A STEM Program Focused on Transfer Student Success at Binghamton University

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***Abstract*— Some transfer students have significant challenges in adapting to the pace and depth of a competitive four-year University. According to the National Student Clearinghouse Research Center, only 60% of transfer students from community colleges have earned their baccalaureate degree four years after transferring. In this paper, we present our program designed to increase the success rate of transfer students. Our goal is to continue Binghamton University's tradition of providing an effective collegiate learning environment for all, and particularly, to increase the success rate of the transfer students in STEM fields.**

Keywords—STEM; transfer students; community colleges

I. INTRODUCTION

Binghamton University is a highly ranked undergraduate university in the "more selective" admissions category[1]. Many of the admitted students are at the top of their class. Transfer students take an alternative path into Binghamton University, typically transferring in after their sophomore year and finishing their junior and senior year at Binghamton University, ending up with a Binghamton University degree. For many, that is a good path. The two years at community college provide a less competitive introduction into the college atmosphere.

However, some transfer students have significant challenges in adapting to the pace and depth of a competitive four-year University[2]. According to the National Student Clearinghouse Research Center, only 60% of transfer students from community colleges had earned their baccalaureate degree four years after transferring[3]. Community colleges form a vital pipeline for increasing the nation's supply of STEM graduates[4].

Studies have identified cohort-forming as a key predictor of student success among both transfer students and full year students[5]. Our goal is to continue Binghamton University's tradition of providing an effective collegiate learning environment for all, and particularly, to increase the success rate of the transfer students in STEM fields.

An interdisciplinary group of faculty developed a STEM program dedicated to improving the success rate of our transfer students. Our program is designed to provide support and opportunities for a more immersive university experience. It is designed around a broad nanotechnology theme, with the participants all having some level of interest in the nanotechnology area. It is modeled after the best known pedagogical methods to improve satisfaction and retention.

In this Work-in-Progress, we illustrate how we establish effective support and retention practices including cohort building through a seminar class, skill development and leadership opportunities, building of peer support networks, and required research and teaching involvement with a nanotechnology theme, along with mentoring and financial support through scholarships. The students chosen for this program have deliberately been diverse and multidisciplinary, with majors including Math, Physics, Psychology, Engineering and Biology.

II. PROGRAM OVERVIEW

A. Program Skeleton

From the students' perspective, the program looks like a scholarship with few conditions or burdens, but instead the offer of a supportive, invigorating environment. . The letter of acceptance that they sign states the following as the formal requirements.

- Participate in the orientation program to take place right before the start of the fall semester.
- Take the one credit STEM seminar class, EECE380A.
- Maintain a 3.0 GPA for the scholarship to be renewed.
- Be actively involved in research during your time at Binghamton. At a minimum, this requires that once during their program you participate in a research experience such as a for-credit independent study, or other research experience acceptable to the Nano STEM committee. However, we encourage you to join and contribute to an active research group throughout your time at Binghamton.
- Once during the program, participate in a teaching role in a science or technology education activity. Some potential acceptable activities include participating as an undergraduate course assistant, acting as a counselor at Go Green program for middle school students, participating in the after-school science program run by Binghamton faculty and students, or other teaching or mentoring activity acceptable to the Nano STEM committee.

Fig. 1. Requirements for the NanoSTEM program.

In return for fulfillment of these conditions, the program provides up to $8000/year for a regular academic year, and has also, on occasion, funded students for summer or winter classes.

In practice, periodic support meetings, and introduction to research activities, form the backbone of our STEM program. The students show up for an orientation program in the fall a day or so before classes start. The orientation consists of a tour of the relevant research facilities, including the

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Nanofabrication Clean Room and the Advanced Diagnostic Laboratory. They are given an overview of research opportunities in their departments and a brief overview about how to get involved in these endeavors.

Thereafter, there is a once-a-week seminar meeting, throughout which the theme of research is subtly stressed. A variety of collaborative activities and common experiences are woven into the seminar class, to promote cohort-building.

At the end of each semester, the students are required to write a brief description of their research and service activities. This holds them accountable to the requirements of the program. The details of the seminar class, and the students' particular research and service activities are covered in subsequent sections below.

B. Recruitment

The key to a successful program is the recruitment of very high-quality students with an overall goal of increasing the number of diverse and economically disadvantaged students in the sciences and engineering. Our two cohorts were recruited through:

a) Flyers circulated to local community colleges

b) Recruitment trips to community colleges in Long Island and Queens

c) Screening of applicants, followed by targeted emails to qualifying students

d) Maintenance of a program website (http://www.binghamton.edu/physics/sstem/)

By far the most successful of these activities was our tightly coordinated work with the Undergraduate Admissions office. Our colleagues in the Binghamton admissions office screened for candidates with high GPAs, STEM interests, and financial need, and identified them to the NanoSTEM committee. Subsequently, the committee sent an email inviting the individual to apply for this scholarship. The committee continues to hone this recruitment process. In the second year of the program, the process has been automated to the point where the admissions office emails invitations to submit an application to the NanoSTEM program to qualified students, and (if they apply) their application materials are forwarded to the NanoSTEM committee for review.

Our recruitment activities improved over time.

2014-2015 Class:	≈10 applicants, 7 awarded
2015-2016 Class:	≈30 applicants, 8 awarded
2016-2017 Class (to-date)	≈30 applicants, 10 offers

C. Orientation

Our cohort building begins with an orientation session, which consists of presentations on undergraduate research from faculty in many fields. A group discussion with faculty from representative departments and the cohort is provided. The students are taken on a tour of major nanotechnology research centers on campus, including the Advanced Diagnostic Laboratory and the Nanofabrication Laboratory. The requirements for the program are reviewed and the students are, we hope, made to feel welcome.

D. Seminar Class

The seminar class serves as the main venue where we interact with and track the students. We emphasize non-technical skills, such as writing and presentations, teamwork, and a bit of engineering design. The larger unmentioned goal is cohort-building. This sort of peer support network has been shown to dramatically increase performance in STEM careers[6].

Table 1: Structure of the Seminar Class

1. Each year, every student gave a presentation (on research topics, if possible, or other topic). This talk was followed by feedback from the other students on the presentation, which was kept constructive.
2. Each semester, every student did a brief, Toastmasters-style, short talk
3. Presentations were arranged in areas of general interest. Examples from 2015:

   "Home Improvement", Prof. Steve Zahorian

   "Adventures in Employment", Prof. David Klotzkin

   "Entrepeneurship", Prof. Ken McLeod
4. Each semester, every student wrote up a one page description of their research activities or service activities, or their plans for the same
5. Every year, the class as a whole was involved in a 'major activity'.

   2014-2015: Mario Kart Lego edition, robot contest

   https://www.binghamton.edu/ece/about/brag-bits/2015-robot-race.html

   2015-2016: Organized and ran 2016 STEM visit

   http://www.binghamton.edu/ece/about/brag-bits/s-stem-visit.html

The students' opinion of the program, and the seminar class, was evaluated through pre- and post-assessments. While their opinion of the program was quite high (and will be presented in subsequent sections) one constructive response received was that they did not feel they got enough feedback on their writing, and in the future our seminar class will include writing assignments with evaluation and revision by the students

This seminar class and this modest set of activities succeeded in building a good team feeling among the cohort of students. In addition, it also provided some help with soft skills, such as presenting, writing and teamwork.

As the students begin the program in their Junior year, they attend the class for two years. In their second year, the veteran students from the previous year informally mentor the new group.

E. Research and Service Activities

The other requirements for this scholarship are the research and service activities. The program requires and facilitates opportunities for the students to fulfill the requirements, but does not directly oversee student research (other than that, as usual, faculty involved in the program may end up supervising student research). The breadth and depth of the activities the students end up in will be covered in section III. Results: First Year Cohort.

III. Results: First Cohort

Below summarizes the student results in the first cohort of students admitted in Fall 2014.

Table 2: Results and Some Activities of the First Cohort, Admitted 2014

Student Status (names omitted)	Field	GPA (after 1 year)	Some Service/Research Activities
1.Graduation expected December 2016	Biology	3.3	Cancer Research, Upstate Medical Institute
2.Graduated	EE	3.86	Interned at Microchip, Binghamton, NY
Dropped out due to medical reasons	Biology	3.42	
3.Graduation expected December 2016	Biology	3.04	Worked at Go Green Institute
4.Graduated	EE	4	Interned at IBM Endicott
5.Graduated	Psychology	3.64	After School Science, African Road Elementary School
6.Graduated	ME	3.38	Undergraduate Research: Prof. Yong, Thermal Fluids

The activities in the final column are not comprehensive, but just a sample of the breadth of teaching and research/internship activities in which our students were involved. Whether by good fortune or careful recruiting, the program selected very strong, motivated students, who are doing quite well. There were originally reservations about simply making the research a requirement, rather than directly providing and organizing research opportunities, but as can be seen, the students generally managed to fulfill the requirements successfully.

As many of the program's students were engineers, not scientists, the decision was made to treat internships and significant professional work as equivalent to research. Student 2 and student 4 are fulfilling their research obligation (and obtaining excellent experience) through such industrial experiences; Student 6 is significantly involved in research in the Mechanical Engineering Department.

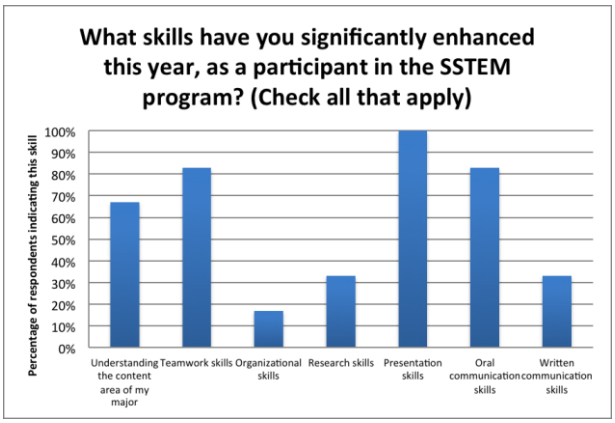

Fig. 2. Students' self-report of skills they feel they have significantly enhanced

However, while the research and practice activity the students found were universally judged to be worthwhile, overall the teaching and service activities were found to be somewhat light, and consisted largely of volunteering at orientation events for a day and the like. One identified area for improvement was to provide students more opportunity for meaningful teaching and service.

IV. Student Feedback: First Cohort

The student participants were extremely positive in their feedback about the program, as provided to our external evaluator, Dr. Greta Myers, in two electronic surveys of the students, as well as in-depth individual interviews. First, Fig. 2 and 3 compare the students' self-reported skill improvement and overall strength in different skills at the beginning and end of the first year.

In survey questions after the first year of the program, 100% of the students were interested in pursuing a STEM career (up from 70% at the beginning of the program). Student comments are also very positive: for example, "The STEM program has been extremely essential for me, in that it has helped me properly transition from acommunity college into Binghamton…".

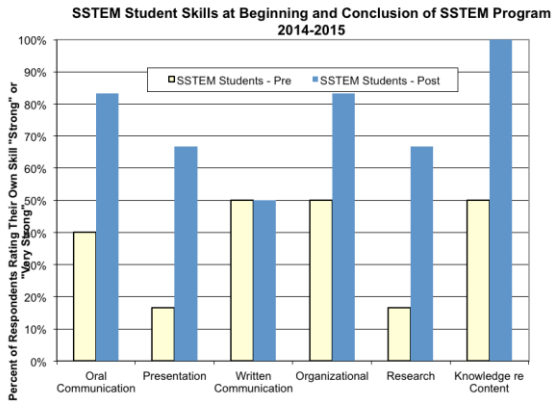

Fig. 3. Students' self-report of strength of skills at onset of the program and at the conclusion of the first year.

Fig. 4. STEM new admits and faculty for 2015. Dr. Jiye Fang is on the left and Dr. David Klotzkin is second from right.

As a whole, the students were quite positive about the program. However, there were two areas that were not as strong. First, though the students we got were unquestionably very strong, we wanted to further improve the selectivity and be able to even better balance the program with a diversity of genders, majors and backgrounds. Second, as noted, we wanted to give the students better opportunities for meaningful teaching and service.

V. Recruitment: second Cohort

For the second cohort, the recruitment efforts were increased. The admission and financial aid office provided contact information of transfer applicants who met the criteria to the NanoSTEM committee; the NanoSTEM committee sent them emails inviting them to apply; the applications were evaluated and offers were made. As a result, the second cohort got 30 applications (significantly more than the 12 for the first class.) This allowed us to select the best students for a balanced class. The second cohort for the NanoSTEM program is shown in Fig. 4. In recruitment for the third cohort, ongoing, the process has been further streamlined.

VI. Improved service activities

The second improvement was to try to give more meaningful opportunities for realistic teaching and service. As it happens, the Binghamton School District Challenge Program was interested in bringing their students in for a STEM activity day. The students in the STEM program volunteered to arrange and host the activities for the visit and provide a meaningful science experience for the sixth graders. About 70 sixth graders visited in two groups in two consecutive days.

Fig. 5.: One of our STEM Students supervising a process improvement activity during the STEM visit from the Binghamton 6th grade visit.

All the ideas and activities were designed by the STEM students. The event as a whole was designed around the movie Divergent (a dystopian adventure in which people were in various factions, called Erudite, Dauntless, and the like, in which emphasized intellect, bravery, or other qualities). This creative framework invented by the STEM students, lent structure to the activities and motivated the 6th graders to complete activities to see which faction they would be in.

Fig. 5. shows a bit of the event. More details can be seen here: http://www.binghamton.edu/ece/about/brag-bits/s-stem-visit.html , and http://www.binghamton.edu/photos/index.php/gallery/archives/2484/ .This whole event was well received by both the students attending, and the STEM students presenting it. It is now planned to repeat this event annually and potentially visit local schools as well.

VII. Attrition

One of our goals was to increase retention. So far, we unfortunately have had two students leave the program (and the school) for medical reasons, and a third student who left after about 8 weeks when she could not make a good adjustment to Binghamton University. Discounting medical reasons, the attrition rate of 1/15 compares favorably with the reported 40% non-completion rate.

VIII. Conclusions

The details of our NanoSTEM program, designed to increase student retention and performance are presented. As a whole, students in the program have been quite successful. In the words of the students from the evaluation survey, “The STEM program is an exciting experience which helped me easily transition from a community college to a four year university.” A formal evaluation of the efficacy of our program is planned after it has been completed by sufficient numbers of students.

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