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Equity in Research Preparedness: The Role of the Library in Promoting STEM Education in Underserved Communities

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Equity in Research Preparedness:
The Role of the Library in Promoting STEM Education
in Underserved Communities

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by

Amy Christine Windham

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ABSTRACT OF THE THESIS

Equity in Research Preparedness:
The Role of the Library in Promoting STEM Education
in Underserved Communities

by

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Master of Library and Information Science
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Professor Thanh Thuy Vo Dang, Chair

STEM (science, technology, engineering, and mathematics) fields lack diversity, especially diversity of race, ethnicity, gender, and socioeconomic status. This can be traced to a lack of female and minority representation in reference books and library collections. Libraries are in a unique position to help correct these omissions through reappraisal of reference collections using feminist standpoint epistemology and the diversity audit. In addition, public libraries can help children from diverse backgrounds feel included in the scientific community by providing STEM programming and encouraging hands-on scientific exploration. Research has shown that

underrepresented students are less likely than their White counterparts to complete STEM degrees, which is often due to a lack of academic support or understanding of the research process. To help mitigate this deficiency, academic libraries, especially those at community colleges where student populations are naturally diverse, can support STEM students by providing library instruction sessions designed specifically for STEM research.

The thesis of Amy Christine Windham is approved.

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University of California, Los Angeles

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INTRODUCTION

Despite being among the highest paying jobs in today's workforce, STEM (science, technology, engineering, and mathematics) fields are also among the least diversified and remain dominated by White males. A 2021 Pew Research Center study found that Black and Hispanic populations remain largely underrepresented in STEM, and while women make up a significant percentage of workers in health-related jobs, they are grossly underrepresented in physical sciences, engineering, and computer science.[1] These trends are rooted in the inequalities seen in higher education, where women earn the majority of all undergraduate and advanced college degrees, yet only a small fraction of degrees in the STEM fields in which they are underrepresented in the workforce, including physical sciences, computer science, and engineering.[2] Likewise, Black and Hispanic populations are also less likely to earn STEM degrees either as undergraduate or graduate students. The Pew Research Center found that, while Blacks make up 12% of the overall adult population, they only earn 10% of all bachelor's degrees, and only 7% of those bachelor's degrees are in STEM. This is similar to data from Hispanic populations, where Hispanic college graduates make up 15% of all college graduates, yet only 12% of those who have earned a STEM degree.[3] This underrepresentation of Black, Hispanic, and female populations in both STEM education and the STEM workforce has led to increased alienation and racial and gendered stereotypes within the STEM community. This adds additional disadvantages to these underserved populations in the form of psychological

[1]Funk, Richard Fry, Brian Kennedy and Cary. "STEM Jobs See Uneven Progress in Increasing Gender, Racial and Ethnic Diversity." *Pew Research Center Science & Society*, April 1, 2021. https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/.

[2] Richard Fry Funk and Brian Kennedy. "STEM Jobs See Uneven Progress."

[3] Richard Fry Funkand Brian Kennedy. "STEM Jobs See Uneven Progress."

barriers that further hinder their ability to earn STEM degrees and perform well in the STEM workforce. The increased levels of discrimination underrepresented populations face in STEM lead to stereotype threat, a psychological phenomenon where people perform poorly in areas where there are societal stereotypes held against them. Despite the fact that diversity is beneficial to scientific advancement,[4] minority populations have been shown to fall victim to impostor syndrome, causing them to question their place in STEM and often drop out of college STEM degree programs. In "The Impact of Underrepresented Minority or Marginalized Identity Status on Training Outcomes of MD-PhD Students," Manuel A. Acosta explains that "impostor syndrome and stereotype threat have been shown to disproportionately affect black students and their performance,"[5] and in *Diversifying STEM: Multidisciplinary Perspectives on Race and Gender*, H. Richard Milner IV and Abiola Farinde-Wu argue that this impostor syndrome and stereotype threat are rampant in minority student populations due to the racial biases found on university campuses. They assert that predominantly White campuses lead to students of color feeling unwanted and isolated, and that their "experience in STEM environments have been conceptualized as racial microaggressions, stereotype threat, and racial taxing that can lead to racial battle fatigue" and contribute to students of color dropping out of STEM programs, or even dropping out of college altogether.[6] In these educational settings, "race operates as a master

[4] Swartz, Talia H, Ann-Gel S Palermo, Sandra K Masur, and Judith A Aberg. "The Science and Value of Diversity: Closing the Gaps in Our Understanding of Inclusion and Diversity." *The Journal of Infectious Diseases* 220, no. Supplement_2 (August 20, 2019): S33–41. https://doi.org/10.1093/infdis/jiz174.

[5] Acosta, Manuel A. Torres, Sidhanth Chandra, Sophia Li, Esther Yoon, Daniel Selgrade, Jeanne Quinn, and Hossein Ardehali. "The Impact of Underrepresented Minority or Marginalized Identity Status on Training Outcomes of MD-PhD Students." *BMC Medical Education* 23, no. 1 (June 8, 2023): 428. https://doi.org/10.1186/s12909-023-04399-7.

[6] McGee, Ebony O., and William H. Robinson, eds. 2020. *Diversifying STEM : Multidisciplinary Perspectives on Race and Gender.* Edited by Ebony O. McGee and William H. Robinson. New Brunswick, New Jersey: Rutgers University Press.

category that perpetuates a racial storyline that 'science is for White people'."[7] These negative encounters are heightened for women of color, who experience backlash due not only to their ethnicity, but to their gender as well. Women of color in STEM "often report that they are disrespected by colleagues and students, are assumed to be "the help," and are referred to as "Mrs." rather than by "Dr." or "Professor," despite holding advanced degrees."[8] In addition, "[t]hey write about often being questioned as leaders or being reminded of their place in the academy, an institution dominated by White males."[9] In order to dismantle the extreme racism and sexism that dominate STEM education and the STEM workforce, change needs to be implemented from the ground up, with new generations being shown that STEM is inclusive and welcoming to all.

In this sense, libraries are in a uniquely powerful position to enact real, quantifiable change. Libraries, both public and academic, are able to influence children from a young age and encourage and support them as they mature into adulthood. If STEM concepts are introduced during formative years and reinforced throughout their education, students from traditionally underserved and underrepresented communities will grow up with the knowledge that they belong in STEM, rather than feeling alienated and unwanted. In order to achieve this shift in STEM perception, libraries must offer STEM programming for children and families, showcase diverse collections, frequently reevaluate reference collections by performing diversity audits, and provide academic and research assistance tailored specifically to STEM students.

In this thesis, I identify gaps in STEM programming at a local Los Angeles Public

[7] Manuel A. Torres Acosta et al. *Diversifying STEM.*

[8] Manuel A. Torres Acosta et al. *Diversifying STEM.*

[9] Manuel A. Torres Acosta et al. *Diversifying STEM.*

Library branch and create a service plan for ongoing, low-cost programming options that other libraries across the nation can easily adapt for their own use. I also outline the ways in which women and people of color have historically been excluded from the STEM community and virtually erased from history despite their undeniable contributions to the field. This is followed by an examination of the ways in which libraries can help combat this erasure through reappraisal of collections using feminist standpoint epistemology and the diversity audit. I conclude with data from my own research in which I interviewed community college mathematics students to learn how they view and interact with their campus library, including their comfort and skill level in using library resources to conduct their own research. The resulting recommendations regarding how libraries can help bridge the socioeconomic gap in STEM education are provided with the intention of achieving academic equity for marginalized communities who have historically been excluded from STEM, so that librarians may be seen as allies for diversity rather than neutral bystanders.

Chapter 1

STARTING YOUNG: THE ROLE OF PUBLIC LIBRARIES

For many children, public libraries are their first introduction not only to the world of literature, but to science and technology concepts as well. Through STEM-related storytime and programs that allow children the opportunity for hands-on learning, observation, and experimentation, libraries have the ability to act as a gateway to a lifelong passion for science. Indeed, the immense influence of public libraries on young children during their formative years of learning and development cannot be understated. In order to boost diversity in the STEM workforce, children of different genders, race, ethnicity, and socioeconomic backgrounds should be surrounded by science from a young age. Public library programming is a vital mechanism that can provide children with an opportunity to interact personally with STEM and to gain the experience and confidence needed to inspire them to enter the STEM workforce as adults.

Under the guidance of the Los Angeles Public Library's senior librarian for children's services, Joanna Fabicon, I identified the lack of STEM programming offered at my local library, the Los Feliz branch of the Los Angeles Public Library system, and created a service plan for ongoing STEM programming for children and families. My proposed service plan includes opportunities for partnerships with local STEM institutions, resources for free or low-cost materials, and methods of implementation. I have also identified innovative and effective STEM programming that is currently offered through other Los Angeles Public Library branches that the Los Feliz branch could easily participate in or adapt to fit their own needs and budget. I have analyzed the Los Feliz neighborhood's demographics in order to determine the neighborhood's

needs and program audience, in addition to methods of promotion, desired outcomes, and local impact.

Los Feliz Demographics

The Los Feliz branch of the Los Angeles Public Library is located at 1874 Hillhurst Avenue at the corner of Hillhurst and Franklin Avenue in the vibrant Los Feliz neighborhood, just under Griffith Park. The library is located in a very walkable stretch of the neighborhood, which is composed largely of young families. According to data from the 2020 census, Los Feliz has a total of 44,678 residents and the median age is 38.2 years.[10] The average household income is $118,015, with 5,669 residents below the poverty line.[11] There are multiple elementary schools within walking distance to the library, including the Los Feliz STEMM Magnet School, Franklin Avenue Elementary School, Our Mother of Good Counsel Catholic School, and the International School of Los Angeles, so the library is an ideal place for children to come after school. There are also a number of childcare centers surrounding the library, further adding to the number of children the Los Feliz Library serves.

Although the Los Feliz Library is a small neighborhood library, it offers a substantial collection of children's books and DVDs, along with children's programming for all age ranges. However, even though the library is located only two miles south of Los Angeles's famed Griffith Observatory, the Los Feliz Library does not offer any STEM-related programming for children. This missed opportunity is especially disappointing given that Los Feliz is home to a prominent STEMM magnet school which places a heavy emphasis on science, technology,

[10] "Los Feliz Demographics and Statistics." Niche, https://www.niche.com/places-to-live/n/los-feliz-los-angeles-ca/residents/. Accessed 1 Nov. 2023.

[11] "Los Feliz Demographics and Statistics."

engineering, mathematics, and medicine,[12] and additional exposure to such topics through public library programs could help reinforce STEMM topics in all aspects of the students' lives. However, given the reality that not all children who live in the Los Feliz area will attend a STEM-focused school, exposure to such topics will likely remain limited and achieving anything even remotely close to equity in STEM education will depend on outside organizations, including public library programming.

The Los Feliz Library building is 10,500 square feet,[13] with only a small space reserved for children's programming purposes. When comparing the children's programming offered at the Los Feliz Library branch to children's programming offered at other Los Angeles Public Library branches, the deficiencies are clear. The Fairfax branch, for example, has hosted guest lecturers from NASA's Jet Propulsion Laboratory (JPL), the Eagle Rock branch offers a moon phase flip book workshop, the Canoga Park branch offers a weekly Science Thursdays program series with a new STEM topic each week, and multiple branches offer DIY slime workshops where children can learn about basic chemistry while delighting in unique sensory experiences.[14] Many of these programs are low-cost and would not require any additional funding or library space beyond what is already available. While it could be argued that since STEM programming is offered at other Los Angeles Public Library branches, the lack of STEM programming at the Los Feliz branch is not truly detrimental to equity in education, it cannot be assumed that all

[12] "Los Feliz Science, Technology, Engineering, Math & Medicine." Accessed November 5, 2023. https://losfelizes.lausd.org/.

[13] folflibrary-main. "Friends of Los Feliz Library | History." Accessed November 4, 2023. https://folflibrary.wixsite.com/folflibrary-main/los-feliz-library-history

[14] "Calendar of Events | Los Angeles Public Library." Accessed November 5, 2023. https://www.lapl.org/whats-on/calendar?title=&field_event_date_value%5Bvalue%5D%5Bdate%5D=2024-02-24&field_event_audience_tid=All&field_event_branch_nid=All&field_event_categories_tid=3445&field_event_tags_tid=All&field_event_language_value=All&field_branch_region_tid=All&field_event_family_event_value=All&field_event_type_value=All&page=1.

families have the means or the ability to travel to a library branch outside of their own neighborhood. By limiting the number of branches that offer STEM programming, the Los Angeles Public Library is therefore limiting the number of children who have access to STEM learning opportunities and resources. These types of limitations further hinder marginalized communities and children from lower socioeconomic backgrounds who are already at a disadvantage when it comes to access to resources and educational opportunities. In order to rectify these disparities in STEM access, I have created the following service plan for the Los Feliz Library branch.

Shoot for the Stars Program Series

This program series, which I have titled the "Shoot for the Stars" series, is completely STEM based with an emphasis on astronomy that highlights the already vibrant astronomy community that exists in Los Feliz. This series can be implemented at little, if any, cost by the Los Feliz Library branch, and other libraries nationwide can easily amend it to fit their own community needs and available resources.

Audience

The intended audience for my service plan is the Los Angeles Public Library Administration, as well as other children's librarians who could observe and modify my programs to fit the needs of their own libraries.

Community Needs

Due to the library's space restrictions, programming at the Los Feliz branch is not as extensive as

at other Los Angeles Public Library branches, and children's STEM programs are nonexistent. I believe this is a missed opportunity given that Los Feliz is home to Griffith Observatory. My service plan aims to bridge this gap by bringing family-friendly astronomy programming to the library. My main age focus will be elementary school children because there are multiple elementary schools within walking distance to the library, including Franklin Avenue Elementary, Los Feliz STEMM Magnet School, Our Mother of Good Counsel Catholic School, and the International School of Los Angeles, so the library is an ideal place for children to come after school. However, many of these programs will also be suitable for the whole family.

Partner Organizations

The Los Angeles Public Library already has established partnerships with lecturers from Griffith Observatory, NASA's Jet Propulsion Laboratory (JPL), and the California Institute of Technology (Caltech), so adding the Los Feliz Library branch to the list of lecture locations should be quite easy to achieve. Docents from Griffith Observatory will be invited to come to the library to lead star and planet gazing parties in addition to leading astronomy lecture programs for older children. JPL and Caltech will also provide lecturers for this program series.

Featured Programs

The Shoot for the Stars program series will offer events for all age ranges, including many for the whole family. This is an ongoing program series.

Neighborhood Science

The easiest way for the Los Feliz Library branch to begin offering STEM programming is

to become a participating location in one of the currently operating Los Angeles Public Library family STEM programs. One example of an ongoing low cost program that supports childhood STEM immersion from a young age is the Neighborhood Science Program. Although there are a number of participating Los Angeles Public Library branches, the Los Feliz branch is not currently a participating library.

The Los Angeles Public Library's Neighborhood Science program, also known as NeiSci, is a part of their ongoing STEAM (science, technology, engineering, arts, and mathematics) initiative programming. NeiSci is supported by the Los Angeles Public Library system as a whole, and a total of thirty-two branches are listed as participants in the program. Although this program is for patrons of all ages, the library offers specific resources and events based on age groups, including children, teens, and adults. The resources for children appear to be best suited for children aged four to twelve, as most may be too advanced for babies or toddlers. Information about the Neighborhood Science program can be found using the "STEAM" link found under the "Services & Programs" tab on the Los Angeles Public Library website.

The concept of the Neighborhood Science program is based on the idea of citizen science, meaning that anyone can gather scientific information and share it not only with their own community members, but also with the global scientific community. In this way, ordinary citizens can help advance scientific knowledge and promote a more inclusive approach to science. Neighborhood Science is an excellent way to introduce children to scientific practices and to show them that science is inclusive, participatory, and open and welcoming to all. The program encourages patrons to collect scientific data from their own neighborhood and then share that data through anonymous collection forms. Given the nature of the data collection

forms, younger children would need the help of their parents or caregivers, although older children could certainly work through the process by themselves.

Each participating library branch offers do-it-yourself (DIY) NeiSci kits that patrons can check out for their own use. These kits are child-friendly and cover a variety of science topics such as cloud observation, mosquito habitat mapping, and biodiversity, among many others.[15] In order for the Los Feliz branch to participate in the program, all they would need is to stock their own supply of the DIY kits. I would also add an astronomy unit to the NeiSci program, which would offer a DIY kit available for check-out with seasonal star charts and celestial tracking maps.

The web page for the Neighborhood Science program offers a variety of additional resources, including a curated book list for children covering a number of science topics as well as information on citizen science in general. The program's web page also includes a calendar of events for NeiSci programming and workshops at each participating library branch, as well as family-friendly research ideas, program finder platforms where parents can find citizen science groups for children, and links to online science games for children. The additional programs I have outlined below can be added to the NeiSci calendar of events to boost program visibility.

Goals for Los Angeles Public Library's Neighborhood Science program include teaching children that everyone can be a part of the scientific community and that science is a natural part of the world around us. By showing children that even their own neighborhoods are ripe with scientific exploration, children will grow up with science as a part of their everyday lives and not feel excluded from or unwelcome in the scientific community.

[15] "Neighborhood Science | Los Angeles Public Library." Accessed November 5, 2023. https://www.lapl.org/neisci.

Guest Lecturers:

Guest lecturers from JPL, Caltech, and Griffith Observatory will lead talks for older children covering a wide range of topics such as Mars missions, Martian topography, rockets, current celestial activity of interest, and more. The lecture program series can include related crafts and activities to keep children engaged, and lecturers can bring objects such as models or diagrams in for children to have visual aids beyond slide presentations or videos. Many Los Angeles Public Library branches already host guest lecturers, so programs already in existence could be used or modified for the Los Feliz Library.

Evening Sky Observations at the Library:

Griffith Observatory can be challenging to visit due to its elevated location within Griffith Park, and it is no longer completely free now that they have started charging money to park. Bringing astronomy to the library is a way for families and children to easily experience the magic of star and planetary observation in a more accessible location. Volunteers from Griffith Observatory would lead observation parties on the library's back patio on days when the library is open until 8:00 P.M. and the sky is dark enough. Telescopes for library use can be acquired at no cost through the New Hampshire Astronomical Society's International Library Telescope Program.[16]

Astronomy Storytime and Crafts

For younger children, there will be astronomy storytime with crafts to introduce young ones to simple astronomy concepts and to teach them about planets and the night sky. Storytime books would include *ABCs of Space* by Chris Ferrie, *Hello, World! Solar System* by Jill McDonald, *Moon! Earth's Best Frien*d by Stacy McAnulty, and *Luna Muna: Outer Space Adventures of a*

[16]Library Telescope. "Home." Accessed December 7, 2023. https://192.119.64.144/.

Kid Astronaut by Kellie Gerardi. Some examples of crafts are planetary coloring sheets, toilet paper roll rockets and space shuttles, DIY telescopes, and solar system models.

Desired Outcomes and Impact

Desired outcomes for the Shoot for the Stars program series include harnessing the vibrant astronomy community in Los Feliz to help promote STEM education among children, and promoting diversity in STEM by helping all children feel part of the scientific community. Introducing children to STEM at a young age will help them see that science is all around them, and that it is a welcoming and inclusive environment. This program series will also introduce children to the concept of citizen science and promote family learning through STEM, in addition to creating strong community ties with local organizations and institutions. By showing children that their own neighborhoods are ripe with scientific exploration, children will grow up with science as a part of their everyday lives and not feel excluded from or unwelcome in the scientific community. Given that STEM fields are in dire need of diversification, this program series is a much-needed way to allow children to grow up fully immersed in science from a young age. This program series encourages exploration, observation, curiosity, and discovery through hands-on learning with nature and direct engagement with professional scientists, and will introduce children to scientific practices and show them that science is inclusive, participatory, and open and welcoming to all.

Promotion

In order to promote the Shoot for the Stars program series, I propose partnering with local elementary schools in Los Feliz including Los Feliz STEM Magnet School, Franklin Avenue

Elementary School, the International School of Los Angeles, and Our Mother of Good Counsel Catholic School. These schools would be instrumental in helping to promote the program and encouraging students to attend library events. In addition, Griffith Observatory could promote the program through flyers and social media announcements. The Los Feliz Library itself would also promote the program through flyers at the circulation desk and announcements on the Los Angeles Public Library website and social media pages. There would also be more astronomy and STEM displays throughout the library, especially in the children's section. Books that would be featured on children's book displays would include *My First Book of Planets: All About the Solar System for Kids* by Bruce Betts, *Planets and the Solar System* (a Smithsonian Kids First Discovery Board Book), and *There's No Place Like Space! All About Our Solar System (The Cat in the Hat's Learning Library)* by Tish Rabe. These displays would help children connect science with safe and enjoyable spaces.

Chapter 2

ANTI-RACIST COLLECTION DEVELOPMENT

Librarians are in a unique position to dictate and in some cases even write our collective history. By choosing what materials to document and collect, we are essentially choosing which communities and voices will be preserved and celebrated in our documented history, and which will be excluded. Throughout history, White male voices have been celebrated at the expense of marginalized communities. When considering the issue of the extreme lack of diversity in the STEM workforce, the systematic erasure of scientific achievements and contributions by women and BIPOC (Black, Indigenous, and people of color) individuals further exacerbates the issue by actively discouraging marginalized individuals from entering STEM fields. Library reference materials in particular, especially scientific biographical dictionaries, are dominated by White men, while BIPOC entries are given little space, if any. Anti-racist collection development policies must therefore be enacted, for both physical and digital collections. One of the most pressing issues in the library world today is how libraries and archives can combat racist collection development policies, including the myth of neutrality, in order to promote a more inclusive national history. This is especially true when it comes to STEM documentation, and if true diversity is to be achieved in library and archival collections, then we must constantly reevaluate our materials. Reference books are often at the core of academic library resources, yet the content of these reference materials are not always reassessed for diversity purposes. As a result, library collections often include out-of-date reference materials that do not present diverse viewpoints or documentation of scientific achievement outside of the established “dead White men’s club.” This whitewashed version of scientific history further exacerbates the already

problematic diversity problem in the STEM community and further establishes science as the White man's territory, making women and people of color less likely to enter STEM fields. Collection development must therefore remain active and fluid, lest we continue to uphold outdated notions that do not accurately reflect the field. Through reappraisal of reference materials and diversity-oriented collection development practices, the systemic racism and sexism that has dominated library collections can be dismantled in order to make room for inclusive research collections that more accurately reflect our communities and celebrate scientific achievements and contributions by historically marginalized individuals.

The Value of Diversity and Need for Updated Reference Materials

The lack of diversity in the STEM workforce is damaging not only to the marginalized communities who are excluded from the scientific community, but to scientific advancement itself. In "The Science and Value of Diversity: Closing the Gaps in Our Understanding of Inclusion and Diversity," Talia H Swartz explains the immense importance that diversity plays in the advancement of scientific knowledge:

> Overwhelming evidence suggests that teams that include different kinds of thinkers outperform homogeneous groups on complex tasks, including improved problem solving, increased innovation, and more-accurate predictions—all of which lead to better performance and results when a diverse team is tasked to approach a given problem. Diverse and inclusive scientific teams can generate new research questions that have yet to be asked by our field, develop methodical and analytical approaches to better understand study populations, and offer approaches to problem solving from multiple and different perspectives.[17]

[17] Swartz, Talia H, Ann-Gel S Palermo, Sandra K Masur, and Judith A Aberg. "The Science and Value of Diversity: Closing the Gaps in Our Understanding of Inclusion and Diversity." *The Journal of Infectious Diseases* 220, no. Supplement_2 (August 20, 2019): S33–41. https://doi.org/10.1093/infdis/jiz174.

Yet despite our understanding of the importance of diverse perspectives when it comes to scientific breakthroughs, we continue to marginalize women and minority populations and prioritize not only documenting, but also acknowledging, celebrating, and rewarding the achievements of White men over the achievements of marginalized individuals. In "Science's Diversity Problem," an article published by the *Stanford Social Innovation Review*, author Daniela Blei acknowledges that although minority men and women have innovative ideas that provide immense benefits to scientific discovery and advancement, they do not receive the same recognition and rewards for their work as their White male colleagues.[18] In a 2017 Stanford University study conducted by Bas Hofstra, a postdoctoral research fellow at Stanford's Graduate School of Education, and Daniel McFarland, a professor of education who focuses on data-based sociology, the trajectories of roughly 1.2 million doctoral recipients in engineering, biology, the physical sciences, earth sciences, social and behavioral sciences, and humanities between 1977 and 2015 were closely examined alongside data from the ProQuest Dissertations and Theses database, Web of Science, the Social Security Administration, and the United States Census. Through this data, Hofstra and McFarland found that "[m]inority and women researchers had more novel ideas, but these ideas were less likely to be adopted by the scientific mainstream, dominated by a white male majority. This reduced the impact of these ideas, resulting in fewer sought-after academic positions for nonwhites and women."[19] The lack of diversity in STEM is therefore a self-perpetuating phenomenon whose roots lie in the systemic racism and sexism that dominates our entire society. When it comes to the reference materials

[18] Blei, Daniela. "Science's Diversity Problem." Stanford Social Innovation Review, 2020. https://ssir.org/articles/entry/sciences_diversity_problem.

[19] Blei, Daniela. "Science's Diversity Problem."

most commonly found in libraries, this systemic racism and sexism is rampant and further impacts the career trajectories of the young researchers who rely on these materials for school assignments. Given the extent to which white men are elevated above all others when it comes to our acknowledgment of scientific achievement, it is not surprising that dictionaries of scientific biography contain alarming levels of racial and gender biases.

Although Charles Gillispie's *Dictionary of Scientific Biography* has been referred to as the standard against which to measure all multi-volume biographical works in history of science,[20] there were a number of startling omissions from his first edition. Compiled between 1970 and 1980, Gillispie's *Dictionary of Scientific Biography* was groundbreaking in that it was one of the most substantial reference works ever published in the field of history of science. The *Dictionary* contained extensive biographies on hundreds of scientific figures, although Gillispie chose to focus only on specific scientific fields. Scientists from mathematics, physics, chemistry, biology, and earth sciences were included in the *Dictionary*, while engineers, physicians, social scientists and philosophers appeared only "when their work was intrinsically related to the sciences of nature or to mathematics."[21] In addition to these initial omissions, women and people of color received shockingly little attention from the *Dictionary*. Indeed, one of the most blatant omissions is that of Benjamin Banneker, America's first Black scientist. Banneker was an astronomer and mathematician during the mid-to-late 18th century. Although the latest edition of *Dictionary* now features his biography, describing Banneker as "the son of a freed slave," in addition to being "an inspiration for his mathematical achievements [and] the first African

[20] Hoskin, Michael (2008). "Book Reviews: A DSB of Astronomers." *Journal for the History of Astronomy*. Vol. 39, no. 135. pp. 272–274.

[21] Gillispie, Charles., ed. *Dictionary of Scientific Biography*. New York: Charles Scribner's Sons, 1970–1980. 16 vols. Introduction, v. 1, pp. ix–x.

American man of science,"[22] he was noticeably absent from the first editions of the *Dictionary*. Also absent were scientists outside of the western hemisphere, which in and of itself severely limits opportunities for diverse viewpoints. Given the extent to which Gillispie's *Dictionary of Scientific Biography* has been used as a reference source when it comes to creating new scientific biographies, its western focus and lack of representation are concerning as these resources hold immense power in their ability to encourage, or discourage, young students. Also concerning is that many libraries fail to update their reference collections, and so these outdated and discriminatory works remain in libraries long after their biases have been exposed and in some cases even corrected.

Combating Erasure and the Stereotype Threat

When it comes to science and technology, the lives and stories we preserve now are vital to the future of the field. STEM fields are among the least diverse in the federal workforce, with only 29% of workers coming from underrepresented racial and ethnic groups, and a dismal 10% of workers being women.[23] This is especially shocking given that individuals from underrepresented racial and ethnic groups comprise approximately 43% of the overall federal workforce, and women comprise approximately 38% of the overall federal workforce. There are numerous factors that contribute to the lack of diversity in STEM, and chief among them is a startling lack of representation and recognition for scientific achievements, which is especially

[22] "Banneker, Benjamin - Document - Gale eBooks." Accessed March 20, 2024. https://go.gale.com/ps/retrieve.do?resultListType=RELATED_DOCUMENT&userGroupName=uclosangeles&inPS=true&contentSegment=9780684315591&prodId=GVRL&isBOBIndex=true&docId=GALE|CX2830905467#173.

[23] National Science and Technology Council, "Best Practices for Diversity and Inclusion in STEM Education and Research: A Guide by and for Federal Agencies." *Executive Office of the President of the United States.* (September 2021). https://www.whitehouse.gov/wp-content/uploads/2021/09/091621-Best-Practices-for-Diversity-Inclusion-in-STEM.pdf.

obvious in reference materials. In "Confronting Our Failure of Care Around the Legacies of Marginalized People in the Archives," a transcript of a talk given by Black librarian Bergis Jules at the National Digital Stewardship Alliance annual meeting where he was one of the keynote speakers, Jules explains how there are gaps in the historical record in what we have chosen to preserve in our archives, which means that marginalized people are essentially being erased from history.[24] This is especially true of digital collections, where Jules asserts that those who create the software or fund the work typically dictate what gets collected, or in other words, which voices and communities get preserved and which are left out of the historical narrative. This erasure is a contributing factor in the psychological phenomenon known as stereotype threat, wherein people tend to perform poorly in areas where there are societal stereotypes held against them. These stereotypes are reflected in library and archival collections when there is an excess of materials documenting the work of White men, while contributions by women and people of color are ignored and, as a result, forgotten. In "Addressing Stereotype Threat is Critical to Diversity and Inclusion in Organizational Psychology," Bettina J. Casad and William J. Bryant explain how stereotype threat is especially damaging to one's executive functions, which "are required to self-regulate one's thoughts, feelings, and behaviors under stress."[25] This self-regulation requires both motivation and ego-strength, which often rely on external factors to reassure us that a task we set out to achieve is, in fact, achievable. Casad and Bryant illustrate how "[r]esearch has shown that women under stereotype threat were quicker to fail at a self-regulation task [...] than women not under threat," and that they were ultimately more likely

[24] Jules, Bergis. "Confronting Our Failure of Care Around the Legacies of Marginalized People in the Archives." *Medium*, November 12, 2016. https://medium.com/on-archivy/confronting-our-failure-of-care-around-the-legacies-of-marginalized-people-in-the-archives-dc4180397280.

[25]Casad, Bettina J., and William J. Bryant. "Addressing Stereotype Threat Is Critical to Diversity and Inclusion in Organizational Psychology." Frontiers in Psychology 7 (January 20, 2016). https://doi.org/10.3389/fpsyg.2016.00008.

to "give up on complex tasks more quickly than participants not under threat."[26] When it comes to STEM education, if women and minority populations grow up being told and shown that there is no place for them in the STEM workforce, then they will internalize those stereotypes and are more likely to perform poorly in those subjects in school. In "Reducing the Impact of Stereotype Threat on Women's Math Performance: Are Two Strategies Better Than One?" Paul R. Jones examines the results of two studies designed to test the impact of the stereotype threat on women's performance in mathematics. In the first study, one hundred University of Maryland undergraduate women and men were shown one of two videos before completing a math task. One video asserted that there are definitive gender differences in math performance, and that men outperform women when it comes to mathematics. The other video purported that math is gender-fair, and that participants' gender would not affect the nature of their performance on the upcoming math task. Not only did the women who viewed the gender differences video perform significantly lower than the women who viewed the gender-fair video, but the men who viewed the gender differences video performed better than the men who viewed the gender-fair video.[27] These results emphasize the importance of representation and show the degree to which encouragement can lead to higher performance levels. As such, when library collections retain outdated reference books such as scientific biographical dictionaries that present a whitewashed view of scientific achievement and fail to provide the representation needed to encourage women and people of color to enter STEM fields, libraries are essentially contributing to the lack of diversity in the STEM workforce, even if that is not their intention.

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[26] Casad, Bettina J., and William J. Bryant. "Addressing Stereotype Threat Is Critical to Diversity and Inclusion in Organizational Psychology."

[27] Jones, Paul R. "Reducing the Impact of Stereotype Threat on Women's Math Performance: Are Two Strategies Better Than One?" *Revista Electronica de Investigacion Psicoeducativa : REIPE = Electronic Journal of Research in Educational Psychology / Universidad de Almeria, Espana, Servicio de Publicaciones y Editorial EOS* 9, no. 2 (September 1, 2011): 587–616.

Dismantling the Implicit Bias Against Women in STEM

The second major phenomenon that contributes to perpetuating a lack of diversity in STEM is known as the Matilda Effect. The bias against women in STEM is a systemic issue that has greatly impacted the current state of scientific occupations. Although women have made many significant and groundbreaking discoveries, male colleagues have often sidelined and ignored their achievements which rarely get documented in reference books. In many cases, male colleagues have taken credit for female STEM achievements, even winning Nobel Prizes for work largely conducted by women. Indeed, this phenomenon is so ubiquitous that in 1993 it became known as "The Matilda Effect" when science historian Margaret Rossiter published a book titled *The Matilda Effect in Science*. Rossiter's chosen name is a reference to "Woman as Inventor," a pamphlet published by American activist Matilda Joslyn Gage in 1870 arguing against the idea that women are less capable in science than men. Gage opens her argument by exposing the truth behind the invention of the cotton gin — arguably one of the most groundbreaking inventions at that time. Although Eli Whitney has been credited with the invention to this day, Gage reveals that it was actually a woman named Mrs. Greene who came up with the original idea and suggested that Whitney begin working on the model.[28] And while Mrs. Greene has unfortunately become lost in our male-dominated history, she is not alone in this oblivion. In 1944, Otto Hahn won the Nobel Prize in Chemistry for the discovery of nuclear fission, despite the fact that physicist Lise Meitner, his female lab partner of thirty years, was the one who discovered the radioactive isotope protactinium-231 and assisted in the experiments that proved the existence of nuclear fission.[29] Likewise, astrophysicist Jocelyn Bell Burnell's research

[28] Gage, Matilda Joslyn. "Woman as Inventor." *Harvard Mirador Viewer*, New York. 1870. https://iiif.lib.harvard.edu/manifests/view/drs:2575141$3i.
[29] "The Matilda Effect on Women in STEM – The Power of Play." Accessed March 10, 2024. https://bostonchildrensmuseum.blog/2021/03/24/the-matilda-effect-on-women-in-stem/.

on quasars led to her discovery of pulsars, yet the 1974 Nobel Prize for Physics was awarded instead to her male doctoral advisor who helped her confirm her findings.[30] Even our modern computer programming languages can be traced back to female achievements in STEM, yet these women's names have largely been lost to history. Dr. Grace Murray Hopper's name is not known to the public, yet she is considered to be one of the first modern programmers and it was her groundbreaking work that led to our modern computer languages. Dr. Hopper developed the first computer language to be based on English-language coding rather than mathematical coding, revolutionizing our approach to computer languages and making computer programming more accessible to people other than mathematicians.[31] However, despite Dr. Hopper's influential work, her name has all but been forgotten.

This trend of keeping women scientists invisible has not only shaped our modern view of science, but continues to marginalize female scientists today. Since history books tell us that nearly all scientific advancements were achieved by men, women are less likely to be encouraged to enter STEM fields today and, once there, are less likely to be taken seriously as scientists. This bias against women in STEM is not only detrimental to women but also to science, as it denies the existence of great minds that are capable of great discoveries simply on the basis of gender. In addition, by denying women their rightful place in history, we are sending the message to young girls that there is no place for them in STEM and that female minds are less capable than male minds when in reality, women have always made meaningful and groundbreaking contributions to the field. A 2019 study conducted by the National Science Foundation found that, although they account for roughly half of the overall workforce, women

[30] "The Matilda Effect: How Women Are Becoming Invisible in Science." Accessed March 10, 2024. https://www.lostwomenofscience.org/news/the-matilda-effect-how-women-are-becoming-invisible-in-science.

[31] YaleNews. "Grace Murray Hopper (1906-1992): A Legacy of Innovation and Service," February 10, 2017. https://news.yale.edu/2017/02/10/grace-murray-hopper-1906-1992-legacy-innovation-and-service.

in the United States make up only 34% of all workers in STEM occupations, federally or otherwise.[32] In order to dismantle this inherent bias, the Matilda Effect must be exposed and women scientists given the credit they deserve, a task that libraries are in a unique position to help facilitate by highlighting the bias and showcasing achievements by female scientists. In order to do so, however, current collections must be reevaluated and in many cases, significant deaccessioning must take place in order to make room for more diverse collections that highlight female and BIPOC scientific achievements. By creating clear reappraisal guidelines for weeding and deaccessioning collection materials, as well as guidelines for selection of new acquisitions, we can build diverse collections that accurately represent and highlight female contributions to the field. In this way, academic and public libraries alike can help ensure that the next generation of women will grow up with the understanding that they are just as capable as men in science and technology. This can be taken a step further with the addition of library programming aimed at teaching and encouraging girls to enter STEM fields. From coding workshops to math labs, libraries can help young women gain the confidence and skill sets needed to pursue a career in STEM. Constant reminders, however small, can be enforced by offering giveaways such as bookmarks featuring various female scientists and their achievements.

The Future of Reference Materials and Collection Development

In order to combat stereotype threat and dismantle the Matilda Effect, scientific contributions from women and BIPOC individuals need to be prominently featured in libraries, in both physical and digital materials. This is especially important when it comes to updating reference collections and selecting new acquisitions. *The Open Notebook*, a non-profit

[32] Catalyst. "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)." Accessed March 10, 2024. https://www.catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/.

organization and one of the leading online sources of training and educational materials for science journalists, explains that the first step in finding diverse research materials is to make doing so not only a priority, but a habit.[33] This is true not only for researchers looking for reference materials, but also for the librarians tasked with collection development. In addition, equal attention must be given to acquiring physical versus digital materials. Using Charles Gillispie's *Dictionary of Scientific Biography* as an example, the first edition of the *Dictionary* was overwhelmed with western, White, male-dominated viewpoints, with little attention paid to female scientists, scientists of color, and scientists outside of the western hemisphere. While the latest edition of the *Dictionary* is certainly not perfect, considerable effort has been made to rectify those inequalities found in the first edition and as such, contains a number of new entries devoted to women and scientists of color. However, this latest edition from 2008, now titled the *Complete Dictionary of Scientific Biography*, is available in digital format only. This raises additional issues of accessibility, especially in rural areas or low-income communities where internet access may not be readily available and patrons may not have access to computers or other electronic devices. When we consider the issue of research equity, we must therefore consider both the benefits and the potential drawbacks of the format of our reference materials.

[33] The Open Notebook. "Finding Diverse Sources for Science Stories." Accessed March 20, 2024. https://www.theopennotebook.com/finding-diverse-sources-for-science-stories/.

Chapter 3

REAPPRAISAL THROUGH FEMINIST STANDPOINT EPISTEMOLOGY

An important step in shifting the dominant view of STEM away from that of the "White man's territory" is to address the biases found in STEM library collections. This can be done by reevaluating current materials with the aim of curating truly diverse collections. In order to do so effectively, it is essential to have clear goals and methods already established before the actual process begins. There are numerous methods of appraisal, but one of the most vital in this case is feminist appraisal, including what Michelle Caswell defines as feminist standpoint appraisal. In her 2019 article, "Dusting for Fingerprints: Introducing Feminist Standpoint Appraisal," Caswell introduces the concept of feminist standpoint appraisal as "explicitly and unapologetically giv[ing] epistemological weight (thereby assigning value to) records created and preserved by, and potentially activated in service to, those individuals and communities oppressed by capitalism, white supremacy, and patriarchy."[34] This form of appraisal when considering STEM collections would elevate the achievements of women and people of color which historically have been overlooked. We need to recognize that the current records dominated by the achievements of White men are only harming any future efforts to diversify the STEM workforce. As a form of activist appraisal, feminist standpoint appraisal dismantles the oppressor standpoint that is currently in place by exposing the reality that our current power structure legitimizes White, western knowledge production over all other forms of knowledge production.[35] It also recognizes that the knowledge produced by marginalized people, including

[34] Caswell, Michelle "Dusting for Fingerprints: Introducing Feminist Standpoint Appraisal." *Journal of Critical Library and Information Studies* 3, no. 1 (2019): 1–36.

[35] Michelle Caswell, "Dusting for Fingerprints."

women and people of color, is dismissed and devalued by those in positions of power.[36] We see this played out in STEM fields, where White men have taken credit for work produced by women and the historical narrative has preserved White male achievements over those by women and people of color. By implementing feminist standpoint appraisal, however, libraries and archives can legitimize non-dominant creators of knowledge and uphold their intellectual value.

Too often, attempts to diversify library collections are enacted as an afterthought or not given the time, effort, and consideration the process needs in order to be truly successful. Feminist standpoint appraisal is therefore an excellent tool by which to evaluate collections, as Caswell explains that it "*begins* with the view from the margins in the determination of archival value. It acknowledges all knowledge is partial and attempts to diminish the perversity of that partiality by serving those most in need."[37] Given the state of current STEM collections and the whitewashed history housed within them, reappraising and building collections starting with the view from the margins is ideal to the curation of truly diverse collections. Current collections disproportionately represent dominant groups and ideas, so employing feminist standpoint ideology will help to correct this over-representation[38] and provide diverse viewpoints, knowledge, and documentation of scientific achievement. As librarians, we must ask ourselves what communities we are serving, and if the materials housed in our collections are accurately representing and serving those communities. We must therefore invert the current power structure so that those who have historically been marginalized and oppressed by the dominant structures are finally placed not only in a position of power, but in a position where their

[36] Michelle Caswell, "Dusting for Fingerprints."

[37] Michelle Caswell, "Dusting for Fingerprints."

[38] Michelle Caswell, "Dusting for Fingerprints."

knowledge and scientific contributions are fully recognized, celebrated, and used as evidence to encourage new generations to pursue STEM fields.

At its core, feminist standpoint appraisal differs from other methods of appraisal because it places the needs of the marginalized before the needs of the dominant power structures. Our current dominant methods of appraisal either value that which is already established in society, or claim an air of neutrality in which the needs of its users are not taken into consideration at all. Neither of these approaches are successful in achieving the diversity that is so desperately needed in STEM library collections. Feminist standpoint appraisal can be viewed as a kind of activism appraisal, which is what is needed in order to dismantle the implicit bias and systemic racism that has plagued the STEM workforce. As previously argued, dismantling the Matilda Effect is advantageous to the advancement of STEM as a whole, as it would promote other ways of thinking and encourage valuable female minds to enter the workforce. In order to do so, however, library collections must showcase knowledge that is both *of* and *for* marginalized people. As we have previously seen, in order to fight against stereotype threat, marginalized people need to see themselves represented in the STEM workforce to know that they, too, have a place in the community.

Managing the Diversity Audit: Reference, Digital, and Archival Considerations

Unless a library is looking to create an entirely new collection from scratch, current STEM collections will need to to be reappraised, which, in most cases, will lead to deaccessioning in order to make room for new diverse acquisitions. According to the American Library Association's, "Building Diverse Collections: Options to Review Print and Digital Holdings through an Inclusive Lens" by Carrie Smith, reappraisal in the form of a diversity audit

has become an increasingly common practice in some libraries, yet the actual data analysis can be daunting.[39] Therefore, in order to effectively reappraise collections through a diversity audit, the first step is to craft clear policies that your library will follow. These policies should be systematic and transparent, and should accurately reflect your institution's mission statement and/or diversity statement. In *Reappraisal and Deaccessioning in Archives and Special Collections,* Katharine Lawrie outlines the policies that the UCLA Library's Special Collections has used in their own reappraisal process. Lawrie emphasizes that reappraisal and deaccession are "a healthy and critical part of collection management," especially given that "research materials that were popular in one decade may not meet the needs of researchers in another."[40] Although STEM collections have historically been dominated by White men while overlooking contributions from the BIPOC community and women, we are now in a position to correct this systemic bias by reassessing the materials currently in our collections. In order to create clear foundational policies, Lawrie demonstrates how UCLA formalized reappraisal guidelines and standards based on the institution's preexisting mission statement for the University Archives, the UC records retention schedule, and established University Archives collecting policies.[41] By basing reappraisal guidelines on preexisting policies, any subsequent reappraisal projects will proceed with clear goals in mind and will be backed by authority and credibility. This transparency should continue through all stages of the project, and Lawrie recommends granting shared access to project documentation to all library staff members.[42]

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[39] American Libraries Magazine. "Building Diverse Collections," June 1, 2023. https://americanlibrariesmagazine.org/?p=138285.

[40] Lawrie, Katharine. "Clear Policies, Full Transparency, Can't Lose: Reappraisal and Deaccessioning at UCLA University Archive.," *Reappraisal and Deaccessioning in Archives and Special Collections*, Laura Uglean Jackson, ed. (Rowman and Littlefield, 2019).

[41] Lawrie, Katharine. "Clear Policies, Full Transparency."

[42] Lawrie, Katharine. "Clear Policies, Full Transparency."

The success that can be achieved in reappraising collections through a diversity audit is further demonstrated by Louisiana State University with their 2019 reevaluation of digital collections. In "Digitization Selection Criteria as Anti-Racist Action," S.L. Ziegler outlines the process by which the Louisiana State University Libraries are implementing an anti-racist collection development policy for the digitization of Special Collections materials and new digital acquisitions. Digital collections are in a unique position to write history, given that the materials selected for digitization are what will be stored and remembered by future generations. Just as importantly, the items that have not been included may cause the erasure of marginalized people or even entire communities from our collective history. Institutions often have diversity statements that help advance their mission statements, yet these are not always put into practice when it comes to digitization selection. Ziegler argues that institutions need to adopt new digitization prioritization policies that speak directly to diversity and inclusion within digital collections. When speaking about Louisiana State University's own strategic plan for digitization prioritization within their libraries, Ziegler mentions the importance for institutions to acknowledge that all institutions have, in the past, failed to recognize and celebrate diversity in their operations and collections.[43] By doing so, institutions can then address their past failures and build new policies and practices that allow them to move forward in a way that gives a voice to all communities, especially those that have been historically marginalized and erased from the collective record. Ziegler notes that Louisiana State University is a predominantly White university located in the American South. LSU is therefore in a unique position to highlight the southern African American experience in the very location in which enslavement, abuse, and erasure of Black culture took place. The university libraries are now choosing to prioritize the

[43] Ziegler, S. L. "Digitization Selection Criteria as Anti-Racist Action." *The Code4Lib Journal*, no. 45 (August 9, 2019). https://journal.code4lib.org/articles/14667.

centering of African American stories along with other traditionally marginalized communities. They have also added an inclusion criteria to their digitization prioritization checklist in order to evaluate how collections can help counteract traditional erasure.[44] Ziegler also highlights the work being done by Jenny Mitchell, the Head of Manuscript Processing at LSU Libraries, in countering the self-censorship that libraries have often imposed on themselves in the past. By choosing not to include certain materials in a collection or not fully describing materials in a finding aid for fear of community backlash or opposition, libraries contribute to the erasure of racial violence and validate racist narratives of White supremacy. In addition, librarians often claim a position of neutrality in these matters, yet neutrality harms marginalized communities even more because it allows the dominant White worldview, and more specifically White male power, to prevail without challenge. University-based collections that rely on donor support are often the worst offenders since they are not willing to showcase anything that might appear to muddy the dominant White historical record, yet Ziegler shows that there are concrete steps that can be taken to rectify the issue by implementing digitization prioritization policies that support and elevate the institution's diversity statements and allow these statements to become realities that are reflected in the library's digital collections.

In addition to the examples set by Lawrie and Ziegler, in "Dusting for Fingerprints: Introducing Feminist Standpoint Appraisal," Michelle Caswell offers a list of questions that can be asked in order to determine the suitability of any given resource within a collection. Although her article focuses primarily on archives, these questions can be easily adapted to suit the needs of any library collection, including STEM collections. By asking questions such as "Do these particular records under consideration give us the perspectives of those who are oppressed? Do they give the perspective of those groups who are even further marginalized within an oppressed

[44] Ziegler, S. L. "Digitization Selection Criteria."

community? [and] "What is the affective impact of my appraisal decision on oppressed communities?"[45] librarians can keep their diversity goals in mind while examining each individual item in their current collection. These questions, along with the creation of transparent reappraisal policies that reflect established diversity goals and institutional mission statements, will guide the reappraisal process in a way that will help ensure success in the curation of diverse STEM collections.

[45] Caswell, Michelle "Dusting for Fingerprints: Introducing Feminist Standpoint Appraisal." *Journal of Critical Library and Information Studies* 3, no. 1 (2019): 1–36.

Chapter 4

SOCIOECONOMIC BARRIERS TO STEM ACCESS

In addition to antiquated reference materials that uphold outdated racist and sexist ideals and poor collection development practices that fail to recognize the harm caused by outdated collections, an additional barrier to STEM access in marginalized communities is socioeconomic status. When it comes to higher education, community colleges are not only an ideal solution for students from low-income backgrounds, but are often the only choice due to financial hardship. As such, community colleges are among the most diverse college campuses in the United States and therefore offer unique opportunities for libraries to support and encourage students from diverse backgrounds to enter STEM fields. Roughly three-quarters of California community college students come from ethnically diverse and historically underserved communities.[46] CalMatters data from the 2022-2023 academic year found that, in California alone, 48.2% of community college students were Latino, 23.16% were White, 13.18% were Asian, 5.49% were Black, 4.11% identified as multiple ethnicities, 0.38% were Pacific Islander, 0.34% were Native American/Alaska Native, and 5.14% were undisclosed or unknown.[47] In addition, ACCT Now, a resource for issues affecting community colleges across the nation, analyzed data from the United States Department of Education and found that, since 2008, community colleges have consistently seen a higher number of female students than male students overall, with approximately 55% of students identifying as female compared to the 45% who identify as

[46]Commentary, Guest. "California Community Colleges Deserve More Support." *CalMatters*, November 15, 2021, sec. Commentary. http://calmatters.org/commentary/2021/11/california-community-colleges-deserve-more-support/.

[47] Echelman, Adam. "This Community College Has 1 Full-Time Black Faculty Member out of 165. Why Campuses Struggle with Diversity." *CalMatters*, January 4, 2024, sec. Higher Education. http://calmatters.org/education/higher-education/2024/01/faculty-diversity/.

male.[48] When comparing this data to that from four-year universities in California, including both public and private universities, we can see that community colleges more accurately reflect the natural diversity found in high schools and that better reflect the diversity of the United States as a whole (see Figure 1.1).

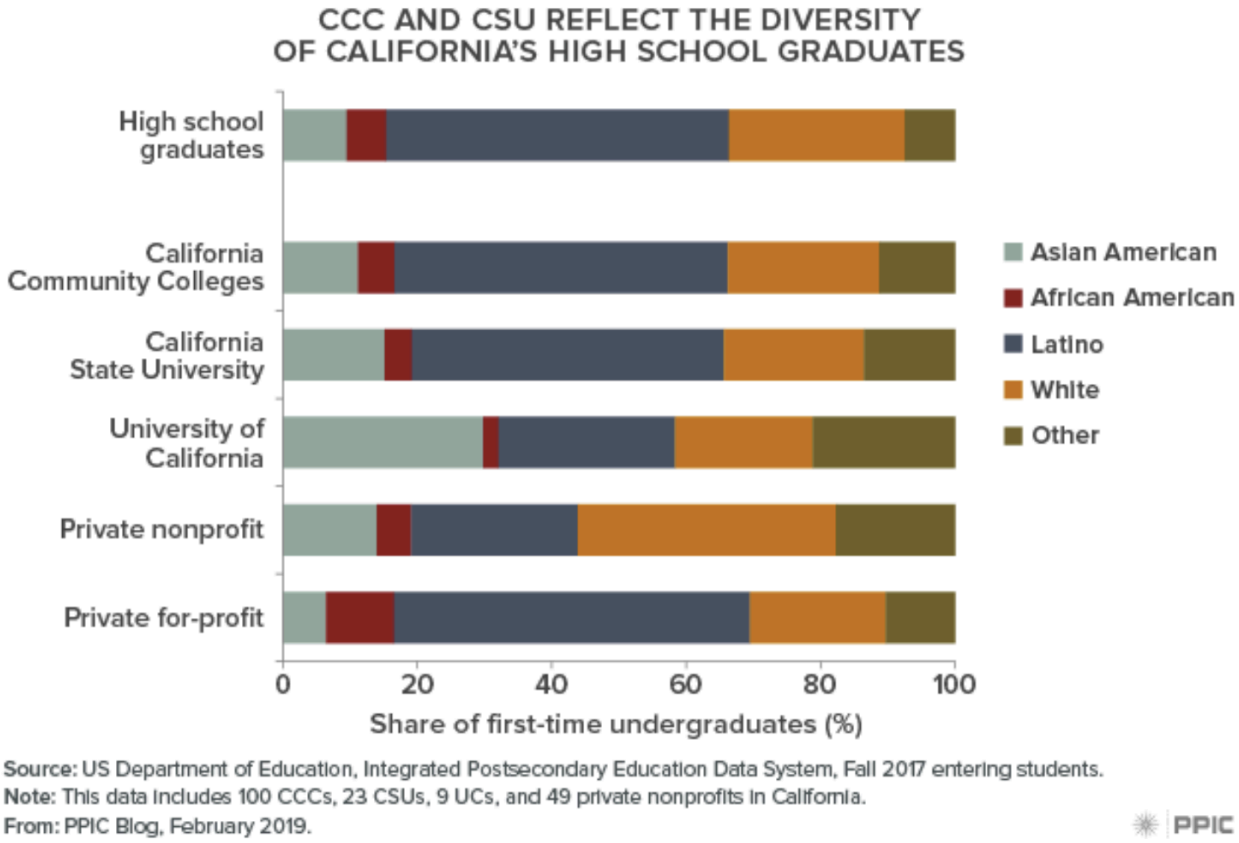

Figure 1.1
Source: Public Policy Institute of California (PPIC)

Given the elevated diversity levels found in California community colleges, they are ideal institutions for promoting, supporting, and encouraging STEM students from diverse backgrounds. I therefore chose to conduct my own original research at Pasadena City College, one of the state's top rated community colleges. Pasadena City College has been consistently

[48] "Diversity of Community College Students in 7 Charts," June 18, 2018. http://perspectives.acct.org/stories/diversity-of-community-college-students-in-7-charts.

ranked among the top five community colleges in California,[49] so I was eager to learn how Shatford Library, the PCC campus library, serves its diverse student body and provides outreach to STEM students. In order to do so, I wanted to talk to the students themselves to find out how comfortable they are using the library and if they feel the library is a reliable support system that can help them achieve their educational and career goals. I wanted to learn how community college STEM majors use their campus library and to determine the role that academic libraries play in student success among STEM students. I was especially interested in how confident students feel navigating both the physical library building and the library's website and digital catalog, including the use of databases. In this way, I can determine how successful the library has been in providing STEM students with fundamental academic skills and helping them prepare to transfer to four-year universities.

Background

My decision to conduct research at Pasadena City College was largely due to the personal connection I have with the school stemming from my own time as a student there. When considering my options for an affordable, yet quality education, I had been impressed by statistics showing that, among Los Angeles community colleges, PCC has consistently high graduation rates, transfer rates, and retention rates.[50] From 2015 to 2019, I attended Pasadena City College and completed their Library Technology Certificate program before earning an Associate Degree in English and transferring to California State University, Northridge to complete my Bachelor's Degree in English Literature. As a former Pasadena City College

[49] "Pasadena City College - 360° Tour." Accessed December 6, 2023. https://app.cloudpano.com/tours/koLPAkAQP4Am_.

[50] "Pasadena City College Graduation Rate & Retention Rate." Accessed April 17, 2024. https://www.collegefactual.com/colleges/pasadena-city-college/academic-life/graduation-and-retention/.

transfer student, I have had personal experience not only with the college, but with Shatford Library as well. Completing PCC's two year Library Technology Certificate program in 2017 gave me additional insight into how the library operates and connects with students on campus.

While completing my associate degree at Pasadena City College, I met Dr. John Sepikas first as a student in one of his math classes, and then later as a student in his astronomy class. During my time at PCC, I worked as a lead writing tutor at the campus Writing Support Center, which at that time offered writing help only to English students given that the center fell under the jurisdiction of the English Department. If a student needed writing help in any other subject, we were unable to help them. After numerous discussions with Dr. Sepikas in which we lamented the lack of writing support available to STEM students, I approached the head of the Writing Support Center to propose a partnership in which I would offer writing support for STEM students as an embedded tutor in Dr. Sepikas' weekly physics seminar. My proposal was granted, and the embedded tutoring approach was so successful that students continued to reach out to us to share how it helped them succeed in their academic careers long after my time at PCC had ended. Given the immense success of our first academic partnership, I was therefore eager to work with Dr. Sepikas again for my thesis research, this time to learn how academic libraries can help support STEM students.

Methods

My research subjects came from two Pasadena City College math classes taught by Dr. Sepikas. The first group came from a calculus class that met twice a week, on Monday and Wednesday evenings. This class consisted of twenty-one students. The second group came from a precalculus class that met once a week on Tuesday nights and had an additional online

component to the course. This class consisted of thirteen students. I conducted my research from August to December 2023, through individual interviews and Google surveys. In order to gain the students' trust and build rapport before I began the interview process, I visited each class to introduce myself and explain the process and purpose of my research. I shared details of my own time as a student at PCC, including the vulnerabilities I felt having returned to school ten years after my high school graduation. I told them about my struggles acclimating to an academic environment after such a long absence, as well as my experience transferring from a community college to a four-year university and then applying to UCLA for a master's program. I explained how my own experiences as a community college student and as a writing tutor in Dr. Sepikas' physics seminar led me to want to learn how libraries could help support STEM education, especially in a community college setting. I also reassured them that their participation in my research was purely voluntary and that it would not affect their course grade in any way. I encouraged them to ask questions, and while there were a few questions asking about UCLA campus life, the majority of the questions were about the transfer process. One student asked me how difficult I found the curriculum once I was at CSUN, and another student asked if I felt that PCC had adequately prepared me for the Cal State program. I used these questions to emphasize the importance of becoming familiar with their campus library and learning how to conduct academic research, and I explained what a vital role that would play in their success at a four-year university.

I felt that these initial class visits went well, and I visited each class a second time to provide more details of my research and answer questions before I started the initial stage of my interview process, which was to send out Google surveys for students to fill out with data including their age, gender, college major, college year, career aspirations, and previous library

experience. This was extremely useful in helping me identify basic trends such as age groups and gender when it comes to STEM majors. Through this data, I was able to see that, despite recent societal efforts to encourage women to enter STEM fields, 75% of the STEM majors among my research subjects identify as male. Yet in terms of race and ethnicity, the students came from diverse backgrounds, further demonstrating the diversity opportunities available at community colleges (see Figure 1.2). Students reported majoring in a variety of STEM fields, including civil engineering with an environmental emphasis, biology, mechanical engineering, computer science, chemistry, psychology, statistics, and oceanography.

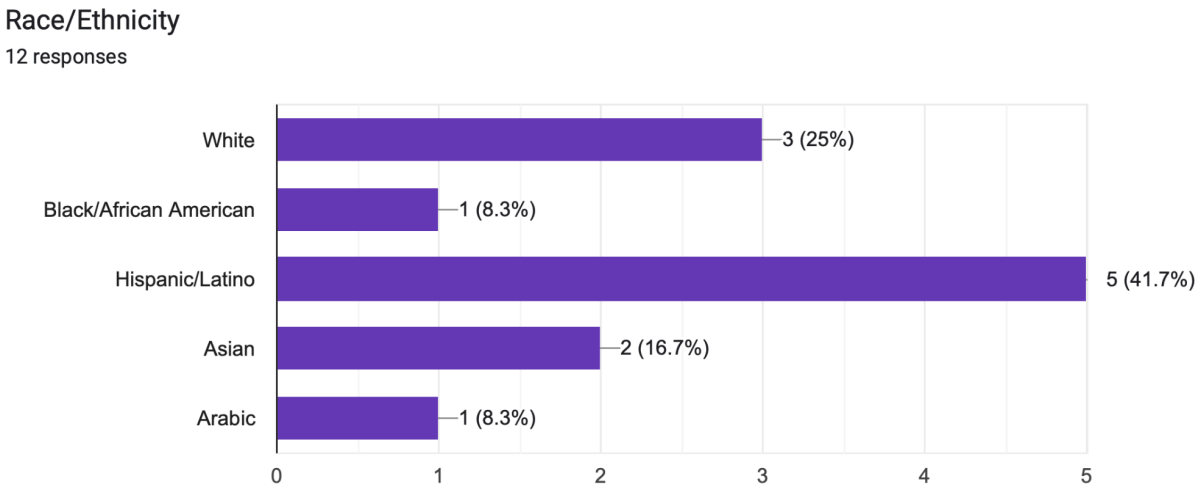

Figure 1.2
Source: Author's original research

As I entered the interview process, the biggest challenge I expected to find was that there would be students who did not want to participate in the interviews given that I had emphasized that their participation was purely voluntary. I was pleasantly surprised, therefore, when only one calculus student elected not to participate. All other students in both classes willingly

participated in the interview process, for a total of thirty-three interview subjects. The bigger challenge was when I sent out the Google surveys for students to fill out on their own, as only twelve students between the two classes submitted completed forms. I had used the Google surveys as my initial interview with the in-person discussions acting as follow-up interviews, yet I quickly realized that in-person interviews were a much more effective way to get the data that I needed. I wanted to make sure our conversations were private so that students could feel comfortable sharing their experiences without fear of being overheard by their peers or professor, so I conducted each interview in an empty classroom away from their regular classroom. I met with each student individually, and while the interviews all started in an organized format with the same standard list of questions, the nature of each student's response inevitably led to follow-up questions, and in some cases even longer discussions about their thoughts on the function of libraries and how they had personally benefited from libraries throughout their lives. One calculus student was eager to tell me that her mother is a public librarian, so she had grown up in libraries and was excited to be part of my research.

I learned that many of the students felt more comfortable sharing their experiences, or more commonly, their lack of experience, with their campus library in person rather than through the Google form. When asked on the form if they had used their campus library before, some students had indicated that they had, but did not elect to provide more details. In our face-to-face interviews, however, many of those same students confessed that they had not actually used it at the time they had filled out the form, but had been embarrassed to admit so previously. In order to encourage students to use the campus library for STEM-specific research, Dr. Sepikas assigned each class a series of short essays in which students would write about notable female and BIPOC figures in mathematics. For these essays, students were required to cite academic

journal articles, which helped me learn more about their experiences navigating library resources. In addition to asking questions about how students use their campus library, such as for book or equipment rentals, study space, or on-site computer use, I also asked if they felt comfortable using the library website and online databases, if they felt confident navigating the library's physical building, if they had used any reference services, if there were any services they needed that the library does not currently offer, and if they had ever attended a library orientation or instruction session of any kind.

Data Analysis

A common trend I noticed through my interviews is that many community college students see their campus library as a resource to help them lower the cost of their education. In addition to using the library to access academic journals, students reported using the library to rent books and equipment that they would otherwise be unable to afford. The most commonly rented items were graphing calculators and laptops, both of which are vital tools for completing a STEM degree. This finding shows that libraries can play a major role in helping to bridge the socioeconomic gap between students when it comes to having access to required materials.

The most surprising, and indeed alarming, trend that I noticed through my interviews is that Pasadena City College's Shatford Library does not offer library orientations or instruction sessions specifically for STEM students. In fact, only five students had attended a library orientation of any kind, either in-person or online. Two of those students attended an orientation through their English classes, one student attended through a College 1 course, and two students attended through Pathways, which is a Pasadena City College initiative program designed to help students transition successfully from high school to college. No students had been given a library

tutorial through a STEM class, despite many STEM courses requiring the use of academic journals for class research. This is especially concerning for students who plan to transfer to a four-year university to complete their degrees, as most STEM courses require scientific research and the use of peer-reviewed journals to complete assignments. All five students who attended a library orientation session stated that they felt comfortable navigating library resources and conducting online research as a result of those orientations. In comparison, only four of the students who had not attended an orientation stated that they felt comfortable navigating library resources, and two students said that they had to ask a librarian for help using online databases before they felt comfortable doing so on their own. One additional student said that her chemistry professor had demonstrated how to use online databases in class, which is why she now feels confident using the library's online resources.

The students who had never attended a library instruction session consistently reported being confused by the library's online catalog or being unsure how to access resources. One student used our time together to ask me for help accessing an online journal article, explaining that he had figured out how to search the library's catalog and had successfully located the library record for the article he needed, but from there was unsure how to actually access the article itself. To me, this was a devastating revelation to find that students who are typically already at a disadvantage are being hindered even further by a lack of training in research readiness. Another student appeared visibly surprised when I asked if he had attended a library instruction session of any kind, saying that he was unaware that the library even offered such services. I followed up by asking him if he would attend one if given the opportunity, and he responded with "Absolutely. The website is really overwhelming so it would help to know how to use it." In addition, when I asked students whether they had ever used the library to rent

equipment or electronics, eight students said that they were not even aware that the library offered equipment rentals. Of those eight students, seven reported never having attended a library instruction session. Given that many students from lower socioeconomic backgrounds have difficulty accessing computers and other electronic devices needed for higher education, ensuring that community college students are aware of rental opportunities is a simple, yet effective way that libraries can help bridge the socioeconomic gap.

Through my research, I realized that when it comes to community college libraries, student needs are not being met on a very basic level. The students who are most comfortable navigating the library, whether in person or online, are the students who have attended a library instruction session. These sessions, however, are only being offered to English classes and speciality programs such as College 1 classes or the Pathways program. STEM students do not receive the same library support, even though their academic success will depend heavily on their ability to conduct in-depth research on complex topics. In fact, library support for STEM students in the form of learning how to effectively use the library is almost nonexistent. As it stands, these students must rely on their professors to explain the purpose of online databases. Furthermore, I saw multiple cases where STEM students did not understand the concept of databases and academic journals at all. When asked whether they felt comfortable navigating library databases, two precalculus students asked me what a database is and admitted that they just use Google Scholar or Wikipedia for their school assignments, one calculus student said that she doesn't understand "why we need to use databases when we can just use Google," and five students between the two classes reported confusion about what makes an article or journal academic and were unfamiliar with the concept of peer review.

For first generation college students and students new to college this is a serious problem. It is also a challenge to older students who are not familiar with current technologies including online resources. This lack of library support only further exacerbates the gap in knowledge and ability once community college students transfer to four-year universities, which will create additional barriers to STEM education and career readiness and will likely result in underserved students feeling as though they are unable to complete their degree programs. Given that community college students are largely composed of already underserved populations, it is vital that academic libraries address these barriers and begin to offer the same support to STEM students that they already offer to English students.

CONCLUSIONS

Bridging the Socioeconomic Gap: Community College Libraries as STEM Allies

Students from lower socioeconomic backgrounds and racial minorities are less likely to major in STEM fields in the first place, but once there they are also more likely to drop out of their degree programs.[51] This can occur for a number of reasons such as financial difficulty or challenges stemming from racial discrimination or stereotype threat, but an additional contributing factor is a lack of academic support in higher education. Many underrepresented students are first-generation college students whose parents either do not have a college degree, or attended college in a different country. As a result, these students do not have parents or older siblings at home whom they can turn to for academic guidance or help navigating the higher education system. It is therefore essential for academic libraries, especially those at community colleges, to teach students how to use library resources and how to conduct scientific research.

A contributing factor to student apprehension and inability to effectively navigate library resources is academic and library terminology, where it is assumed that students understand the difference between an abstract and a full-text article, or what it means for a journal to be peer-reviewed. In "Assessing Freshmen Undergraduate Students' Comprehension of Library Vocabularies in Library Orientation Sessions," S.M. Zabed Ahmed explains how, among college students, a comprehensive understanding of library terminology is directly correlated with student success and GPA.[52] When it comes to being able to access online databases, a certain level of literacy is needed in order to decipher library terminology such as "full-text" or

[51] Manuel A. Torres Acosta et al. *Diversifying STEM.*

[52] Ahmed, S. M. Zabed, and Md Noman Hossain. "Assessing Freshmen Undergraduate Students' Comprehension of Library Vocabularies in Library Orientation Sessions." *Libri* 72, no. 3 (September 1, 2022): 253–62. https://doi.org/10.1515/libri-2021-0042.

"abstract." Ahmed describes a 2014 study in which forty undergraduate students participated, and "only 10 (25%) students could correctly retrieve the full-text articles across several different databases."[53] These findings match the results of my own research, where students displayed confusion regarding the use of databases and reported being unable to navigate the online library catalog or retrieve full-text articles even once they had located the correct library record. Given that information literacy is vital to student success and degree completion, community college students not only need access to library resources, but they need to be taught how to use those resources in order to gain the necessary STEM research skills that their degrees will require. As previously discussed, community college campuses reflect the natural racial, ethnic, gender, and socioeconomic diversity found within the United States as a whole, so these campuses are ideal locations for libraries to provide instruction to a diverse student body. In order for this diversity to become reflected in the STEM workforce through the successful completion of college degrees, academic libraries need to provide orientations or instruction sessions specifically for STEM majors in order to introduce them to terminologies and basic research skills, including an introduction to STEM databases and journals, and the concept of peer-review.

Library instruction sessions can be conducted either in person, which is the ideal, or virtually. An in-person library instruction session allows for personalized demonstrations in the STEM research process where students can ask questions, interact, and receive real-time assistance and feedback. Depending on each professor's preference, librarians could come into the classroom to teach, or the class could make a visit to the library. For online classes that do not meet in person, a virtual library instruction session can be offered, where the librarian joins the class in the virtual setting and conducts their instruction by sharing their computer screen to demonstrate the research process and library catalog. Students can still interact and ask

[53] S. M. Zabed Ahmed and Md Noman Hossain. "Assessing Freshmen Undergraduate Students' Comprehension."

questions, and librarians can create activities for the students to perform their own research and receive feedback on the effectiveness of their process.

Such sessions would require relationships to be built between the library and STEM professors, where the instruction session could be built into the course schedule at the start of each academic term. In building these professional relationships with STEM professors, it should be emphasized that these library instruction sessions will benefit the professors as well as the students, as students will gain a deeper understanding of the research process and will be better equipped to handle course assignments. In my own research at Pasadena City College, we found that as the semester progressed and students gained more experience in the research process, their increase in skill and research knowledge was directly reflected in the quality of the essays that they produced and their grade on each subsequent essay. In fact, this was discovered to be so beneficial to the students that Dr. Sepikas has continued assigning research papers to his math classes even after the conclusion of my research project.

Rewriting the STEM Narrative

Despite having been ignored, overlooked, and even deliberately erased from the historical record, underrepresented communities including women and people of color have always been a vital part of the STEM workforce. They have made significant contributions to their fields, even though they have not always received the recognition they deserve for those contributions. The enduring whiteness that has long dominated STEM reference materials has skewed the narrative to perpetuate the harmful and hateful myth of White male superiority. As librarians, we need to acknowledge that this enduring whiteness is harming the value of our collections when it comes to preserving the whole story behind human history, especially in terms of distorting the female

and Black experiences and essential contribution to scientific advancement. In this sense, librarians cannot remain neutral, otherwise they continue to uphold racist standards in collection development that promote White supremacy and erase racial bias, especially against African Americans. It is therefore essential for libraries to create and adhere to anti-racist strategic plans and the reappraisal of current reference materials. Likewise, female contributions to science can no longer be ignored and we cannot accept the narrative of White men who have taken credit for female achievements. From breakthroughs in nuclear fission to the development of computer programming languages, female contributions to science have not only gone unrecognized, but have instead been credited to men. By remaining silent in these matters, librarians show complicity with the dominant narrative and actively promote a damaging and inaccurate view of scientific history. We need to place a greater value on challenging the neutrality myth and campaigning to give a voice to marginalized communities through our library collections, both digital and physical. In order to do so, we need to reappraise our collections and deaccession materials that perpetuate harmful narratives and stereotypes and are not representative of the field. By using feminist standpoint epistemology as a guideline for reappraisal and diversity audits, librarians can ensure that their collections are inclusive and diverse, which will help advance the diversification of STEM.

Libraries can also help shift the discriminatory STEM narrative by ensuring that children from diverse backgrounds grow up secure in the knowledge that they belong in the STEM workforce. By offering STEM programming for children, including hands-on exploration through citizen science, public libraries can promote scientific inclusivity that will help students overcome stereotype threat and the impostor syndrome that often follows. In *Diversifying STEM: Multidisciplinary Perspectives on Race and Gender*, Monica F. Cox argues that people of color

in STEM, especially women of color, face constant discrimination that forces them to have to justify their right to exist within the STEM community. Cox poses the question: "why do women of color (WOC) faculty in science, technology, engineering, and mathematics (STEM) in the twenty-first century have to prove their worth and their educational pedigrees despite their pursuits of advanced technical degrees, their persistence in higher education, and their professional successes?"[54] Immersing children in science at a young age will help ensure that future generations grow up with the understanding that science is a natural part of all of our lives, and is for everyone rather than an elite few. No one should have to justify their right to exist in STEM, and all should be supported on their educational journey to become a part of the STEM workforce. Libraries must therefore make themselves a STEM ally rather than take a stance of neutral complacency. Community college libraries can likewise be powerful allies, and by offering library instruction sessions that teach new STEM students the research skills and terminologies that they will need to succeed, academic libraries can work together with STEM professors with the shared goal of ensuring that STEM students are adequately prepared for the research that their field will require. This, in turn, will help ensure that students from historically underserved communities will have the knowledge, support, and confidence needed to be successful both academically and professionally.

[54] Manuel A. Torres Acosta et al. *Diversifying STEM.*

APPENDIX A

Google Survey Form

1. Age:
2. Race/Ethnicity:
3. Gender Identity:
4. Are you a first-generation college student? (If your parents did not attend college, or if your parents attended college outside of the U.S.)
5. College Level (i.e., Freshman, Sophomore, etc.):
6. Are you a returning student? (Has there been a significant gap between when you graduated high school and when you started college, or are you returning to college after having taken a significant amount of time off from school?) If yes, please explain:
7. College Major:
8. What are your educational goals?
9. What are your career goals?
10. Why are you taking this class?
11. Did you go to public libraries as a child? If yes, for what purpose(s)? (e.g., checking out books, using technology like computers/ internet, participating in programs such as story time or summer reading programs):
12. If you answered yes to the above question, did you attend any STEM and/or STEAM programs? If yes, what programs?
13. Have you used public libraries as an adult? If yes, for what purpose(s)? (Checking out books for pleasure and/or for school, using technology such as computers/ internet, etc.):
14. If you answered yes to the above question, have you attended or participated in any adult programs at a public library? If yes, what programs?
15. Did you attend a library orientation when you started at PCC? If yes, how helpful was it?
16. What is your confidence level with navigating libraries and using library resources? Are you equally confident using academic and public libraries, or are you more confident with one over the other?
17. Do you think libraries are helpful for your specific major? Why or why not?

18. How do you feel about libraries? (Are they intimidating, helpful, safe, etc.):

19. Is there anything else you would like to add?

APPENDIX B

Interview Questions

1. How have you used the campus library up to this point?
2. Have you checked out any library materials?
    a. If yes, what type of materials?
    b. Have you rented any equipment such as a calculator, laptop, etc?
3. Do you feel comfortable navigating the library website?
    a. If yes, why?
    b. If no, why?
4. Do you feel comfortable navigating the library building in person?
    a. If yes, why?
    b. If no, why?
5. Have you used any reference services?
    a. If yes, were they online or in person?
    b. Were they helpful? Did you get the information/resources you needed?
6. Have you attended a library orientation at this institution?
    a. If yes, what did you learn in this orientation?
7. Has the library helped you in this class?
    a. If yes, which resources/services were most helpful?
    b. If no, why?
    c. Has it been helpful in other classes you are taking? More so, the same, or less?
8. Are there any services you need that the library does not offer?
9. Have you used a public library to help with this class?
    a. If yes, please elaborate:
10. Is there anything else you would like to add?

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