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STEM

The New Face of STEAM

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According to the National Science Foundation (http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_digest.pdf) (PDF) and the National Academies (<http://www.nap.edu/read/12984/chapter/1>), women and certain ethnic groups – blacks, Hispanics, and American Indians – are considered underrepresented in STEM. We are combating this phenomenon by integrating STEAM (science, technology, engineering, arts, and math) into all the classes at Boston Arts Academy (BAA), and by including culturally responsive instruction in our STEAM lab. BAA is Boston's only public high school for the visual and performing arts, where students come from every neighborhood to explore their passion while also receiving a full college preparatory education. As the director of the STEAM lab, I oversee an environment that is part makerspace, part artists' studio, and part fabrication laboratory. The STEAM Lab and Boston Arts Academy is also where:

- Students and teachers collaboratively explore 3D modeling, design, electronics, digital media, and fabrication.
- **Artscience** curriculum focuses on human microbiome led by TERC (<https://www.terc.edu/display/HOME/Home>) researchers and supported by the National Science Foundation.
- Students from underrepresented minority groups (UMGs) connect with creative techniques and computational tools that are usually in the exclusive domain of professional designers, artists, and engineers.

An Inclusive Future

As an African American woman who completed doctoral-level graduate work in computer-generated art/design and digital media, my stewardship and presence in the lab models a pathway into STEM for minority groups. I also model an ethos inspired by my scholarship in Afrofuturism (<http://www.ebony.com/entertainment-culture/black-alt-enter-afrofuturism-999#axzz40aFjNtGQ>), a creative practice that takes black thought and re-imagines themes in STEAM, science and speculative fiction, and fantasy (<https://rowman.com/ISBN/9781498510509/Afrofuturism-2.0-The-Rise-of-Astro-Blackness>). Characterized by *inventiveness*, *adaptability*, *imagination*, *(re)appropriation*, and *persistence*, Afrofuturism is a framework that supports those agentive dispositions that enable my minority students to succeed in the worlds of art and science.

Based on these experiences, I offer the following three recommendations for helping students from underrepresented minority groups successfully navigate STEAM curricula:

1. Teach culturally relevant narratives to inspire students from UMGs to learn and master tools in innovative ways.

Help students produce inventions by merging aesthetic and technical production methods through redeployment, re-creation and re-conception (https://muse.jhu.edu/login?auth=0&type=summary&url=/journals/american_quarterly/v058/58.3fouche.pdf) (PDF). My students learn how hip-hop pioneer DJ Grandmaster Flash created a cross-fader device to mix different audio sources. They learn that first-generation Mexican students built underwater robots based on low-rider culture. These stories help students re-envision themselves as technically savvy inventors and creators.

2. Provide choice, autonomy, and time for collaboration.

Authors Alondra Nelson and Thuy Tu (<http://trove.nla.gov.au/work/33300956?selectedversion=NBD22202330>) note how technical skills are gained through casual use of technologies and through networks of informal apprenticeships where peers demonstrate their techniques to each other. Kayla, a student in the STEAM lab, laser-etched artwork into wood and painted the relief areas with electric paint – all connected to a touch board that triggers music videos. To innovate at this level, Kayla required group support, as well as sufficient access to materials, time, and autonomy in order to experiment.

3. To motivate learners, assess their needs, interests, goals, abilities, and cultural backgrounds.

Early assessment and intervention are extremely important in helping students get on track for college and career success, particularly in STEM. Through idea mapping (<http://ideamappingsuccess.com/>), BAA students demonstrate their interest and knowledge level regarding specific concepts like visual and spatial design. Guided exploration (<http://www.springer.com/us/book/9781441912497>) and personal interpretation (<http://isites.harvard.edu/icb/icb.do?keyword=qualitative&pageid=icb.page340906>) are also important to discovering students' innate interests and potential future in STEM. Such assessments help us support BAA student Nathaniel's current interest – designing a revolutionary device that can turn any space into a "smart space" via projection and sensor technology.

Kayla and Nathaniel are just two examples of students geeking out (https://mitpress.mit.edu/sites/default/files/titles/free_download/9780262013369_Hanging_Out.pdf) (PDF) – taking a proactive role in technological creation in ways that extend their personal interests and everyday interactions. In addition to the independent student work, BAA teachers bring classes to the STEAM lab to participate in workshops with artists and practitioners, like legendary sonic architect Hank Shocklee (<http://shocklee.com/>), who have backgrounds that align with our UMG students.

What Do Students Think of STEAM Lab?

Of the students surveyed about their STEAM lab activities:

- 75% learned and used new skills to achieve an outcome.
- Over 90% said that learning to use previously unfamiliar equipment was a good way to explore a class subject.
- 60% indicated that they would like to deepen their investigation of a STEAM subject and explore its utility.
- 70% reported increased attention, defined as "curiosity and interest."
- 68% reported an increased sense of relevance, defined as "linking learner needs, interests, and motives."
- 67% felt increased levels of confidence, defined as "developing positive expectations for success."

At a recent STEAM Fair led by BAA faculty, I talked to young people about what it means to project their own images and interests onto STEAM, and to see their communities, histories, and cultures at the center of this world. And as a community, we continue to celebrate our recent achievement -- being one of only eight schools in the nation to be awarded the prestigious innOVATION STEAM Grant (<https://www.ovationtv.com/the-ovation-foundation-the-presidents-committee-on-the-arts-and-the-humanities-and-americans-for-the-arts-announce-the-recipients-of-the-innovation-steam-grant-awards-program>) .

The stories of what occurs in our STEAM Lab and school have been shared widely (<http://baa-steam.tumblr.com/>) , and are an ongoing testament to how much we have learned, and will continue to learn, about motivating UMG students to engage in STEAM.

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