DOI: 10.36315/2020end104
Education and New Developments 2020

BUILDING INTEGRATED PATHWAYS TO INDEPENDENCE FOR DIVERSE BIOMEDICAL RESEARCHERS: PROJECT PATHWAYS

Maryam Foroozesh[1], Kathleen Morgan[1], Marguerite Giguette[2,3], Kelly Johanson[1], & Clair Wilkins-Green[3]
[1]Department of Chemistry, Xavier University of Louisiana (USA)
[2]Office of the Provost, Xavier University of Louisiana (USA)
[3]Office of Institutional Research and Decision Support, Xavier University of Louisiana (USA)

Abstract

Diversity of backgrounds and life experiences on scientific teams is known to lead to more innovative ideas and better scientific products. However, in the United States, the percentages of individuals from underrepresented racial and ethnic groups who obtain doctoral degrees in the Sciences continue to be significantly lower than their percentages in the population. This has resulted in the need for nation-wide initiatives to remedy this inequality, and consequently produce more productive teams of scientific minds. Xavier University of Louisiana is a historically Black and Catholic university that is widely recognized in the US for the success of its undergraduate Science, Technology, Engineering, and Mathematics (STEM) programs. *Project Pathways* at Xavier is one of ten federally-funded Building Infrastructure Leading to Diversity (BUILD) programs with the overarching goal of diversifying the Biomedical research workforce. *Project Pathways* is designed as a holistic, integrated, and coordinated program across Biomedical academic departments, student academic and career support offices, and the University's faculty development center.
The overall hypothesis of *Project Pathways* is that if individuals from groups underrepresented in scientific research careers are provided with a) early awareness and deepening exposure to Biomedical careers, b) supportive relationships as they move through the pathway, c) suitable infrastructure, and d) meaningful engagement in Biomedical research experiences and adequate research resources, then a higher number will succeed in entering and successfully completing graduate programs, leading to increased diversity in the Biomedical research workforce. Here, the significant strides of this program during its first five-year funding cycle are presented.

Keywords: *Diversity, student research training, biomedical workforce.*

1. Introduction

Xavier University of Louisiana is a mission-driven, minority-serving, liberal arts institution, and is also a national leader in the number of its STEM alumni who go on to receive doctoral degrees in Medicine, Science, and Engineering. In Fall 2019, approximately 81% of the 2,512 undergraduate students enrolled in the College of Arts and Sciences at Xavier were Black/African American, and about 72% of undergraduates majored in the Biomedical Sciences (Bioinformatics, Biochemistry, Biology, Chemistry, Computer Science, Data Science, Mathematics, Neuroscience, Physics, Psychology, Public Health Sciences, Sociology, and Statistics) (Data provided by Xavier University's Office of Institutional Research and Decision Support). The University is ranked second in the nation in the number of Blacks/African Americans who earn bachelor's degrees in the Physical Sciences, and fourth in the number earning bachelor's degrees in the Biological and Biomedical Sciences ("Top 100 Degree Producers 2018"). A 2013 National Science Foundation report rankes Xavier as first in the nation in producing Black/African American graduates who go on to receive Life Sciences PhD degrees, fifth for those who go on to receive Science and Engineering PhD degrees, and seventh for those who go on to receive Physical Sciences PhD degrees ("Baccalaureate Origins of U.S.-Trained S&E Doctorate Recipients"). The 2012 Diversity in Medical Education report published by the Association of American Medical Colleges (AAMC), ranked Xavier as first in the number of Black/African American alumni who successfully complete their Medical degrees ("Diversity in Medical Education").

Despite recent progress, there is still a significant disparity in the percentage of individuals from underrepresented groups (Blacks/African Americans, Hispanics/Latinos, Native Hawaiians/other Pacific Islanders, American Indians, and Alaska Natives) who obtain doctoral degrees ("Annual Estimates of the Resident Population"). The 2017 US Census Bureau data showed that these individuals made up 39.3%

of the US population, however, according to the National Science Foundation, National Center for Science and Engineering Statistics (2017 Women, Minorities, and Persons with Disabilities in Science and Engineering Report), these individuals only made up 30.5% of doctoral degree recipients in all Biomedical fields. Based on these reports, there is a more significant disparity between the percentage of Blacks/African Americans in the US population (13.4%) and their percentage obtaining doctoral degrees (in all Biomedical fields (6.7%); Life Sciences (6.5%); Physical and Earth Sciences (2.5%); Mathematics and Computer Science (2.8%); Engineering (3.9%); and Psychological and Social Sciences (7.7%)). Nationwide initiatives are required to address this equity and social justice issue which is deeply threatening to the nation's progress and long-term social and financial well-being.

Xavier is one of ten institutions in the United States that are receiving competitive funding from the National Institutes of Health's (NIH) National Institute of General Medical Sciences (NIGMS), Division of Training, Workforce Development, and Diversity (TWD) under the BUILD Program. BUILD's ultimate goal is to increase the diversity in scientists pursuing Biomedical research careers, and thus the NIH-related workforce ("Building Infrastructure Leading to Diversity"). The ten BUILD programs work closely with the National Research Mentoring Network (NRMN) and the Coordination and Evaluation Center (CEC) under the Diversity Programs Consortium umbrella.

2. Objectives

The BUILD Program at Xavier, *Project Pathways,* aims to transform Xavier's educational and support systems to better educate and engage students on the pathway to a Biomedical research career, particularly those students at high risk of not entering or of exiting this pathway.

3. Methods

The Program is comprised of four cores that work together to achieve the Program's goals. The Student Training Core (STC) engages students in hands-on mentored research experiences on- and off-campus and provides them with research skills training, exposure to various Biomedical research areas, and opportunities to attend and present at local and national meetings. The Research Enrichment Core supports: curriculum development activities tailored to enhancing students' research skills and improving Biomedical curricula at Xavier leading to enhanced student preparedness and competitiveness for graduate studies; faculty and staff mentor training; post-baccalaureate training to enhance recent graduates' skills and competitiveness for graduate school; and pilot research project funding and grant writing workshops for faculty. The Institutional Development Core (IDC) provides students with foundational knowledge of Biomedical careers as well as extensive academic and career development support mechanisms available to all Xavier students; the IDC works closely with the STC to coordinate activities. The Administrative Core oversees and unifies the overall project initiatives. Additionally, through partnerships with a number of research intensive institutions, the BUILD Program provides Xavier students with enhanced research experiences that prepare them for entering graduate programs at such institutions with the skills to be successful once there. The Program initiatives are evaluated internally by program evaluators, and externally in the context of the DPC by the CEC. In addition, each BUILD site is assigned an NIH team that provides input and closely follows the Program's progress.

4. Discussion

The first five-year cycle of BUILD Program funding ended in June 2019 and has had significant impacts on Xavier and its students:

- Most students come to Xavier with Medical or Pharmacy careers in mind, and are not familiar with Biomedical research careers and opportunities they provide. New initiatives have been implemented to introduce Xavier students *and their parents* to careers in Biomedical research as early as during New Student Orientation events.
- To further introduce and interest students in such careers, research shadowing opportunities are provided. In the first funding cycle, research shadowing was only offered to freshmen and sophomore students, however, due to its success, all students are now eligible for participation in this activity.
- The Program has led to increased availability of hands-on Biomedical research opportunities for Xavier students and recent graduates, both on- and off-campus (on-campus: 162 pre-BUILD to 208 in Year 4 of the Program), as well as an increased number of students who are pursuing Biomedical graduate degrees (a 57% increase observed for the 2016-2017 graduates compared to the 2013-2014 graduates). During the first five-year cycle:
  - **82** undergraduate students participated in hands-on, mentored research experiences under the BUILD Program;
    - **78%** of the Program's alumni matriculated into graduate and professional programs;

- **41 recent** Xavier graduates participated in one-year post-baccalaureate research training as technicians to improve their competitiveness for graduate studies in Biomedical fields; and
  - **69% of** the technicians who completed the Program entered graduate programs in Biomedical **disciplines** (the percentage is **83%** if we include graduate, Medical, and Pharmacy programs).

- Initiatives have been implemented to improve and synergize the academic and career support resources, and the Biomedical curricula to increase student success rates.
- The Program has led to increased research productivity through faculty support (faculty release time, grant writing workshops, and funds for supplies, equipment, travel, and research infrastructure improvement):
  - **17** research publications;
  - **133** research presentations at regional and national conferences; and
  - **49** research proposals submitted by faculty; **26** funded and **4** pending review at the end of the fifth year.
- Faculty development initiatives have been implemented in the form of interdisciplinary pedagogical, grant writing, and mentor training workshops and seminars.
- 110 (out of 223) faculty members from all disciplines and 53 research and program staff have completed the formalized mentor training program, leading to a significant improvement of the mentoring culture across the campus.
- A robust network has been established with 16 research-intensive partner institutions providing students with research and graduate school opportunities and faculty with new collaborations.

5. Conclusions

The second phase of *Project Pathways* was funded in July 2019 for a second and final five-year cycle, and has been designed to respond to the findings of the first cycle by identifying the initiatives which are most impactful, cost-effective, sustainable, and transferable, and widely disseminate the findings to the greater academic community. The outcomes of the first cycle have already proven the *Project Pathway's* hypothesis by identifying effective and transferable initiatives for increasing diversity.

Acknowledgements

The authors acknowledge the funding received from the National Institute of General Medical Sciences of the National Institutes of Health under Award Numbers UL1GM118967, TL4GM118968, and RL5GM118966. The content is solely the responsibility of the presenters and does not necessarily represent the official views of the National Institutes of Health.

References

American Association of American Medical Colleges (2012). *Diversity in Medical Education* from URL https://members.aamc.org/eweb/upload/Diversity%20in%20Medical%20Education%20Facts%20and%20Figures%202012.pdf

Building Infrastructure Leading to Diversity (BUILD) Initiative. Bethesda, MD: National Institute of General Medical Sciences from URL https://www.nigms.nih.gov/training/dpc/pages/build.aspx

Diverse Issues in Higher Education (2018). *Top 100 Degree Producers 2018: Baccalaureate* from URL http://diverseeducation.com/top100/pages/BachelorsDegreeProducers2018.php?dtsearch=&dtrace=African%20American&dtmajor=&dtschool=Xavier%20University%20of%20Louisiana&dtstate=&dtpage=0

Fiegener, M.K., & Proudfoot, S.L. (2013). *Baccalaureate origins of U.S.-trained S&E doctorate recipients* (NSF 13-323). National Science Foundation, National Center for Science and Engineering Statistics from URL https://www.nsf.gov/statistics/infbrief/nsf13323/nsf13323.pdf

National Science Foundation, National Center for Science and Engineering Statistics. 2017 Women, Minorities, and Persons with Disabilities in Science and Engineering Report, Survey of Earned Doctorates, U.S. Citizen and Permanent Resident Doctorate Recipients by Broad Fields of Study, Ethnicity, and Race: Selected Years 1997-2017 from URL https://ncses.nsf.gov/pubs/nsf19301/data

U.S. Census Bureau, Population Division, Annual Estimates of the Resident Population by Sex, Age, Race, and Hispanic Origin for the United States and States. Retrieved March 22, 2019 from URL https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml