T-SITE: A UMBC Community of Transfer Scholars in Computing, Information Technology, and Engineering

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1. Introduction

To retain our stature as a science and technology leader, the U.S. will need to increase the number of students earning undergraduate STEM degrees by about 34% annually [24]. While all STEM occupations are important, the need for computing and engineering professionals is critical to our nation's future economic success and protection of its assets and infrastructure [20-22]. Between 2014 and 2024, the number of jobs in the computer and mathematical occupational group will grow by 12%. There will also be higher than average growth in the areas of biomedical (23%), environmental (12%), and petroleum engineering (10%) [2].

Nationally, nearly half of the undergraduates completing STEM degrees begin their academic careers at community colleges [9]. Women and members of ethnic/racial minority groups currently make up 70% of all college students, but they continue to be underrepresented in both computing and engineering majors at two- and four-year institutions. The broader term "underrepresented students" is typically used to refer to a subset of the larger population of undergraduate students that continue to be underrepresented in computing and engineering majors at two- and four-year institutions and in these careers, including: women, African American, Hispanic, first-generation college students, adult learners, and students with disabilities. These underrepresented students often choose to begin their education at community colleges because of their affordability, career programs that provide job training, developmental programs that enable college readiness, English as a Second Language (ESL) programs, convenient locations, and flexible class schedules and delivery formats. Community colleges are also the first choice for many high-achieving, traditional-age students from diverse backgrounds who are undecided about their career direction, have financial constraints, or have family situations that preclude their starting at a four-year residential college or university [4, 8, 15].

Despite the benefits, beginning at a community college can negatively impact bachelor's degree attainment, due to the realities of high levels of attrition among community college students, difficulties associated with transferring, and attrition after transferring [25]. Once at the university, transfer students face multiple challenges associated with adjusting to the new academic and social environment. Women of color in STEM fields who transfer from community colleges face unique challenges related to the intersection of gender and race—also referred to as the "double bind" [16]. Women of color in STEM face "isolation, invisibility, discrimination, not belonging and disconnects from external social and cultural networks" ([25], p. 244). One of the major leaks of talent in the STEM pipeline occurs between community colleges and universities. Programs are needed that effectively recruit, transition, retain, and graduate talented transfer students, especially underrepresented minorities and women.

The UMBC T-SITE (Transfer Scholars in Information Technology and Engineering) Scholars program has addressed the national need to increase the number and diversity of new computing and engineering graduates by providing financial, academic, and professional development opportunities to transfer students in computing, information technology, and engineering majors.

T-SITE is funded by the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program and managed by the Center for Women in Technology (CWIT) at the University of Maryland, Baltimore County (UMBC). CWIT has implemented three S-STEM Scholars programs since 2007. The first, "Scholarships in IT & Engineering (SITE)" (DUE-0630952) served 30 students through spring 2011, 50% of whom were women or underrepresented minorities. CWIT's second and third S-STEM projects are titled, "A Community of Transfer Students in Information Technology and Engineering (T-SITE)" (DUE-1154300) and "A Diverse Community of Transfer Scholars in Computing and IT (T-SITE-C)" (DUE-1458343). The two most recent grants provide the basis of support for the T-SITE Scholars program, which is now in its fifth year at UMBC.

The T-SITE Scholars program design is based on empirical evidence in the literature and best practices related to transfer student success, women in engineering and computing, and underrepresented minorities in STEM. In this paper, we discuss (1) the impetus for designing a Scholars program to address the unique needs of transfer students (particularly women and underrepresented minorities) in computing and engineering, (2) share key outcomes that highlight successful and replicable elements of the T-SITE Scholars program, and (3) discuss the challenges encountered throughout the implementation of T-SITE, as well as some ways we have responded to those challenges.

2. Background

Maryland ranks second in the nation in professional and technical workers as a percentage of the workforce [18]. UMBC is a major producer of engineering and IT graduates prepared with the necessary skills to fill the needs of Maryland employers. The T-SITE Scholars program contributes to the regional and national need for technology professionals. UMBC has been aggressively focused on improving the success, retention, and graduation of all undergraduate students. Prestigious merit scholarships promoting STEM diversity have primarily been available only to first-time full-time freshmen. Until programs such as SITE, T-SITE, and others emerged, there were no formalized scholarship programs that provided intensive support services for high achieving transfer students with financial need in engineering and computing majors at UMBC. Within this context, T-SITE has been extremely important to the success of transfer students and has aligned with the priorities of the University and the College of Engineering and Information Technology (COEIT).

Extensive research about the transfer student experience has shown that the challenges of the transfer process can be eased by orientation and other programs targeted toward transfer students that facilitate academic and social integration into the university [15, 25, 26, 27]. The reality is that four-year institutions dedicate more time and resources to first-year programs for freshmen [27]. First-year seminars, welcome activities, and other transition services are designed to meet the needs of younger students with no college experience. Transfer student programming at two- and four-year institutions should make students more aware of courses to take for transfer and the financial aid process. Programs are needed that provide community college faculty, advisors, and students with current information about the four-year institution and its expectations. Transfer program elements should be tailored to address the academic and social transition issues associated with the demographics (gender, ethnicity, race, socio-economic variables) of specific populations

of transfer students [27]. Research has clearly demonstrated that undergraduate success and persistence in STEM is enhanced by highly structured programs that combine multiple interventions such as financial support, intrusive advising, mandatory study groups, faculty mentoring, and community-building activities [1, 3, 5, 6, 7, 10, 13, 14, 19, 23]. The T-SITE Scholars program has substantially expanded the available financial support and cohort-based support services for academically talented students interested in transferring into computing engineering majors, especially for women and underrepresented minorities.

3. T-SITE Scholars Program

The T-SITE Scholars program seeks to achieve the following outcomes: (1) apply the highly successful CWIT support structure and community-building scholar model to transfer students in computing and engineering majors with financial need to increase their success; (2) provide the T-SITE Scholars with academic and professional development information and opportunities, including connections to internships and research opportunities; and (3) solidify relationships with faculty and staff at five Maryland community colleges (Anne Arundel Community College, Community College of Baltimore County, Howard Community College, Montgomery College, and Prince George's Community College) with a focus on expanding the pipeline of transfer students pursuing computing and engineering majors, especially women and underrepresented minorities.

T-SITE Scholars are fully integrated into the CWIT Scholar community and support services are provided by CWIT staff and faculty in each academic department. Each group of Scholars benefits from high scholarship requirements, community participation expectations, and the strength and synergy of the expanded peer network. T-SITE Scholars are expected to participate in academic, professional, and community-building activities and maintain at least a 3.0 GPA. The CWIT programming model integrates effective faculty mentoring, intensive staff advising, ongoing peer support, a first-year experience, and access to undergraduate research, internships, and career development events and industry mentors. Each of these support elements are intertwined to create an integrated experience for Scholars. For transfer students, this holistic model of support safeguards the transition process and nurtures the development of T-SITE Scholars as successful UMBC students and future professionals in engineering and computing.

3.1 Key elements of the CWIT model, which support the academic and professional development of T-SITE Scholars, include:

a) <u>New Scholar Retreat and First Year Seminar</u>: Each incoming cohort of T-SITE Scholars participates in a two-and-a-half day retreat with the new Scholars of other CWIT programs. The retreat is organized and implemented by upper-class Scholars (with staff oversight) and held in August before classes begin. It builds cohort cohesiveness, offers student panels that discuss what it takes to be academically successful, and includes time to meet with faculty mentors, CWIT alumni, and COEIT faculty and staff. T-SITE Scholars also participate in a First-Year Seminar specifically tailored for computing and engineering students in their first semester at UMBC.

b) <u>Monthly Family and Cohort Meetings</u>: T-SITE Scholars meet regularly with the whole CWIT community, as a T-SITE family, and by cohort. A regular schedule of topics has

been developed that addresses academic topics such as picking courses for the next semester, senior year job search, obtaining a first internship, and managing test anxiety. Time is set aside in each monthly meeting for team-building activities and paired or small group discussions.

c) CWIT Social Activities: The CWIT Student Council, a recognized student organization on campus, plans social activities for the Scholar community each semester, such as movie outings, holiday parties, a CWIT formal, and midnight bowling.

d) Online Community Building with myUMBC Group, Facebook, and Twitter: CWIT has a members-only myUMBC Group within the UMBC portal that provides a source of information and news for Scholars. Scholars also maintain a closed Facebook group and Twitter account. The use of online social networking has increased the cohesiveness and daily connection of scholars with each other, CWIT staff, and the greater UMBC community.

e) Faculty Mentoring: All new T-SITE scholars are intentionally paired with a faculty member from their major. The nature of the faculty mentoring relationship is much more than academic advising. Faculty mentors get to know their protégés on a deeper level, help them set academic goals, and personally connect them with undergraduate research opportunities. Scholars are encouraged to meet monthly with their mentor while they are in the program. Faculty mentors are Co-PIs of the grant and receive a small stipend.

f) Peer Mentoring: T-SITE Scholars are paired with an upper-class peer mentor, called a BigWIT, in the first semester. Peer mentors provide ongoing advice, information about the major, and support to Scholars. Assessment data shows that new Scholars and Affiliates are especially satisfied with CWIT's peer mentoring program and that BigWITs help new Scholars with the transition into their major.

g) Professional Staff Advising: A CWIT staff member closely monitors T-SITE Scholars' progress and participation in academic and professional development activities. Scholars meet monthly and receive holistic, professional, intensive advising related to long-term goal setting, academic progress, and personal and professional issues.

h) Professional Development Networking Events: Each semester, CWIT organizes Women in Technology events. These interactive networking events feature industry professionals and CWIT alumni who share information about their own career paths and opportunities within their companies or organizations.

i) Career Center Programming: CWIT staff members collaborate closely with UMBC's Career Center to foster T-SITE Scholars' career management knowledge and skills. Scholars are required to utilize the Career Center's resources for resume writing, internship/job search and networking. Career Center staff also deliver tailored workshops for the CWIT community and promote Scholars to employers they work with who are seeking interns and full-time employees.

j) Industry Mentoring: T-SITE Scholars are assigned an industry mentor within the first semester of their second year at UMBC. Industry mentors inspire Scholars to think about the range of work options available and actively support their career exploration, professional development, and networking in their field and/or industry. CWIT's Industry Mentors are volunteers from private companies and government organizations. Scholars are encouraged to meet monthly with their mentors during the semester they take the Industry Mentoring Practicum (IMP). The IMP provides instruction and facilitates discussion about students' strengths, workplace culture, and culminates with the creation

of a written career plan. Some continue to meet after the term of formal mentoring is complete. Many mentors attend one of the IMP class sessions and serve as additional resources for the whole cohort.

k) Leadership Development and Service Learning Opportunities: T-SITE Scholars are encouraged to assume leadership positions in engineering and IT student organizations at UMBC including the Society of Women Engineers, Tau Beta PI, Information Systems Council of Majors, the Mini-Baja Team, Engineers without Borders, and the CWIT Student Council. In addition, T-SITE Scholars volunteer for ongoing STEM related events such as FIRST Lego League competitions, the US Science and Engineering Festival, and high school or community college visits. T-SITE Scholars are also encouraged to serve on the planning committees for WIT events, the new Scholar retreat, and "Bits and Bytes" (CWIT's overnight STEM program for high school girls).

3.2 T-SITE Successes

Since its inception in 2012, T-SITE has served 32 transfer students with diverse backgrounds from Maryland community colleges who are majoring in engineering or computing and have demonstrated financial need. Forty-four percent of these scholars identify as women, and 47% identify as African American or Black. Scholars in the first four cohorts came to UMBC with an average transfer GPA of 3.41 and 59 credits completed. The average time to graduation for T-SITE Scholars is three years after transferring to UMBC. Twelve of the 13 scholars in the first two cohorts have graduated; one is still pursuing a computing degree at UMBC. Two of the fifteen scholars in the third and fourth cohorts have graduated and five are expected to graduate in spring 2017. One hundred percent of all students in the first four T-SITE cohorts have been retained in engineering or computing majors. A fifth cohort of four T-Scholars entered the program in fall 2016.

In addition to their academic successes, T-SITE Scholars take advantage of opportunities to develop professionally and advance their career potential. Scholars have completed internships with employers such as IBM, General Electric, Exelon, NSA, and Northrup Grumman, as well as undergraduate research experiences at the University of Pittsburgh and Worcester Polytechnic Institute. Eighty-six percent of T-SITE scholars in the first four cohorts have engaged in an internship or research experience and almost half (13 of 28; 46%) of the scholars in the first four cohorts have obtained full-time jobs prior to graduation.

T-SITE Scholars play active roles in raising awareness about the T-SITE program and the complex issues faced by transfer students. Throughout the life of the program, Scholars made presentations at University events, participated in panels, and promoted the program to potential applicants. When asked about the impact that the T-SITE program has had on their academic and professional success, Scholars said the following:

> *Being a T-SITE Scholar has contributed a LOT in my academic and professional success from day one. Before I even started [at] UMBC, T-SITE taught me a lot about how to make the best out of my major, the opportunities I had, and I was assigned a mentor who is really flexible and helpful. – T-SITE Scholar (fourth cohort)*

> *Being a T-SITE scholar helps to hold me accountable for my performance in my courses, and helps motivate me to be a better student and to engage more both in and out of the classroom. I also get the benefit of being part of a group of individuals who share a lot of the same problems that I have experienced in the past or may experience as a transfer student at UMBC. – T-SITE Scholar (fourth cohort)*

> *I do not really think I would have made it through my first semester at UMBC if it wasn't for the T-SITE community. … What I appreciate most about the T-SITE program is the fact that it is a community. Being in the community has helped me a lot. I have people I trust, people I can talk to and go to for help. – T-SITE Scholar (fifth cohort)*

Awareness of T-SITE and UMBC's STEM transfer opportunities has also grown among Maryland community college STEM faculty, advisors, and students. Through T-SITE, important insights have been gained about the transfer student experience and have been continuously shared with the broader higher education community. Results from the T-SITE program have been disseminated via national conference presentations as well as accessible online publications [17, 11, 12]. Additionally, knowledge gleaned from the T-SITE program will inform CWIT's newest NSF funded project, "Developing, Implementing, and Evaluating a Post-Transfer Pathways Program for Computing and Engineering Majors" (DUE-1626413), which will provide pre- and post-transfer advising, as well as a special first year experience course for incoming transfer students in COEIT majors starting in fall 2017.

3.3 T-SITE Challenges

Challenges in the successful execution of the T-SITE Program have resulted from both student situations and program constraints.

3.3.1 Student-level Challenges

Demographically, T-SITE Scholars possess different characteristics than incoming freshman students. They tend to be older, with different responsibilities and motivations than first-time freshmen. The outside responsibilities of transfer students tend to be both greater and more varied than those of freshmen. Most have worked full-time while attending the community college and a number have spouses and/or children.

Although transfer students have completed numerous courses at community college, they may not have planned strategically to select courses that will lead to completion of a four year degree. Additionally, some transfer students have not firmly decided on their major and may change majors during their first year at UMBC. Although transfer students attain the required total number of credits, the credits earned for previous courses in their declared major are not always accepted by UMBC. In our experience, math and science courses tend to articulate well, with the community college versions preparing students well for later course work. Computing courses tend to match less reliably, even when articulation agreements declare courses equivalent. Because different schools partition topics into the first two computing courses differently, students are strongly encouraged to take both courses at the same institution. Still, some students resort to retaking their last computing course when they arrive at UMBC in order to ensure that they are well prepared.

Engineering courses, with the exception of freshman design, are rarely offered at community college and so must be taken at UMBC.

We have also found that transfer students have not consistently developed the study habits, time management skills, and analytical thinking skills needed to be successful at UMBC. The psychological and emotional aspects of transferring from a community college to a four-year institution pose challenges not generally experienced by typical incoming freshmen. A substantial portion of transfer students are dealing with personal issues (*e.g.*, family issues, extreme stress, mood/depression, lack of family support) that impact their ability to focus on academics. Students from developing countries, who did not attend high school in the US but are now permanent residents, often lack experience with programming and technology, which can hinder their ability to succeed in computing and engineering majors. Similarly, non-native English speakers can face unique academic, social, and career development challenges.

CWIT staff and COEIT faculty help to mitigate challenges faced by T-SITE Scholars. In their first year, T-SITE Scholars are enrolled in the First Year Seminar course, taught by the CWIT staff, which is designed to acclimate new students to the norms and expectations of an Honors University and focuses specifically on academic issues and career goals of engineering and computing majors. Incoming T-SITE Scholars are also supported by faculty mentors in their majors who provide advice and guidance on course progression, academic expectations, and transfer of credits from their community colleges. In their second year at UMBC, T-SITE Scholars enroll in the IMP course, taught by CWIT staff in collaboration with the UMBC Career Center, which includes intensive career exploration and planning as well as an assigned industry mentor. Throughout the program, T-SITE Scholars attend monthly individual meetings with the CWIT Associate Director, who manages the T-SITE program. T-SITE Scholars also receive academic and social support through the CWIT peer-mentoring program.

While appreciating the benefits of program participation, T-SITE Scholars have offered two suggestions for ways to enhance their experience: (1) more structured interaction between cohorts so that new students can benefit from knowing about the challenges faced by earlier cohorts and how the challenges were addressed; and, (2) more events and opportunities for networking with other students in the same major so that upper classmen and recent graduates can share lessons learned from their particular academic and career paths.

3.3.2 Program-level Challenges

The process of recruiting and selecting competitive candidates for the T-SITE Scholars program has been challenging. Although the total number of applications each year has appeared to be adequate, the number of applicants that meet the minimum eligibility criteria (have a GPA of 3.0 or higher, demonstrate financial need, and are either a US citizen or permanent resident) has significantly limited the pool of eligible candidates for each cohort. Additionally, we have had difficulty recruiting and selecting qualified students who are women or members of underrepresented minority groups studying computing and engineering at the community college level. Students having all of the desired characteristics for T-SITE have been difficult to identify, difficult to reach, and, are generally limited in number at community colleges.

To maximize our efforts, we have focused our recruitment activities on the five Maryland community colleges that source the majority of UMBC's transfer students, and developed relationships with key STEM faculty and staff at those institutions. CWIT staff have presented information sessions about the T-SITE Scholars program at community colleges and hosted events for groups of community college students, faculty, and staff to visit UMBC. Despite the interest these efforts have generated among transfer students about the T-SITE Scholars program, we have found that the application timeline may pose a hindrance to our recruitment efforts. Unlike the process for first-time freshmen, transfer students can take advantage of a rolling deadline to apply to UMBC and may be more likely to apply for funding opportunities once they have decided on their chosen institution. When applications for T-SITE are due in March, transfer students have not yet received confirmation of their acceptance to UMBC, and some may have not even decided whether or not they will apply to the University. While the early spring application deadline has been necessary to facilitate sufficient time for selection and engagement in priority orientation and the New Scholar Retreat, it has constrained our ability to engage a greater quantity and quality of applicants.

University infrastructure and enrollment procedures have also made first course registration at orientation particularly challenging. In computer science and engineering programs, transfer students often find courses that are required as prerequisites for advancement in the major are closed and are put on waiting lists. Because of changing majors, insufficient completion of prerequisite courses, and a lack of transfer credits, some T-SITE Scholars do not graduate within the two and half years for which the program had originally allocated financial aid. To address this issue, the program was amended in summer 2014 to permit Scholars, on a case-by-case basis, to receive financial aid for up to three years.

The scope and diversity of outside responsibilities and challenges of transfer students presents a challenge for the students, but also an additional challenge in designing support structures to assist them. Support structures must be both more personalized and more flexible. Compared to support for those who start as traditional freshmen, this support is likely to include a greater proportion of one-on-one intervention and problem-solving. This mode of "casework", rather than group support, may be a limiting factor to scaling the program.

4. Implications

The T-SITE Scholars program has had broad impacts on transfer student success, improving computing and engineering education and increasing the representation of underrepresented students in technological fields. Specifically, T-SITE has contributed:

a) expanded educational and financial support opportunities for transfer students pursuing computing and engineering majors and careers;
b) the expansion of infrastructure to improve learning, retention, and success of transfer students in computing majors at UMBC and beyond;
c) groundwork for new opportunities to facilitate cross-disciplinary collaborations between computing and engineering programs at UMBC and community college faculty and staff that benefits transfer students in Maryland; and,
d) benefits to society by contributing to a larger and richer pool of computing graduates and workers with the talent to solve important and complex problems.

5. Conclusions

The T-SITE Scholars program is achieving its intended results and having positive impacts on the experiences of transfer students in computing and engineering at UMBC. Scholars have developed academically and professionally in the program, graduated, and obtained desirable jobs; the CWIT support model has contributed greatly to transfer student success. We now seek to maintain and advance our impact by exploring ways for T-SITE Scholars to foster more strategic connections with other students within their major and participate more actively in the T-SITE recruitment and selection process. We are developing more robust ways to assess the outcomes and impact of the T-SITE Scholars program, including comparative analyses of the outcomes for T-SITE scholars and COEIT transfer students who do not participate in this program. Now that there is a robust group of T-SITE alumni successfully in positions in the local workforce, we also plan to invite T-SITE alumni back to campus for a reunion and to meet current T-SITE Scholars. We hope to have them participate in discussions focused on the needs, successes, and contributions of transfer students within the UMBC community.

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