

Leveraging Undergraduate Research to Foster Diversity and Achieve Equity

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**Building Faculty-Student Research Teams via  
a Vertically Integrated Project (VIP) Framework**

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As a mechanism for multidisciplinary undergraduate education, Howard University has experimented with a framework for faculty-student research projects. The university is a culturally diverse, comprehensive, research intensive, and historically black private university. Its enrollment (as of fall 2013) counts 10,002, composed of undergraduate students (6,688) graduate students (1,837), and first-year professionals (1,477). The number of undergraduates in the College of Engineering and Architecture amounts to 612, with an ethnicity breakdown of 83.8 percent black or African American students, 12.5 percent nonresident aliens, 1.1 percent Asians, and 1 percent whites and/or Latinos.

The framework is called a Vertically Integrated Project (VIP), a model adopted by a consortium of 24 institutions formed in 2015 and funded by the Helmsley Charitable Trust Foundation, which fosters long-term research-based team projects for undergraduate and graduate students in any discipline. Howard University is a member of the consortium. In a VIP team, vertical mentorship is naturally practiced from the professor to the undergraduate and graduate students. The team project experience particularly for first- and second-year students provides them with a sense of belonging to their discipline and thus encourages them to remain in their discipline. In the VIP framework, an undergraduate student may join a VIP project in lieu of a course in the degree curriculum or join without course credit to earn experience. The long-term participation provides the students with enough time to master technical and “soft” skill sets as well as the research environment.

In the experimentation period, the following areas were targeted: (1) a minimum of one professor per discipline in engineering who forms and continues to supervise a team; (2) an equal number of student participants from first year to fourth year; and (3) an equal number of student participants from each discipline. Survey results revealed that, from the VIP launch in spring 2015 to spring 2017, the number of VIP teams increased from 5 to 11, the number of professors rose from 4 to 8, the number of faculty disciplines increased from 2 to 5, and the number of undergraduate students grew from 28 to 51.

In assessing the target items, Shannon’s diversity index was adopted (named for mathematician Claude Shannon; see “Student Handout 1-A” n.d.). A diversity index is a mathematical measure that has been used for determining species diversity in a given ecological system or community. Shannon’s diversity index is expressed by a sum of product of two terms for all the types in a system. The first term is the proportion of the number of individuals per type (“abundance”) and the second (the logarithm of the abundance), and the result is the measure of the diversity of the system. The more unequal are the abundances of the types, the smaller is the corresponding Shannon diversity index. Examples of applying the Shannon diversity index

to the VIP project are the following: if all faculty advisers are from one discipline, the Shannon index would be zero. If there are no faculty advisers in the same discipline, the diversity index would be the maximum.

Comparing each semester from spring 2015 to spring 2017, the diversity index for measuring the range of disciplines for faculty advisers has increased from 0.24 to 0.65. Regarding the diversity in the levels of participating students each semester, the number of first-year through fourth-year students was counted, and the Shannon diversity index measure was applied. The diversity for participating students’ year levels has increased from 0.30 to 0.54. However, the diversity for participating students’ disciplines has seen a minimal increase from 0.55 to 0.56.

The students acquired the following top-four soft skills: understanding of contemporary technology, understanding of engineering design, working in a multidisciplinary team, and acquiring a sense of personal responsibility. In assessing acclimatization to the research environment, two indexes were devised to reflect student experiences: a fun index and a pain index that sought to measure the students’ level of joy and frustration, respectively. In spring 2015 and spring 2017 semesters, according to survey, the students’ joy and confusion gradually increased together until the middle of the semester, from which the two curves started to depart, fun-index increasing and pain-index decreasing.

In sum, diversification has gradually increased over the period for multidisciplinary faculty and student participation as well as for multilevel student participation. The participants have gained soft skills as well and have been gradually acclimated to the real research environment. Implementing the VIP framework at Howard University has brought a unique opportunity for underrepresented students to acquire practical experiences and skill sets that encourage them to remain in their respective disciplines and graduate, thus leading to increased employment opportunities for the students and workplace diversification for the nation.

## References

“Student Handout 1A: How to Calculate Biodiversity” (n.d.) <http://www.protectingusnow.org>, available at [http://entnemdept.ifas.ufl.edu/hodges/ProtectUs/lp\\_webfolder/9\\_12\\_grade/Student\\_Handout\\_1A.pdf](http://entnemdept.ifas.ufl.edu/hodges/ProtectUs/lp_webfolder/9_12_grade/Student_Handout_1A.pdf)