

Enhancing STEM Education through Project-Based Learning: Barriers versus Benefits

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Abstract

A practical research experience is an important tool to enhance and reinforce learning in STEM fields, as well as shape commitment to science and engineering careers. Through an integrated approach to STEM education focused on real-world, authentic problems, students learn to utilize and reflect on the problem-solving process. Although the benefits of project-based learning are well documented, institutional culture often discourages broad based adoption of these practices. Barriers exist structurally as well as organizationally. The presenters will speak to how to utilize the strength of undergraduate research as pedagogy to expand the practice within the classroom, as well as collaborate with industry and community partners.

Extended Abstract

A practical undergraduate research experience is often defined as a the pursuit of an original piece of scholarship through scientific method, creative exploration, or deep study. This research can occur in informal contexts through independent studies, or through more formal environments such as national and regional summer programs. General outcomes of undergraduate research include higher rates of persistence, higher levels of graduate school enrollment, greater level of interaction with the faculty, and gains in problem solving and research skills (Swaner & Brownell, 2008). In addition, a study by the Association of American Universities found the undergraduate research experience “helps the students develop critical thinking skills, the ability to work with ambiguity of open-ended questions, an ability to apply skepticism to the daily flow of information and an appreciation of what it takes to create new knowledge” (Merkel, 2001).

Although practical research experiences, including applied research and project based experiences, are valued as high impact experiences (Kuh, 2008), they encounter significant institutional barriers. These barriers include an increased burden on faculty workload, lack of funding for basic programmatic needs, and a lack of recognition in traditional university reward structures. In addition, many institutions take a fragmented approach to coordinating undergraduate research. Individual departments and colleges may be supportive of undergraduate research, but are unable to expand beyond organizational borders.

In 2010, GVSU reorganized and consolidated undergraduate research programs and services into the Office of Undergraduate Research and Scholarship (OURS). Hallmark programs of OURS include:

- Academic Conference Fund, a grant program established to provide travel funds for GVSU students to present/perform at academic conferences. This program supports over

120 students annually in presenting their scholarship at over 50 conferences and professional meetings;

- Student Summer Scholars, an opportunity for mentored, student-driven research and reflection on diverse and intersecting disciplines. Since the inception of the grants, 75% of the faculty-student teams are from the STEM disciplines;
- McNair Scholars Program, a program supporting student-faculty research through the federally funded Ronald E. McNair Post-Baccalaureate Achievement Program and Minority Science Education Center Program (MSEC) housed in the Office of Multicultural Affairs. In McNair, undergraduate students work closely with a faculty mentor in a relationship similar to that of an advisor and graduate student.

In addition to traditional programs, OURS has undertaken a structural, programmatic, and pedagogical approach to increasing the institution's capacity to support undergraduate research and applied research. Methods to increase institutional capacity include: inclusion of undergraduate research in the formal and informal curriculum, encouraging innovative tenure processes which recognize curricular innovation and independent research with students, and scaffolding research experiences through the curriculum to include students in the lower division, as well as the upper division. These innovative efforts have increased both the visibility and capacity of undergraduate research and applied research at the institution.

References

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