Evaluation of MemphiSTEM

FINAL EXTERNAL EVALUATION REPORT

Jeanne Small | External Evaluator | April 27, 2015
Introduction

“MemphiSTEP: A STEM Talent Expansion Program” (DUE-0756738) is a $2M program funded by the National Science Foundation in 2008 for five years. This project, named “MemphiSTEM” on the University of Memphis (UM) campus, focuses on increasing the number of majors and graduates across various science, technology, engineering, and mathematics (STEM) areas through the incorporation of activities that strengthen recruitment, retention, and persistence among students. This is a holistic project that concentrates on all stages of a STEM student’s undergraduate experience and combines the strengths of the University’s support infrastructure with efforts and expertise of faculty, staff, students, administrators, and the professional community, while building on research, best practices, and local lessons learned. The major strategies incorporated in the STEM Talent Expansion Program (STEP) program plan of activities are: a Pre-Calculus Bootcamp summer bridge program targeting preparation for calculus; an undergraduate research program; peer learning and networking initiatives, faculty development efforts; development of learning communities; and engagement with professional student organizations on campus.

Progress in Year 7

MemphiSTEM is finishing its seventh and final year (the second year of no-cost extension). The project is estimated to end May 31, 2015. The Year 7 annual project report, viewed April 26, 2015 in draft form, details the many successes of the project to date. Almost all key objectives have been met. The very few problems reported were accompanied with sufficient explanation to assure the reader of the circumstances of the problem; for example, the number of graduates from the College of Engineering did not meet benchmarks (but rose steadily each year of the project) because of the disparity between the grant proposal baseline year and the actual project baseline year. The project has been thoroughly evaluated during the course of its initial six years of operation, leading to positive conclusions on its efficacy. In terms of project strategies, while all activities were associated with higher retention/graduation and GPA levels for MemphiSTEM students, the community-building strategies demonstrated the most marked effects of GPA and retention. In particular, the Networking strategy, designed to facilitate interaction between STEM majors and faculty through STEM-focused group events, resulted in the highest retention/graduation and performance effects.

As the project draws to a close, project staff have analyzed the impact of MemphiSTEM on the overall persistence (graduation and year-to-year retention rates) of STEM majors at UM.\(^1\) Data

\(^1\) “Final Findings for Reference to All Data,” Rachel Arthur, MemphiSTEM internal document provided March 12, 2015.
were obtained from UM’s Office of Institutional Research in collaboration with the Consortium for Student Retention Data Exchange (CSRDE) based at the University of Oklahoma. Peer institutions were categorized as those that had had and those that had not had their own NSF STEP grants. In comparison to UM, peer institutions (with and without STEP grants) had a greater percentage of students continue to the second and third years of STEM degrees during the baseline years of the MemphiSTEM project (2004-2007). Between 60% and 70% of students from peer institutions (with and without STEP grants) continued to Year 2 and between 40% and 50% continued to Year 3. At UM, typically only 30% to 40% of STEM majors continued to Year 2 and, 20% to 30% continued to Year 3. However, after the onset of MemphiSTEM in 2008, the percentage of UM students continuing to the second and third years increased, more closely approximating those peer institutions without STEP grants. (Peer institutions with STEP grants appear to have higher retention rates than peer institutions without STEP grants as well as UM). In terms of graduation, students from peer institutions with STEP grants were more likely to obtain a STEM degree after four years than students from UM or peer institutions without STEP grants. UM students and non-STEP grant peers were more likely to continue to a fifth year of study.

According to the Project and Data Manager, the project data collected and analyzed indicate that MemphiSTEM is helping to foster increased STEM graduation numbers at UM. Although the increased graduation numbers in STEM cannot be linked solely to MemphiSTEM student activities, the data for years 1 through 6 suggest that the strategies are indeed fostering student persistence. A comparative analysis of MemphiSTEM and non-project STEM (control) students indicated positive trends regarding retention, graduation and performance among project students.

The sustainability of the MemphiSTEM project was addressed in an earlier External Evaluator Report. This report found that the MemphiSTEM program is already highly sustained within UM’s standard operations and campus culture. Recommendations included focusing on the most effective components of the MemphiSTEM program (specifically, the Networking activities) and looking toward industry contributions for long-term sustainability.

Final Evaluation

The final project evaluation was performed at the end of Year 7. The External Evaluator, Dr. Jeanne Small, visited the UM campus on April 23-24, 2014. The visit was sited primarily in the offices of the UM Center for Research and Innovation in STEM Teaching and Learning (CRISTAL).

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2 http://csrde.ou.edu/web/index.html
3 “Final Findings for Reference to All Data,” Rachel Arthur, MemphiSTEM internal document provided March 12, 2015.
Over the course of two days, Dr. Small met with the project’s current leadership team, Dr. Stephanie Ivey (PI), Dr. Alistair Windsor (coPI), Ms. Regina Hairston (coPI), and Dr. Rachel Arthur (Project and Data Manager), in addition to current CRISTAL staff, Dr. Peter Bridson (Director) and Dr. Catherine Wilson (Associate Director), and several students and support staff. On Friday, April 24, 2014, Dr. Small attended the final Networking event of the semester, presented by guest Anthony Fasano of The Engineering Career Coach.\(^5\)

The aim of this final evaluation was to determine the long-lasting impact of the MemphiSTEM project on the UM campus. Having established earlier that the project was successful and was being sustained, this evaluation examined the transformation of UM faculty, administration, and student services, as a result of having had the MemphiSTEM project at UM. Additionally, the evaluation considers the project’s legacy from the point of view of the UM campus, the State of Tennessee, the nation and the general public. The impacts in specific areas are described in individual sections below.

**IMPACT ON UM FACULTY**

Faculty were targeted for involvement in MemphiSTEM in several ways, with the key involvement being through the STEMinar seminar series. Additional faculty roles in other MemphiSTEM activities tended to involve them in a traditional manner – for example, in meeting with students to explain their research and give tours of their laboratories, and in offering them research lab experiences. The STEMinar series, in contrast, was originally introduced to give faculty ideas for reforming courses to better engage students. By introducing methods that have been demonstrated to improve student learning outcomes at the undergraduate level, and setting up a social dynamic that encouraged and supported change at UM, the series was the MemphiSTEM tool for changing what happens to students in their classrooms.

Indeed, conversations with UM faculty confirmed that the STEMinar series worked as intended. Faculty experimented with change in their classrooms, exploring the use of clickers, blended learning environments, flipped classrooms, and other techniques. Within departments such as Chemistry, introductory-level, multi-section courses were better coordinated among sections, with more coherent learning goals and better methods for measuring student learning. Other forces worked in concert with the MemphiSTEM STEMinar series to provoke change, including accrediting agencies such as the Accreditation Board for Engineering and Technology, Inc. (ABET) and the Southern Association of Colleges and Schools (SACS); the Tennessee Board of Regents’ policies for higher education; and the UM’s change in budgeting (in academic year 2014-15). It appears that the STEMinar series was embraced by a critical mass of UM faculty.

\(^5\) http://engineeringcareercoach.com/
who understood the importance of change, and the mechanisms of change, at a time when they were being required to change.

The STEMinar series will continue in the future, being organized by CRISTAL. The series has evolved to become less topically focused on STEM education methods for faculty, and now serves the career-development needs of students as well. Students have always been welcome at the STEMinar series, and their comments on classroom practices have helped shaped a broader discourse on how to improve education at UM.

Another area of impact on faculty was the MemphiSTEM-funded undergraduate research experiences. While undergraduate research was always part of the culture in the UM College of Arts & Sciences (A&S), it had not been in the College of Engineering (COE). The MemphiSTEM project initiated an “explosion” of undergraduate research in COE, now manifested by COE faculty including support for undergraduate researchers in their proposals.

**IMPACT ON UM ADMINISTRATION**

The creation of CRISTAL in 2009, and its institutional funding in 2012, are manifestations of the UM administration’s commitment to the goals of the MemphiSTEM project. The founding PI and coPIs of the MemphiSTEM project were vocal in promoting the benefits of the project to the UM administration, and as of now the current administration remains deeply committed to STEM student success. CRISTAL is currently supported by A&S and the Provost’s office, using year-to-year funds (typical for this type campus center).

Throughout the project, the UM Office of Institutional Research has been helpful in collecting and analyzing STEM student persistence data, and fully participating in the national Consortium for Student Retention Data Exchange in order to obtain comparative data from other academic institutions.

**IMPACT ON UM STUDENT SERVICES**

UM has always offered support to students, but that support has not always been achieved. Because of MemphiSTEM, no STEM student at UM can escape the knowledge of what services are available to him or her. The communication channels used by CRISTAL involve general email, targeted listservs, and major forms of social media. The attempts to communicate are unrelenting and evolving as technology changes. This is critical, as 85% of UM students commute to campus, and 83% of them work full time or part time while taking classes.

Because students are a transient population at any university, perceptions of long-term change in student culture have to be observed by the faculty and staff who serve them. The MemphiSTEM project transformed the campus so that faculty and staff are more likely to refer a struggling student to the offices best suited to helping him or her. Students are more likely to
speak up to ask for – and expect – help. Faculty and staff speak of UM being more connected than before the MemphiSTEM project, when “everything was separate.”

While a focus on diversity was not a priority in the MemphiSTEM project, it was integrated into the project by having Ms. Regina Hairston as a coPI. Ms. Hairston is the Project Director for the Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP), an NSF program. The aims of TLSAMP and MemphiSTEM are synergetic, and underrepresented minority (URM) students participated in MemphiSTEM activities. Ms. Hairston said that MemphiSTEM stirred up a broader discussion and awareness of diversity among faculty, and better awareness of how the TLSAMP program can support URM students in STEM programs.

A key legacy of the MemphiSTEM program is the tutoring and mentoring culture that involves advanced students helping less advanced students. Near-peer mentoring and tutoring is one of the ways that UM maintains a social structure in which all students benefit, including those with high STEM self-efficacy and STEM identity.

**UM CAMPUS PRESENCE**

CRISTAL, the sustained element of MemphiSTEM, maintains offices and rooms for student activities in Dunn Hall (which houses the Mathematical Sciences Department in the College of Arts and Sciences). It has a well-crafted web presence suited to its ongoing in-reach (to the UM campus) and outreach (targeting the STEM pipeline in West Tennessee). Its leaders are dynamic advocates for STEM education at all levels, and exude the passion and knowledge of how to make things work within and around UM. Brochures offered at the CRISTAL office show savvy knowledge of STEM career and employment opportunities targeting the Memphis, state, and national levels. CRISTAL participates in UM faculty and student activities, and in activities involving the parents of UM students. In communications with parents, CRISTAL reinforces its messaging about the importance and practicality of STEM education, and the availability of support services for STEM undergraduates.

**TENNESSEE STATE PRESENCE**

CRISTAL’s website\(^6\) links to the West Tennessee STEM Collaboratory,\(^7\) which has this vision:

> The West Tennessee STEM Collaboratory unites K-12, institutes of higher education (IHE), and STEM industry partners in an unprecedented approach to transforming STEM education and workforce opportunities throughout the region. The vision will be achieved through the establishment of a West Tennessee STEM Hub and STEM Platform

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\(^6\) [http://www.memphis.edu/cristal/index.php](http://www.memphis.edu/cristal/index.php)

\(^7\) [http://www.memphis.edu/cristal/stem_hub.php](http://www.memphis.edu/cristal/stem_hub.php)
School that will facilitate regional knowledge-sharing, research, and productive partnerships for supporting K-12 students and teachers in STEM.

While K-12 involvement was not part of the MemphiSTEM project, a legacy of the project is the hiring of UM students to be STEM Ambassadors, who aid K-12 students in STEM classrooms in the Memphis area. UM faculty are involved in the West Tennessee STEM Hub by providing material for STEM challenges and competitions, for example.

During the course of the project, MemphiSTEM established communication channels with regional community colleges. Faculty at regional community colleges are on the faculty communication listservs announcing STEM events at UM, and their response rate to invitations remains high.

It is impressive to see the development of the West Tennessee STEM Hub and its emerging excellence in establishing and nurturing a regional K-20 STEM pipeline along with industries in the region. This embodies the “workforce development” aim of the NSF Experimental Program to Stimulate Competitive Research (EPSCoR), yet was done without the investment of the Tennessee EPSCoR project.

NATIONAL PRESENCE

UM is a member of the national Consortium for Student Retention Data Exchange, based at the University of Oklahoma, and shares its student retention data with the organization. With strict privacy controls, this data is accessible only by other institutions that have agreed to the privacy constraints mandated. But with this level of trust, qualified institutions of higher education will be able to see and analyze what has happened at UM as a result of MemphiSTEM.

Manuscripts have been published using the data from the project, which were carefully maintained and analyzed by the two leadership team members with professional expertise in evaluation and statistics (Dr. Rachel Arthur and Dr. Alistair Windsor). The External Evaluator was impressed with the quality of the data being obtained on students who participated in the Networking event on April 24, 2015. Their student ID number was recorded along with their major, so that any analyses in the future will be able to track the specific student’s participation in MemphiSTEM legacy events.

The NSF Division of Undergraduate Education offers a STEM Central8 website that gives projects such as MemphiSTEM the opportunity to share resources with interested parties. Dr. Rachel Arthur, the MemphiSTEM Project and Data Manager, has posted several products of MemphiSTEM to this website, and has generated the posters presented at annual gatherings of NSF STEM Talent Expansion Program awardees.

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8 https://stem-central.net/
PUBLIC WEB PRESENCE

Currently, MemphiSTEM is maintaining a website\(^9\) dedicated to the project. Elements of the website are particularly admirable, for example the Project Quick Facts.\(^{10}\) Plans are underway for a legacy web page that highlights the aims and achievements of the MemphiSTEM project. This web page will be housed in the CRISTAL website, and should include the Project Quick Facts, the Year 7 MemphiSTEM poster, the names and contact information of the project’s PIs and coPIs, a link to the project on the NSF website,\(^{11}\) and a description of the project’s history and legacy.\(^{12}\)

Summary

For UM, the MemphiSTEM project was clearly the right project at the right time. It mobilized faculty, benefitted students, impressed administrators, inspired regional STEM leadership, and furthered excellence at UM in STEM education. The legacy of the project is entrenched at many levels at UM, and is a credit to the hard working faculty and staff who made the project a success.

Over the course of eight years (from proposal stage to the second year of no-cost extension), the team of PIs and coPIs, and the Project and Data Manager, maintained high levels of competency in executing the project plan. Enthusiasm for all projects that improve the STEM experience for UM students remains high, and the current project personnel are actively submitting proposals for future work on the topic. In cases where proposals are not funded, many of the ideas they include are nonetheless implemented at the available scale at UM.

It has been said that “it takes a village to raise a child.” The philosophy at UM, resulting from the MemphiSTEM project, is that “it takes a well-integrated campus community to raise a STEM student.” With this final report, I offer my kudos to all who have made the MemphiSTEM project successful.

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\(^9\) http://www.memphis.edu/memphistem/
\(^{10}\) http://www.memphis.edu/memphistem/projectquickfacts.php
\(^{11}\) http://www.nsf.gov/awardsearch/showAward?AWD_ID=0756738
\(^{12}\) For example, see http://www.stc-mditr.org/