hands-on science activities at least once a week (Education Commission of the States, 2021).

Fourth graders in the poorest schools have less access to science labs and materials (Education Commission of the States, 2021). Students in the poorest high schools have the least access to CS (Education Commission of the States, 2021).

Case in point, although students of color are more likely to attend schools with high poverty, inequality in school is not restricted to just race. Achievement gaps persist between both high academically achieving White students in affluent neighborhoods and high academically achieving White students from low SES schools (Plucker et al., 2014).

Achievement gaps between White students based on family income mean that inequity is not just an issue for predominately minority schools but also for White schools. It is no wonder that the testing gap in standardized test scores of affluent and low-income students is double the gap between Blacks and Whites (Tavernis, 2012). In addition to inequitable school funding that affects Black males having access to resources in STEM, there are additional noncurricular issues for Black males once they are interested in STEM classes and careers.

In the past, teachers would provide supplemental educational services to students after school to help boost student achievement, particularly in STEM courses. However, due to limited staff in many school districts, teachers have larger classrooms to manage and do not always have sufficient time to tend to the students that need more personalized attention. Some teacher union contracts limit the amount of time that teachers can work. Furthermore, some students are not able to attend after-school sessions because their parents or guardians are not able to provide transportation when the typical school day ends or they have sport, work, or younger sibling obligations.

Private tutoring is one way to address these barriers, but few parents can afford private tutors, and many household incomes have dwindled due to the impact of the coronavirus pandemic. As many schools have closed due to the pandemic, and schools strive to shift toward providing more online content and instruction, the punitive reality of the digital divide hits hardest for students of color – including how lack of broadband access can cause homework gaps (Auxier & Anderson, 2020). The "homework gap," refers to the barriers students face when working on homework assignments at home without access to the internet, and it is even more pronounced as teachers are relying more and more on digital learning instruction and materials for their virtual classrooms.

Unfortunately, as of 2015, one in five teens cannot consistently finish their homework because they do not have access to either a computer or internet (Anderson, Perrin, 2018).

Moreover, 15% of US households with school-age children do not have a high-speed internet connection at home, according to a Pew Research Center analysis of 2015 (Anderson & Perrin, 2018). Broadband disparities are even more pronounced for Black (25%), Hispanic (23%), and most of all for low-income (<$30K) students (35%). In this same PEW 2015 survey, about 10% of students said they often use public Wi-Fi to do schoolwork because of this lack of broadband in the home (Anderson & Perrin, 2018). This percentage is higher for both Blacks (21%) and low-income students (21%) but not for Hispanic or White students. We won't fully know the extent of the coronavirus pandemic on Black, Hispanic, and poor students (<$30K) until the 2022 National Assessment of Educational Progress (NAEP) scores are available. However, we know that the racial achievement gap and the digital divide are increasing (Anderson & Perrin, 2018; Education Commission of the States, 2021). In 2019, both NAEP reading and mathematics scores for Blacks were the lowest for all racial/ethnic groups (Mathematics Assessment, 2019, Reading Assessment, 2019). Although Black students in 2019 compared to 2009 obtained NAEP mathematics scores that were either the same or slightly higher in both grade levels of fourth grade and eighth grade, the NAEP readings scores for Black students in 2019 stayed the same for the fourth grade and dropped slightly for the eighth grade.

## THEORETICAL FRAMEWORK

One research program that aims to center positive racial presentations of Black, Brown, and Indigenous communities is CRC. CRC builds on the theories and lessons from culturally responsive teaching (Gay, 2018) and culturally relevant pedagogy (Ladson-Billings, 1995) but focuses mainly on technology and computing education. CRC often focuses on the "translation" of Indigenous knowledge, vernacular practices, civic engagement, technology hacking, and/or culture-based forms of entrepreneurship into computing education (Eglash et al., 2013). Although there has been a growing amount of work in CRC that focuses on broadening the participation of girls of color in computing fields, there has been less work on boys of color. Programs designed for boys do exist, but that work is not represented in the CRC literature. For example, Scott and Garcia's (2016) library program COMPUGIRLS supports computational thinking through social justice education that begins by "identifying the individual and collective talents of COMPUGIRLS participants and using their funds of knowledge as a base for nurturing their habits of mind toward undertaking techno-social activism" (p. 67).

COMPUGIRLS curriculum supports programming robotics with the explicit goal of empowering young women of color to be technosocial change agents within their local community (Scott & White, 2013). The Digital Youth Network's (Barron et al., 2014) Digital Youth Divas program combines activities like fashion and jewelry with coding and circuitry to promote a sense of STEM agency among young women of color (Pinkard et al., 2017). In a unique instance of CRC in a university setting, Rankin and Thomas (2016) found that leveraging everyday algorithms (like food recipes) helped achieve 100% retention of African American women in an introductory CS course. There are also some male-focused programs in culturally responsive and relevant education, as well as CRC.

For culturally relevant and responsive research, there has been a large focus on broadening the participation of African American young men in STEM using hip-hop (Emdin & Adjapong, 2018). DiSalvo and colleagues have leveraged games to broaden the involvement of Black boys and men in computing specifically (DiSalvo et al., 2011; DiSalvo et al., 2008). In CRC, Searle and Kafai (2015) found that despite Indigenous boys' preconceived notions of sewing as "women's work," e-textiles could be used to engage them in computing. Searle and Kafai suggest that e-textiles can simultaneously reify and challenge gender stereotypes. Black males seem to thrive in classes by working collectively and are stimulated with variety in their materials and learning environments (Bonner, 2000; Ransaw, 2013). Additionally, there have been many CRC educational technologies (e.g., Adinkra Computing, Tooled Leather – see csdt.org) designed based on masculine practices but have been less reported on as such in the literature. Still, the majority of CRC research, especially curriculum design, has focused on cultural and social constructs of femininity.

The focus on femininity and traditionally associated feminine practices in computer-based broadening participation programs are well motivated. Women, in general, tend to be more underrepresented than men in CS and, when comparing intra-group gender representation, women of color tend to be underrepresented at a higher rate than men of color (Zweben & Bizot, 2019, p. 22). For example, of CS bachelor's degrees from 155 US departments awarded to men in 2018, 8% were awarded to those who identified as male and Hispanic, but of the total number of female CS bachelors' recipients, only 6% identified as Hispanic (Zweben & Bizot, 2019, p. 22). The same study found that while there was a larger total number of bachelor recipients who identified as male and Black or African American (483 or 3%) in the total sample of males, those who identified as female and Black or African American made up 4% (144) of the total sample of female CS bachelor recipients. There is an obvious need for CRC to use an intersectional lens to address the underrepresentation of people of color across genders. In an effort to address the continued underrepresentation of men of color, and Black men in particular, in CS, we propose a study on leveraging the social and cultural constructs of Black masculinities in CRC education by focusing on both educational technology design and culturally sensitive programmatic curricular development.

## DISCUSSION/RECOMMENDATIONS

### *Equity Ethic Framework*

One suggestion to increase Black male interest in STEM and STEM careers is to utilize the equity ethic framework conceptualized by McGee and Bentley (2017) to detail the absence of Black and Latinx college students and expanded by Nathen-Kingery et al. (2019) who emphasized the need for social justice practices for engineering and computing doctoral students. Students with an equity ethic are motivated to help others. A main premise behind the equity ethic is to deemphasize the focus on STEM fields as lucrative, and instead emphasize minority students' sense of value for social justice, empathy, and equity as a means to recruit more underrepresented groups (McGee & Bentley, 2017). "Although systemic problems need collective solutions, promoting an equity ethic in engineering and computing students is an important step in transforming society to be more equitable and just" (Nathen-Kingery et al., 2019, p. 351).

This perspective moves away from points of view such as stereotype threat, imposter syndrome, the White gaze, and hostile schooling environments as reasons for achievement deficits and missed opportunities to connect with Black male students.

An equity ethic also differs from the opinion that students need to see it to believe it, i.e., that minority students need to be motivated by seeing people that look like them to imagine themselves in the same positions. From the lens of an equity ethic, students of color can indeed see themselves in fields where they are not represented because they feel that their unique contributions may have been overlooked. Students of color thrive when they have close contact with mentors and faculty they connect with, regardless of the ethnicity of the person who invests in them (Cornwall, 2020).

It is also prudent to remember that Black students may not necessarily be concerned about working in White corporate America but are interested in taking what they have learned back into their communities (McGee & Bentley, 2017). Furthermore, minority students are often motivated to increase racial and ethnic diversity in STEM fields when they see a lack of representation (McGee & Bentley, 2017). It should also be noted that minority students often come from a culture that prioritizes collective identities over individual identities and prefer working in groups (Faitar, 2006). Teachers who work with Black males through an equity ethic lens have the two-fold benefit of facilitating Black male achievement in STEM by connecting with their sense of community and also encouraging an increase in STEM careers by capitalizing on Black male preference to support their communities. It also stands to reason that teachers who teach through an equity ethic lens may positively increase equitable educational practices and enhance cultural competency with Black males. Educators that embody and foster an equity ethic naturally create CRC practices. Classroom teachers with an equity ethic accept that there are not only different examples of demeanor but also different ways of being that are outside of the dominant narrative. Teachers with an equity ethic also embrace the idea that collective identities are just as important as individualistic identities.

*Smartphones: A Viable Alternative as Compared to Desktop or Laptop Computers*

Our second suggestion to improve STEM opportunities for Black teens is to operationalize the resources and technology available to Black students. Because of the lack of internet or a reliable computer in the home for Black and low-income teens, about a fifth of Black (21%) and low-income teens (21%) are much more likely to use public Wi-Fi to do their homework as compared with 11% of White teens and 9% of Hispanic teens (see Table 10.1). Although having access to broadband internet and having a home computer (i.e., desktop, laptop, or tablet) is not equitable among Black, Hispanic, low-income, and White teens, mobile smartphone technology is internet-enabled technology that is equitable, provides equal access, and bridges the digital divide (Schaeffer, 2019) as shown in the table.

A mobile phone is either a cell phone (e.g., voice and text only) or smartphone; however, a smartphone is a cellular telephone that provides internet access, digital voice, text messaging, e-mail, still and video cameras, web download capacity for recorded programs, video viewing, and even video chat. Smartphones today are essentially mobile computers. Smartphones also can run downloadable software applications. The cell phone market today is dominated by smartphones. Therefore, the rise in smartphones has the necessary enabling technology to enable school districts and teachers to provide supplemental education on mobile platforms for students in low-income communities. Ironically, recent studies reveal that despite the fact that almost all US teens (95%) have access to a smartphone coupled with the fact that 45% say they are "almost constantly" on the internet visiting entertainment and social media sites, the majority of US teens (90%) use their cellphones to pass the time versus learning

***Table 10.1.*** Black, Hispanic, Low-Income, White Teen Technology/Internet Access (2018).

| Black, Hispanic, Low-Income, White Teen Device Ownership for US Teens | White | Black | Hispanic | Low-Income |
|---|---|---|---|---|
| Access the internet using public Wi-Fi because of no home internet connection<br>*% teens who use Public Wi-Fi* | 11% | 21% | 9% | 21% |
| Lack of reliable computer or internet connection<br>*% teens who lack computer or internet in the home* | 13% | 25% | 17% | 24% |
| Broadband in the home<br>*% teens who have broadband internet access at home* | 90% | 75% | 77% | 65% |
| Cell phone ownership<br>*% teens who have a cell phone of any kind* | 25% | 32% | 34% | 38% |
| Smartphone ownership<br>*% teens whose cell phone is a smartphone* | 94% | 94% | 95% | 93% |
| Desktop/Laptop computer ownership<br>*% teens who have a computer* | 90% | 89% | 82% | 75% |
| Gaming console<br>*% teens in each group who have a gaming console* | 87% | 78% | 81% | 85% |

*Source:* Adapted from Pew Research Center, Anderson and Perrin (2018); Anderson and Jiang (2018).

new things. Thus, there is an opportunity gap that might be immediately filled by providing educational services via the smartphone. Teachers could encourage students to use educational cell phone applications (e.g., assign homework assignments using mobile apps) to strengthen their learning and mastery of subjects. Edutopia (Edutopi.com, 2021), the foundation that tracks trends in educational innovation, is a good source for guides on mobile learning.

Therefore, filling this opportunity gap holds the promise that it may reduce both the achievement gap and the digital divide, enabling greater student achievement for Black, Hispanic, and all low-income students. Thus, the rise in smartphones can enable school districts and teachers to provide supplemental education on mobile platforms for students in low-income communities. Ironically, studies have shown that the use of mobile phones and computers for education is minuscule compared to their use for entertainment. This "time-wasting gap" is particularly prevalent in poor communities where youth heavily use mobile internet access and computer resources. Thus, there is an opportunity for teachers to encourage students to use educational cell phone applications to spend more time on learning activities and less time on social networks and entertainment platforms. We must address how we can redirect the availability of mobile phones to make it as equally convenient to learn as it is to use for social media. A twenty-first century classroom that embraces a mobile learning platform unlocks the ability for students to learn anytime, any pace, and anywhere. This is because the internet has created new paradigms of social interaction, and mobile devices (smartphones) provide greater learning, equity, and access to online educational services for all students than ever before.

### *Barbershop Computing: Exploring Culturally Responsive Black Masculinities*

Our final suggestion to improve STEM opportunities for Black males is a K-12 STEM program called "barbershop computing" that embeds the cultural capital of Black men into the design and implementation of educational technologies. Barbershop computing seeks to bridge the knowledge and culture of Black barbershops with visual programming and physical computing by using a race-positive framework where Black masculinities become a foundation for innovation in STEM education.

Inspiration for the barbershop computing program came after one of the CRC programs I was running on cosmetology and computing in an urban library in the Midwest. I started a conversation with a young man in high school who frequents the library and is well known by the librarians, staff, and visitors like myself. I knew that he had been talking with the librarians about the computing programs at the library and was interested in participating. However, he had expressed dissatisfaction with the fact that the programs appeared to be for young women and wanted to know why there were no programs for young men like himself.

The barbershop computing application (https://csdt.org/culture/barbershop/index.html) was developed based on this conversation. It seeks to find contact zones between African American barbershop culture and technology. The website includes a background section on the history of African American barbering, which reaches into relationships between current-day hairstyles in North America and Africa. It also has a visual programming environment where users can recreate styled patterns that barbers design on their clients. In the works is a hardware project where children learn about how the different motors in hair clippers found in every barbershop can be used to make other things. Outreach programs like barbershop computing, which builds on and sustains local cultural assets, offer educators opportunities to use educational technology as an intermediary space between schools and the local communities that they serve. The goal is to apply technologies that not only support schools but also create wealth generation.

## CONCLUSION

CRC was a suitable frame in which to examine best practices to engage Black males in STEM classes and STEM careers. CRC is in line with the equity ethic framework that enables educators to connect cultural knowledge and cultural ways of being like using technology to improve one's community in a way that is both empowering and liberating. Capitalizing on the accessibility and popularity of smartphones in the Black community has the potential to positively increase student–teacher interaction while increasing academic achievement in a way that is also culturally responsive. By designing educational technologies and curricula that build on local community strengths like barbershop computing, we can create visions for directing STEM knowledge and resources toward localized needs and desires.

Finally, the authors feel that it is appropriate to close with advice from the contributing author who has had the most success as a Black male in STEM, Kevin Green.

- *Don't procrastinate*. It is much easier to prepare for an exam by studying regularly if not daily – for a course.
- *Always ask questions in class*. Most professors and teachers welcome questions from their students. They generally don't like lecturing or having a discussion with themselves.
- *Study continuously*. No "mental dust" will occur if you regularly review the course content.
- *Use old exams for studying*. Once I had access to old exams, I learned why some students outperformed others and certainly not because they were any smarter than the rest of us.
- *Form study groups and collegial friendships with high-performing students*. I learned the importance of reaching out to students from other countries that may have a totally different viewpoint toward education and test preparation.

(Green, 2009)

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