



Building an Infrastructure to Enhance and Sustain the Success of STEM Majors Who are Commuting Students

Dr. Josué Njock Libii, Indiana University-Purdue University Fort Wayne

Josué Njock Libii is Associate Professor of Mechanical Engineering at Indiana University-Purdue University Fort Wayne, Fort Wayne, Indiana, USA. He earned a B.S.E in Civil Engineering, an M.S.E. in Applied Mechanics, and a Ph.D. in Applied Mechanics (Fluid Mechanics) from the University of Michigan, Ann Arbor, Michigan. He has worked as an engineering consultant for the Food and Agriculture Organization (FAO) of the United Nations and been awarded a UNESCO Fellowship. In addition to IPFW, he has taught mechanics and related subjects at many other institutions of higher learning: The University of Michigan, Eastern Michigan University, Western Wyoming College, Ecole Nationale Supérieure Polytechnique, Yaoundé, Cameroon, and Rochester Institute of Technology (RIT). He has been investigating the strategies that help engineering students learn, succeed, and complete their degree programs for many years. He is an active member of two research groups in his department: The Undergraduate Projects Lab and the Energy Systems Lab. He is currently the PI of an NSF grant titled "Building a Sustainable Institutional Structure to Support STEM Scholars at IPFW", Award Number:1565066.

Building an Infrastructure to Enhance and Sustain the Success of STEM Majors who are Commuters

Introduction

The US has been experiencing a shortage of STEM workers for many years now and, if current trends continue, projections indicate that the US will be short 1.1 million STEM workers by 2024 [1]. How to increase the number of STEM workers is a matter that is still being debated in the US, including in the Senate Subcommittee on Immigration. Some people encourage the US to hire STEM workers from other countries, in order to allow employers to fill urgent shortages. Others argue that bringing foreign workers into the US creates incentives to displace workers who are born in the US [2], [3]. Many others believe that we should concentrate on urging and supporting schools to increase the interest of their students in STEM, and colleges and universities to increase the number of students who not only major in STEM fields but also complete degree programs in those fields [4].

The National Science Foundation (NSF), for example, is working with colleges and universities to help increase the number of American students who complete their STEM degrees at all levels. One program that illustrates this effort is the NSF Scholarships in Science, Technology, Engineering, and Mathematics Program (NSF S-STEM). This program seeks: “ 1) to increase the number of low-income academically talented students with demonstrated financial need obtaining degrees in STEM and entering the workforce or graduate programs in STEM; 2) to improve the education of future scientists, engineers, and technicians, with a focus on academically talented low-income students; and 3) to generate knowledge to advance understanding of how factors or evidence-based curricular and co-curricular activities affect the success, retention, transfer, academic/career pathways, and graduation in STEM of low-income students [5].”

Indiana University-Purdue University Fort Wayne (IPFW) was awarded a five-year NSF S-STEM grant in August of 2016. This paper describes this project, presents the sponsored activities that were undertaken in the first year, summarizes the results achieved during that year, and sketches the challenges encountered along the way [6].

The NSF S-STEM project at IPFW

Indiana University-Purdue University Fort Wayne (IPFW) is an urban, nonselective institution with a high percentage of returning-adult, commuter, under-prepared, first-generation, and low-income students. Approximately 93% of applicants are admitted in the first year. In the fall of 2017, it enrolled 10,414 students, 57.8 % full time and 42.2 % part-time [7], [8], [9], [10], [11]. Low-income students tend to enroll in colleges and universities that are nonselective [12]. And, indeed, most students at IPFW receive financial aid. A wide gap in the rates of admission,

retention, and degree completion currently exists between highly selective colleges and universities and those that are nonselective.

This project focusses on STEM majors who are commuters. Commuter students attend school full-time or part-time, they live off campus, and their daily obligations are divided among home, work, and school. This NSF project is investigating what institutions like IPFW can do to help students decrease the time it takes them to complete their undergraduate degrees in engineering, engineering technology, and computer science [6]. Because most of the IPFW students are commuters with employment outside of school, their graduation tends to be delayed. This program is designed specifically to accelerate the degree completion of the participating students and to lead to a stronger workforce in Northeast Indiana, which is the service region of IPFW [7], [8], [9], [10], [11].

Design of the program

This project works on building an infrastructure to enhance and sustain the success of STEM majors at IPFW. Naturally, it focusses on commuters, because about 94 % of the students at IPFW are commuters. The infrastructure being built at IPFW consists of five pillars: 1) funding; 2) support services and supportive individuals and groups of individuals from within the university campus; 3) support services and supportive individuals and groups of individuals from outside of university; 4) a team to do research on the academic success of STEM majors; and 5) the S-STEM scholars themselves [14].

- 1) Funding. Grant funding came from NSF to provide scholarships to low-income students who are high achievers in their STEM majors.
- 2) Support from within the university campus. It consists of a network of four communities and individuals from within the university campus who will provide support to STEM majors:
 - A STEM student learning community
 - A STEM faculty learning community
 - A group of faculty and staff that chose to affiliate itself with the project
 - Partnerships with nonacademic departments within the campus that work to help students succeed.

Each community or partnership commits to participate in the project in specific ways that help students succeed.

- 3) Support from outside the campus. It consists of a supportive network of organizations and individuals that are located within the region served by the university:
 - Employers of STEM graduates
 - Professional societies, and
 - STEM professionals.

Each organization or individual commits to participate in the project in specific ways that help students succeed.

- 4) An S-STEM research team. It does research on the academic success of STEM majors at our institution and at other institutions, with particular focus on commuters. The research team works to advance our understanding of the factors, practices, and experiences

(curricular and co-curricular) that affect commuter students' success, retention, and degree completion. Areas of focus for which data are collected include: (a) learning how commuters prioritize the three aspects of their lives (home, work, and school); (b) understanding how commuters use the financial assistance that they receive and its impact on the progress they make towards completing their STEM degrees; (c) identifying the support practices and interventions that enhance the academic success of commuter students from among the many that are provided by universities and colleges; and (d) identifying the challenges that commuters face with juggling responsibilities and obligations from home, work, and school and what the successful commuters do to succeed in this juggling act.

A team consisting of teaching faculty, mentors, academic advisors, and peer mentors has been created to support the NSF S-STEM scholars. These teams are organized and do their work using the well-established concepts of faculty and student learning communities and follow the recommendations from the well-known study by the National Research Council (NRC): *How People Learn*, which identifies four interrelated perspectives of effective learning environments: *Learner-centered environments*, *Knowledge-centered environments*, *Assessment-centered environments*, and *Community-centered environments*. Together, these environments work to create and sustain the mutual support and encouragement of students and the active involvement of all faculty, staff, administrators, fellow students, and employers of the graduates of STEM academic programs [13].

- 5) NSF S-STEM scholars at IPFW are selected following a competitive process during their sophomore year from among eligible full-time students, based on their high-ability or high-potential and demonstrated financial need. They receive scholarships during their junior and senior years.

Activities and their results

Activities in the first year consisted of establishing processes and procedures for the implementation of the proposed work, recruitment and selection of the first cohort of students into the scholarship program, the establishment of a faculty learning community and its schedule of work, and launching the work with the scholars that were selected.

A. Processes during the first year of the project. Two types of actions were taken:

A.1. Advertising: To let students know about the availability of the opportunity for NSF S-STEM scholarships, a flyer describing the scholarship program was created to make students aware of the opportunity. Copies of this flyer were posted on the college website, on each available bulletin board in the building that houses the administrative offices of the college and its STEM departments, and on the bulletin boards of classrooms where STEM classes meet often. Copies were also sent to the administrative assistant of each STEM department of the college for distribution to the students of that department.

A.2. Developing applications forms, their formats, and associated deadlines. A detailed application process consisted of four items: 1) a detailed application form; 2) a letter of recommendation; 3) an essay written by the applicant that addressed existing financial needs,

how the scholarship funds would help meet those needs, and how they would enhance academic achievement and shorten the time to complete their degree program; and 4) a transcript of the academic work completed during the first three semesters of full-time study in a STEM major.

Results: These activities yielded 48 enquiries, 35 applications, and the selection of 9 scholars as part of the first of three cohorts. One student transferred to another university and was dropped from the recruited group, leaving 8 who joined the program in August 2017. They represented five different STEM departments in the college (civil and mechanical engineering, electrical and computer engineering, computer science, manufacturing and construction engineering technology, and computer engineering and information technology) and seven different counties in Northeast Indiana and one in southern Michigan [14].

B. Requests to the university. Two types of actions were taken:

B.1. Lab space. A request for dedicated lab space was submitted to the dean of the college, who forwarded it to the Campus Space Committee with a positive recommendation.

B.2. Web space. A request for dedicated web space was also submitted to the director of web space allocation in the Information Technology Services (ITS) of the university.

Results: The decision on the request for a lab space is still pending. However, web space was granted, a website was created and it is open to the public [14].

C. Establishment of a research team and a faculty learning community. Two types of actions were taken:

C.1. The S-STEM Team, a leadership committee for the implementation of the project, was formed and it met once a month to discuss processes, procedures, the recruitment and the selection of scholars. It consisted of seven faculty and one staff member. *Results:* The team met once a month during the academic year of 2016-2017 and during the fall semester of 2017. It created application forms, received and reviewed applications, and selected 9 students out of 35 to receive scholarships. Also, under the leadership of Dr. Donna Holland, Ph.D., Associate Professor of Sociology and Director of the Center for Social Research at IPFW, three surveys were designed: One for students, one for faculty, and the third one for alumni. The survey for students was administered to 136 STEM freshmen in the fall of 2017.

C.2. Faculty Learning Community (FLC). The S-STEM Team served as the core of the STEM Faculty Learning Community. It consisted of seven faculty and one staff member. *Results:* In the fall of 2017, the FLC met once a month. During each meeting, one member of the FLC made a presentation about undergraduate STEM Education at IPFW to the rest of the group.

D. Establishment of Partnerships. Two types were established:

D.1. Partnerships to support the scholars were established within the university with the following six units:

D.1.1. The Center for Academic Success and Achievement (CASA). *Results:* Each scholar meets once a month with the director of CASA to determine what needs that student may have for academic support. The director then will direct them to the appropriate people who can help.

D.1.2. The University (Helmke) Library. *Results:* Ms. Sarah Wagner, who is the university librarian assigned to work with the College of Engineering, Technology, and Computer Science (ETCS) has been working on creating online modules that instruct students on how to use library services requested by students. A list of topics was submitted to students to choose from and modules on three different topics were completed in the fall of 2017 [15], [16].

D.1.3. The Financial Aid and Bursar offices. *Results:* Meetings with the leaders of the office of financial aid and the office of the bursar took place to discuss and plan the monthly disbursement of scholarship money to NSF STEM Scholars. Scholarship money was disbursed monthly during the fall of 2017.

D.1.4. The Office of Institutional Research. *Results:* Meetings with the director of this office took place to discuss and plan the collection of institutional data and the facilitation of surveys of students. Institutional data needed by the S-STEM team are being provided upon request.

D.1.5. The Office of Assessment. *Results:* Meetings with the leaders of this office took place to discuss and plan and design assessment instruments and the administration of assessment surveys. The director designed a survey instrument that was administered to the scholars at the end of the fall of 2017. This assessment will be used at the end of every fall and spring semesters.

D.1.6. Partnership with affiliated faculty. *Results:* Applicants to the scholarship program identified faculty and staff of IPFW and other institutions who were willing to take time to write letters of recommendation for applicants and provide advice on the application process and support students in other ways, as needed. There were fourteen members in this group during the academic year 2016-2017. This group was different from the S-STEM team. Each affiliated faculty assisted at least one applicant during the first year of the project [14].

D.2. Partnerships were established with organizations within Northeastern Indiana to support the scholars in specific ways that were congruent with the mission of each organization. These partnerships were in addition to the local businesses that wrote letters of support to NSF as part of the proposal process. *Results:* the names of the organizations include the Indiana Department of Transportation (INDOT), the office of the city engineer of the city of Fort Wayne, Indiana, and the Fort Wayne Engineers' Club. Each organization is prepared to help students as needed.

E. The challenges that were encountered during the first year are listed below:

- Communication with commuter students
- Completing the documents that were required by the Institutional Review Board (IRB) of Purdue University
- The slowness of approval processes within the institution and the disbursement of funds
- The limited time available to participating faculty and staff

Conclusion

All in all, much was accomplished during the first year of work on this grant and the PI gratefully acknowledges the invaluable support of the National Science Foundation (NSF) and that of the Co-PIs, all participating faculty, staff, university administrators, and organizations in Northeastern Indiana.

Note: This work is supported by NSF through NSF Award #1565066. However, the opinions expressed in this document are those of the author and do not, necessarily, reflect those of the National Science Foundation (NSF).

References

[1]Talent Wave. http://www.talentwave.com/the-shortage-of-stem-workers-in-the-us/ [Accessed February 1, 2018].
[2] US Senate https://www.judiciary.senate.gov/meetings/the-impact-of-high-skilled-immigration-on-us-workers [Accessed February 1, 2018].
[3]. The U.S. News/Raytheon STEM Index Shows America Will Have to Depend on Foreign Workers to Fill STEM Jobs https://www.usnews.com/info/blogs/press-room/articles/2016-05-17/the-us-news-raytheon-stem-index-shows-america-will-have-to-depend-on-foreign-workers-to-fill-stem-jobs [Accessed February 1, 2018].
[4] United States Department of Labor https://www.bls.gov/opub/mlr/2015/article/stem-crisis-or-stem-surplus-yes-and-yes.htm [Accessed February 1, 2018].
[5] https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5257 [Accessed February 1, 2018].
[6] https://www.nsf.gov/awardsearch/showAward?AWD_ID=1565066&HistoricalAwards=false [Accessed February 1, 2018].
[7] http://new.ipfw.edu/offices/ir/Consumer%20Information%20Page%20-%20FTPT%20Status%20Trends.pdf [Accessed February 1, 2018].
[8] http://ipfw.edu/offices/ir/docs/Sirs201810.pdf [Accessed February 1, 2018].
[9] Northeast Indiana Regional Partnership http://www.neindiana.com/about-us/northeast-indiana-regional-partnership [Accessed February 3, 2018].
[10] Indiana University-Purdue University Fort Wayne. https://www.ipfw.edu/about/ [Accessed February 3, 2018].
[11] IPFW Community Research Institute (CRI) http://ipfw.edu/centers/cri/reports/ [Accessed February 3, 2018].
[12] Increasing College Opportunity for Low-Income Students: Promising Models and a Call to Action, The Executive Office of the President, January 2014 https://obamawhitehouse.archives.gov/sites/default/files/docs/increasing_college_opportunity_for_low-income_students_report.pdf [Accessed February 3, 2018].
[13] J.D. Bransford, A. L. Brown, and R. R. Cocking, <i>How People Learn: Brain, Mind, Experience, and School: Expanded Edition</i> . Washington, D. C.: National Academy Press, 2000.
[14] NSF-STEM program at IPFW. https://www.ipfw.edu/departments/etcs/depts/nsf/index.html [Accessed February 2, 2018].
[15] Library Tutorials. http://ipfw.libsurveys.com/Infolitsurvey [Accessed February 2, 2018].
[16] Library Tutorials. https://guides.library.ipfw.edu/modules_ [Accessed February 2, 2018].