Women in the Academy: Female Leadership in STEM Education and the Evolution of a Mentoring Web

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Abstract

Women continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields and in STEM leadership positions. According to the most recent data available from the National Science Foundation, in academia only 31% of full-time STEM faculty and 27% of STEM deans and department heads are women. By comparison at Stevenson University (SU), 71% of the full-time STEM faculty members are female and 100% of the academic leadership in STEM is provided by women, which sets the university apart from the national norm. Together with an informed, innovative approach to curriculum reform, synergistic leadership and management principles and practices have allowed the School of the Sciences (SOS) at SU to do more with less in STEM education. Total enrollment in the SOS has grown dramatically in recent years and now represents 29% of the total full-time undergraduate population. Local and national STEM outreach programs led by the SOS serve to complement the undergraduate programs and to strengthen the STEM workforce and education pipelines at multiple points.

By sharing strategies and results in a case study format, this paper will demonstrate a model for "what works" with regard to female leaders building and sustaining successful and effective academic programs in STEM. An important element of the model is the mentoring web that has been developed to support and sustain the leaders, faculty, staff, and students in the SOS. The SOS network includes both formal and informal structures in which one-on-one and group mentoring occurs on a regular basis. The nature of the mentoring is tailored to the position of the participants involved, but in each case the mentoring contributes to professional growth and development. The emphasis on mentoring has contributed to an increased sense of community and collegiality in the SOS and has enabled the School of the Sciences to make rapid progress in STEM curricular reform and program improvement.

Introduction

The words "quiet crisis," "creeping crisis," and "gathering storm" have been used to describe the status of the United States in an increasingly flat world (Friedman 2006; National Academy of Sciences 2006). In *The World Is Flat: A Brief History of the Twenty-First Century*, Thomas Freidman addresses the "education gap" that is emerging in the United States and sounds an alarm intended to rouse people to action (2006, 323–359). Similarly, Project Kaleidoscope (PKAL), the national alliance dedicated to improving undergraduate science, technology, engineering and mathematics (STEM) education, has stepped up the urgency of the call for fundamental, long-term, coordinated transformational change of the entire system so as to prepare the United States for the future (PKAL 2006, 1–27). From the perspective of women in

the academy, it is of special interest to note that these concerns occur in the context of a gender imbalance in the STEM workforce.

Women continue to be underrepresented in STEM fields and in STEM leadership positions in the United States. For example, data reported in *Science and Engineering Indicators 2010* show that only 26% of the college-educated workforce in science and engineering are women (NSB 10-01 2010, 3–32). When considering first-time college freshmen in the national student population, more males (41%) than females (30%) select science or engineering as their intended field of study (NSB 10-01 2010, Appendix Table 2-6). Interestingly, females end up earning 50% of the bachelor's degrees but only 40% of the doctoral degrees in science and engineering (Burrelli 2008, 1; NSF 09-305 2009, 39). In academia 31% of full-time faculty in science and engineering are women, with the preponderance in the life sciences (NSB 10-01 2010, 3–32). Further, only 27% of STEM deans and department heads are women according to the most recent data available from the National Science Foundation (NSF 09-305 2009, 14, 254). There are ample reports in the literature that address the underlying reasons for this imbalance and it is not the purpose of the present paper to add to this body of knowledge. Rather, the question that has emerged in writing the present report is a pragmatic one: given the gender imbalance in the STEM workforce, what can be done to encourage, enable, and empower women to engage and be successful in the STEM disciplines?

By sharing strategies and results in a case study format, this paper will demonstrate a model for "what works" with regard to women leaders building and sustaining successful and effective academic programs in STEM and will suggest approaches that may be helpful in working to achieve gender equity in the STEM workforce.

CASE STUDY INSTITUTION

Stevenson University

Stevenson University (SU) serves as the case study institution. Located near Baltimore, Maryland, SU is an independent, comprehensive institution of over 3,400 students pursuing bachelor's and master's degrees whose primary niche is career-oriented liberal arts education. In *U.S. News and World Report's* 2010 edition of "America's Best Colleges," Stevenson climbed to the 11th ranking among the "Best Baccalaureate Colleges-North Region" and again was recognized as one of the nation's "Top Up-and-Coming Schools" and "Great Schools, Great Prices" (U.S. News and World Report America's Best Colleges 2010).

It is worth noting that Stevenson University has been Stevenson University for only two years (since 12 June 2008). After nearly four years of careful deliberation and an extensive vetting process, the institution that had been Villa Julie College for 60 years was redefined from a college to a university with a new name that better reflects its scope and mission. Decades of program development, curricular expansion, enrollment increases, and growth in the size and scope of the campus itself contributed to the recent institutional transformation. This bold and

dramatic step is characteristic of the institution well-known in the local community for its entrepreneurial spirit, innovative culture, and responsiveness to the needs of the workforce.

School of the Sciences

With the transition to university status the institution was reorganized into six schools, one of which is the School of the Sciences (SOS). The SOS houses four academic departments (biology, chemistry, mathematics, and nursing) as well as the Office of Research Development. The SOS offers six undergraduate majors in the natural and health sciences as well as two bachelor's-to-master's programs linked to forensic science. The University's enrollment has more than doubled over the last eleven years, and the SOS's programs have kept pace with this growth rate. In the fall of 2009, the School of the Sciences welcomed the largest share (38%) of the University's new freshman class and is home to 29% of all students at the University, thus making it the largest of the schools at Stevenson.

Demographically, 84% of full-time SOS majors are female, and 31% of full-time SOS majors are underrepresented minorities. Given that nursing is a predominantly female profession, it is instructive to look at the numbers when this population of students is removed. If only the science and mathematics majors are considered, the female majority persists, with 73% female (247 of 339) and 27% male. A summary of the demographic data for students in the SOS can be found in Tables 1 and 2.

It is also notable that the school, each of the four departments, and the Office of Research Development are all led by women, which sets the University apart from the national norm of females being underrepresented in STEM fields and in STEM leadership positions (National Commission on Mathematics and Science Teaching for the 21st Century 2000; Bradburn and Sikora 2002; NSF 09-305 2009; NSB 10-01 2010). Further, 17 of the 24 full-time faculty members (71%) in the School of the Sciences are female, in comparison to 51% for the entire University. Again, if nursing faculty are removed from the mix and only the biology, chemistry and mathematics departments are considered, 10 of the 16 full-time faculty members (62%) are female, which again is in dramatic contrast to the national average of 30% reported for full-time female faculty in the natural sciences (Burrelli 2008, 1; NSF 09-305 2009). A summary of the demographic data for faculty in the SOS can be found in Table 3.

As an institution with a reputation for innovation and responsiveness, Stevenson has spent years exploring and establishing its role in preparing an educated, creative, and motivated STEM workforce that will meet the challenges of the twenty-first century. The preponderance of women faculty and students in the School of the Sciences combined with the University's low faculty-to-student ratio (1:14) afford an excellent opportunity to encourage more women to enter the sciences and mathematics and thereby contribute to workforce development in these fields. As Trower and Chait (2002, 34) report, it is the percentage of women faculty members that serves as a bellwether of success for female undergraduates, which positions SU well to make an impact on women in the sciences.

Women at the Helm

Together with an informed, innovative approach to curriculum reform, synergistic leadership and management strategies have allowed the School of the Sciences at SU to do more with less in STEM education. Fundamental to this success has been the evolution of a mentoring web within the STEM academic unit, which is led entirely by women. Formed in 2002, the all-female Leadership Team in the SOS is made up of the dean of the school and the academic administrators of the four departments in the SOS: Biological Sciences, Chemistry & Physical Sciences, Mathematics, and Nursing. The team meets weekly for two hours throughout the academic year for the purposes of planning, problem-solving, and professional development. The returns on this investment of time have been remarkable as evidenced by the quality and quantity of initiatives generated by the SOS over the past ten years, summarized in Table 4.

Mentoring

In reflecting upon the successes enjoyed by the SOS, it has become clear that mentoring relationships make up a common thread that ties the wide variety of initiatives together. Mentoring in the SOS takes place informally as well as via formal mechanisms. Many of the initiatives described below constitute formal mentoring programs, developed by design; however, numerous opportunities have evolved for informal mentoring as well. While informal mentoring relationships may be more powerful, the element of chance inherent in this type of interaction may leave gaps, thus necessitating the creation of more formal mentoring programs (Chao and Gardner 1992, 630–631; Wasburn 2007, 59). In the SOS, four types of mentoring relationships have emerged: mentoring leaders, mentoring faculty, mentoring students, and mentoring others outside the University.

There is a considerable body of literature on mentoring. As Harris (2002, 54) and Tauer (2002, 169) point out, the practice dates back to the ancient Greeks with the story of Odysseus, his son Telemachus, and the trusted advisor named Mentor. It is perhaps beside the point of this paper but of interest to note that it was the goddess Athena, a female, who took the form of Mentor in order to protect the hero's son (Fagles 1996, 101). Given that the goddess took the form of a man in order to advise Telemachus, is this impersonation, perhaps, the earliest evidence in support of the single gender mentoring dyad?

There is no shortage of definitions of mentoring. Reviews of the literature by Scanlon (1997, 40–45), Enomoto, Gardiner, and Grogan (2002, 209–212), and D'Abate, Eddy, and Tannenbaum (2003, 361–365), offer a look at many of these definitions, but it is perhaps the assessment by Harris (2002, 65) that best suits the overarching message of the present paper: "Rather than struggle to find a single definition for mentoring, perhaps it is time to accept the fact that mentoring is a multifaceted process whose outcomes depend on a number of variables." Indeed, the phrase "developmental interactions" as defined by D'Abate et al. may be more apropos in that it "involves interactions between two or more people with the goal of personal or professional development" (2003, 360).

For the present discussion, mentoring will be understood to include both formal and informal interactions and/or exchanges of information between a protégé and some combination

of his/her peers and/or supervisors for the purpose of constructive professional development. In the SOS model, "peer" is defined within the context of position, but the mentor holds an aspirational status relative to the protégé. For example, an Assistant Professor may have a Professor as a mentor, a freshmen undergraduate student may have a junior undergraduate student as a mentor, and so on. Regardless of whether the mentor is a peer or a supervisor, the interactions are grounded in professional development.

Mentoring Leaders

The Leadership Team in the School of the Sciences engages in mentoring both formally and informally. While strategic planning, community building, and day-to-day management were priorities in the early years of the Leadership Team, it became clear that professional development was just as important. Each academic administrator in the SOS regularly participates in one or more national meetings targeted to academic leadership, which are helpful to varying degrees. Attending these conferences, however, is both expensive and time-consuming, which typically means going to only one meeting per year. Further, attendance is usually individual, which limits the opportunity for a collective growth and development experience. For these reasons the dean initiated a program of shared responsibility for professional development within the Leadership Team. Each semester the team reads a publication related to leadership, management, higher education, and/or STEM, with members taking turns leading the discussion of a different chapter each week. Casually referred to as "Book Club," these weekly "book reports" have contributed to fostering synergy, coherence, and expertise within the Leadership Team.

The weekly forum also allows the team to create and implement a shared vision for the SOS, while frequent informal communications throughout each day facilitate shared leadership and personal growth. Each member of the team brings her own skill set to the table, which optimizes problem-solving, consistency, strategic planning, and day-to-day operations. The intentional clustering of the offices of the academic administrators further promotes the development of a collective wisdom that benefits the School of the Sciences as well as the University.

The mentoring, growth, and development of leaders in the SOS are the result of an organic evolutionary process that has naturally aligned with best practices as reported in the literature. In some respects, the formal and informal mentoring of the SOS leaders parallels facilitated group mentoring models that have been shown to be successful in developing critical career competencies in university women (McCormack and West 2006, 409–431; Clifford 2003). These critical competencies include deeper institutional knowledge, increased confidence, support, and networking (McCormack and West 2006, 409–431; Clifford 2003). These skills and attributes are also consistent with the idea that intentional management development and mentoring are among the best practices for women as reported by McDonald and Hite (1999, 35–41). These authors found that persistence, initiative, taking on additional responsibilities, assertiveness, drive, and excellence were especially necessary for women seeking career advancement (McDonald and Hite 1999, 35–41). A major theme that emerged from their study was the perception that performance expectations are greater for women than for

men (McDonald and Hite 1999, 35–41), which magnifies the need for women to engage in strategic professional development. The Leadership Team in the SOS reports similar experiences, with the initiatives outlined in Table 4 serving as evidence of the positive outcomes of the Team's drive, initiative, high standards, follow through, and ongoing self-sustaining professional development.

Mentoring Faculty

Though perhaps counterintuitive, the mentoring of faculty has been the most recent as well as the most deliberate of the four types of mentoring relationships to evolve in the School of the Sciences. Returning to institutional history for a moment, it is important to note that prior to 2001 the University had an extremely flat organizational structure. The creation of academic divisions in 2001 with the appointment of individual division directors was useful in prompting academic initiative and accountability while dispersing authority more broadly. The division directors, and subsequently the department chairs, were promoted from among the University's faculty, which explains an early focus on student development and curricular initiatives. As the curriculum matured and student learning improved, the Leadership Team began to focus its attention on faculty development as the next step in promoting excellence in student learning.

From the very beginning, faculty were engaged and included in the process of defining the academic unit: first the division in 2001 and then the school in 2009. The mantra, "Together we are strong," served to remind everyone that it was going to take a collective effort to move forward. Aside from the reorganization, another significant development in the institution's history was the implementation in 2004 of a faculty evaluation system. Prior to this date student evaluation of instruction was the only measure of faculty performance, and the expectations of the faculty member were not well defined.

As Boyer (1990, 2) reported, establishing clear criteria for teaching, research, and service are vital to the success of faculty at an institution. Optimizing the definitions for and time spent in each of these activities are also necessary (Boyer 1990, 2), which likely explains why the faculty and academic administrators in the SOS proactively sought clarity with regard to the process of faculty evaluation. One major project involved the creation of a faculty job description, which was quickly followed by the creation of documents that detail expectations for each level of faculty rank. Together these documents now serve to clarify the day-to-day expectations of a full-time faculty member as well as what is required of the faculty member seeking promotion in rank.

As with most of the other initiatives described herein, the faculty job description project was a collective effort afforded due process and adequate time to complete. The initial charge and discussions were held at the division level, and more detailed discussions were held at the department level. Once each department had formulated and summarized its thoughts and recommendations, a draft job description document was crafted and circulated for review and revision. After several iterations the Faculty Job Description was adopted by vote of the faculty in May 2008. It is important to note that this process was carried out in full communication with the faculty governing body (Faculty Council); in fact the chair of the Faculty Welfare Committee

at the time was a member of the biology department. The document, then, was consistent with the University's faculty policies; it simply provided more specific guidelines and examples intended to assist the faculty member and the department chair in planning and implementing faculty work.

As part of crafting the job description it became apparent that it would also be necessary to discuss and define the different expectations of faculty depending upon the rank held or desired. For example, to achieve or maintain the rank of Professor, for example, would require more of a faculty member in terms of teaching, scholarship, and service than to achieve or maintain the rank of Associate Professor. For this reason, once the job description was adopted, the next project became drafting and adopting the so-called "rank expectations" documents to assist faculty members in moving toward promotion and earning long term contracts. The process for this effort was similar to that described for the job description and the rank expectation documents were adopted by vote of the faculty in May 2008.

The process of defining faculty work and clarifying expectations while also providing a mechanism for support and guidance took a number of years, but studies have shown the importance of taking this type of approach. For example, transparency in policy and practice has been shown to facilitate equity and collegiality among faculty members, which is especially important for new hires, women, or minorities in the department (Bensimon, Ward, and Sanders 2000, xix, 25, 42, 67, 129, 133; Trower and Chait 2002, 37). Because the SOS faculty were involved from the outset in defining the policies and practice, there is meaningful buy-in, support, and compliance. Furthermore, the three newest hires in the SOS also find the policies and practices to be reasonable and helpful, which is consistent with the aforementioned reports in the literature. The positive outcomes for this collaborative process are in contrast to the negative or ambivalent outcomes often associated with a more typical top-down administrative approach (Bennett and Figuli 1990; Lucas 2000). The job description and rank expectations initiatives are discussed in the context of mentoring because they provide the framework for defining, measuring, and supporting faculty performance objectives in ways that permit an interactive optimization of professional development and advancement.

A number of universities have addressed the need for guiding faculty via a variety of formal mentoring programs (Wasburn 2007, 59), and SU is no different. In the SOS, a third faculty initiative arising from the discussions of faculty work and expectations was the idea for a small-group or committee approach to faculty development. Along the lines of "it takes a village," the consensus was that faculty would benefit greatly from an environment in which collaboration and shared responsibility for success was the norm. Resulting from this expressed need for shared mentoring and guidance, a more structured program for faculty growth and development was created and adopted by vote of the faculty in the fall of 2008. Featuring the Faculty Mentoring and Evaluation Committee (FMEC), this new, formal approach to mentoring was piloted in the 2008-2009 academic year. Full implementation occurred in 2009-2010. Each faculty member in the SOS who is eligible for promotion is required to have a functional FMEC,

and all other faculty members are encouraged to establish one as well. In addition to the faculty member's department chair, the FMEC must include two faculty peers, including at least one from another department in the SOS.

The purpose of the FMEC is to provide each full-time faculty member in the School of the Sciences with a small group of colleagues who are invested in supporting, guiding, and mentoring the faculty member through his or her process of academic growth and professional development. A letter from the FMEC takes the place of the letter from the Department Chair in a faculty member's application for promotion in rank. The FMEC process is a collegial, constructive, fair, and efficient one that supports each faculty member in a meaningful way. The process minimizes difficulties that might arise between any given individual and his or her department chair, providing a more collaborative environment for professional academic growth and development. The role of mentoring is combined with the role of evaluating, giving the FMEC important responsibility for determining each individual faculty member's academic progression. The first two faculty members seeking promotion under the FMEC program applied in 2010, and both were successful. Feedback from the Subcommittee on Promotion as well as from the Executive Vice President for Academic Affairs was very favorable with regard to the implementation of the FMEC process, and assessment of all facets of the new approach will continue.

The most recent addition to the formal faculty mentoring activities in the SOS is the New Faculty Orientation Program, first implemented in the 2009-2010 academic year. Developed and led by a member of the SOS Leadership Team, the pilot group for this year-long program consisted of the three new full-time faculty members who joined the SOS in August, 2009 (two female, one male). The New Faculty Orientation Program includes introducing the cohort of new faculty members to the people, places, and processes they will need to know in order to be successful at the University. Akin to taking a "Faculty 101" course, the new faculty are taught what to do and how to do it. Their lessons are reinforced with homework that includes drafting a Cumulative Faculty Record and a Professional Development Plan, which are required elements of their annual appraisal. Meeting every week or two during the course of the year, significant amounts of time are devoted to addressing problems or obstacles encountered by the new faculty members, and discussing strategies for solving or overcoming them. Additionally, an FMEC is established for each new faculty member, and the faculty orientation program serves as a catalyst for launching these new committees. A survey and focus group were used to assess the program's first year, and the results were affirming. The new faculty indicated that their questions were answered and that they learned how to solve the problems they faced during their first year. They grew increasingly comfortable in their faculty roles and began to develop the institutional knowledge that will position them for success. Additionally, the cohort developed a special sense of camaraderie and expressed comfort in knowing that there would always be a friendly face or two in the crowd as they attended school and university events. Most importantly, these new faculty members felt prepared and empowered to enter their second year.

Mentoring Students

The mentoring of students is accomplished in myriad ways by academic administrators, faculty, and other students. Perhaps the most obvious student mentoring in the SOS occurs in the context of research. In 2005 the following vision statement was articulated:

> The School of the Sciences at Stevenson University makes inquiry the foundation of a creative synergy among students and faculty that enhances student learning.

The SOS vision celebrates the transformative role that faculty members play when taking on the role of mentor to students. It is worth noting that this vision statement grew out of a collaborative process, in alignment with University goals, designed to impact the daily lives of faculty and students. For SU, perhaps the greatest value of an inquiry-based, research-rich learning environment is in the opportunity for students and faculty to develop strong relationships and to learn by doing. Dr. George Kuh, developer of the National Survey of Student Engagement (NSSE), has demonstrated the power of engaging students and the potential for this approach to provide immense growth in learning outcomes, especially for students who begin college with lesser levels of preparation (2007; 2003). Others have shown that mentoring can ease the transition into higher education for first-generation college students (Galbraith and Cohen 1995 in Harris 2002), which is particularly significant in light of the fact that, on average, 32% of SU freshman students fall into this category.

The departments in the SOS have worked with deliberate speed over the last few years to integrate both inquiry and research into the undergraduate biology, chemistry, and applied mathematics curricula, which in turn has increased the quantity and the quality of faculty-student interactions and mentoring. From the 100-level introductory courses to the senior level capstones, the SOS curricula provide ample opportunity for students to experience the "guide on the side" rather than the "sage on the stage," which means that they are engaging in active learning, authentic research, and, in mentoring terms, professional development. In addition to the curricular opportunities, the SOS offers a competitive extracurricular full-time, paid summer research program for students and faculty. Faculty mentors in biology and chemistry lead the Summer Science Scholars Research Program (S^3RP), which is entering its seventh summer in 2010. An indicator of the success of these research-related mentoring activities is that students are now presenting their findings at local, regional, and national conferences.

The mentoring of students by other students is also a powerful paradigm recently implemented in the SOS. For years, students enrolled in the science freshman seminar were treated to a one-time "Been there; Done that" discussion with upper division students. These sessions were so popular that in 2008, separate and more intentional student mentoring programs were implemented in the biology and chemistry departments. These peer mentoring programs connect a junior or senior student with one or more incoming freshman students. Early assessment reports indicate that both sets of students, the mentors and the protégés, experience benefits that include: an increased sense of belonging to a community, encouragement, and

support. For some students, benefits even extend to successful persistence in the major, despite initial academic difficulties.

Mentoring Others

Evidence suggests that the earlier students become excited about STEM and are engaged in meaningful ways by well-prepared STEM teachers, the likelier they are to retain their interest and go on to major in STEM in college (National Academy of Sciences 2006, 5-1–5-21; National Commission on Mathematics and Science Teaching for the 21st Century 2000, 4–45). To this end, local and national STEM outreach programs led by the School of the Sciences serve to complement SU's undergraduate programs and to strengthen the STEM workforce and education pipelines at multiple points. Of particular note is the nationally implemented Project Lead The Way® (PLTW®) Biomedical Sciences℠ program (Project Lead The Way 2010) for which Stevenson serves as one of only three affiliate universities in the USA. Selected through a competitive grant process by the Maryland State Department of Education to serve as a PLTW® Biomedical Sciences℠ affiliate, the SOS offers an intensive residential summer core training program to high school teachers from around the country, as well as ongoing teacher training workshops throughout the year. Because it is a teach-the-teachers model the national impact on STEM education is tremendous: 80% of high school seniors completing the PLTW® program plan to attend college or community college versus 65% of students nationwide, and these students are 5-10 times more likely to study engineering or a STEM discipline than other first year college students (Walcerz 2006).

In recognition of the quality of the work Stevenson University has done as the Affiliate University for the PLTW® Biomedical Sciences℠ program, the SOS was asked to partner again with the state's department of education to lead another K–12 curricular reform effort. Stevenson received three separate grants from the Maryland State Department of Education to lead a collective process to establish an Academy of Health Professions common course syllabus for Maryland high schools. Stevenson will continue to offer professional development workshops for teachers implementing this curriculum in Maryland, with the potential impact again considerable because it is another teach-the-teachers initiative.

In addition to these two high school initiatives, the SOS outreach to middle school students is growing in scope and size. Current middle school programs include a week-long summer science camp for boys and girls, a two-day forensic science program for girls, a one day hands-on STEM day for a local charter school, and a day-long STEM exploration program for girls that is affiliated with the national Expanding Your Horizons organization. The University's newest middle school partnership was implemented in May 2010: a three-week "Maymester" program designed specifically for eighth grade students attending an urban charter school. For many of these youth, the program marked their first visit to a university. Held on SU's campuses, Maymester was designed to combine STEM content and career exploration with an introduction to college life in ways that would inspire and motivate these rising high school students. In its third and final week as of this submission, formative assessments of Maymester have been positive and additional feedback will be collected at the conclusion of the program. If the program's goals are met, then the feasibility of implementing Maymester on an annual basis will be explored.

Given the pivotal role that K–12 teachers play in inspiring and educating the next generation of scientists and engineers (National Academy of Sciences 2006, 5-1–5-21; National Commission on Mathematics and Science Teaching for the 21st Century 2000, 4–45), Stevenson University's School of Education teacher preparation programs are also of particular importance. Currently, SU prepares teacher candidates for elementary and middle school; in fact, SU's Middle School Program is the first of its kind in the state of Maryland. Students in these education programs must take nine science and mathematics courses (5 math courses totaling 17 credits and 4 science courses totaling 16 credits) as part of their teacher preparation curriculum. If this opportunity is considered to be analogous to the other teach-the-teachers outreach efforts currently underway in the SOS, then improving the academic STEM experience for these education majors at Stevenson can be expected to have an impact that will reach far beyond the confines of the University.

DISCUSSION AND CONCLUSIONS

The purpose of this report was to demonstrate a model for "what works" in the academy with regard to women leaders initiating and sustaining successful, effective, and far-reaching academic and administrative programs in STEM. The extensive catalog of SOS initiatives provides an objective measure that the Stevenson model is successful (Table 4). As a case study, Stevenson University provides a template for developing STEM departments, curricula, and outreach programs in the context of a mentoring web, with insights into how the results may be influenced by the decidedly feminine leadership style. Because Stevenson's STEM leadership team is 100% female and the preponderance of SU's STEM faculty are also female, the University's potential impact on females in the STEM pipeline is considerable. If "the most accurate predictor of subsequent success for female undergraduates is the percentage of women faculty members at their college," (Trower and Chait 2002, 34), then in the context of "Women in the Academy," the SOS model demonstrates practical ways to encourage, enable, and empower more women to engage and be successful in STEM disciplines.

Evidence suggests that women and minorities respond best in more collaborative learning experiences, which include working with mentors (Green and King 2001, 159–160). It is also clear that mentoring relationships are important to the professional growth and development of both women and men (Gardiner et al. 2007; Sullivan-Brown 2002; Enomoto, Gardiner, and Grogan 2002; Kochan 2002). However, for these types of developmental interactions to work effectively, appropriate opportunities for mentoring must exist. In academia, women continue to hold fewer positions at higher rank than men in science and engineering: 42% hold the rank of Instructor or Assistant Professor, 34% hold the rank of Associate Professor, and 19% hold the rank of Professor (Burrelli 2008, 4; NSF 09-305 2009; Trower and Chait 2002, 34-35). Furthermore, women with degrees in science and engineering make up more than half of the part-time academic work force, and they are typically paid less than men for the same job: 36%

less when comparing salaries at the bachelor's level and 21% less when comparing them at the doctorate level (NSB 10-01 2010, 3-35–3-36, 5-19–5-20). The reasons underlying the gender imbalance in the salaries, higher ranks and leadership positions are thought to include a lack of networking opportunities, lack of role models, and slower research progress for women (Appelbaum et al. 2003, 47; Gardiner et al. 2007, 426–427). By virtue of its composition and function, the SOS has created a synergistic environment that both obviates and transcends gender boundaries. Recognizing and embracing this unique position allows the University to contribute to resolving the gender imbalances that still exist in STEM, both inside and outside the academy.

In the SOS, the opportunities for constructive developmental interactions extend beyond the full-time faculty to the part-time, adjunct faculty many of whom are in transition. For example, many applicants for part-time faculty positions are seeking to stay in the workforce but need to reduce their hours because of family or child care responsibilities. Often these applicants are women, which is consistent with national trends (Burrelli 2008, 7–8), but from time to time a male will share the same circumstance. It has become a part of the SOS mission to hire well-qualified part-time faculty and work with them to support their needs while they fulfill the University's needs in an organizational version of symbiotic mutualism. To this end the SOS, as it is able, supports the research endeavors of part-time faculty so that they do not have breaks in their professional activity or scholarly work. Such breaks or gaps are thought to be responsible, at least in part, for the lower numbers of women faculty holding higher academic ranks or leadership positions (Rosser and Taylor 2009, 7–10). By providing laboratory space and resources to the part-time faculty members, the University gains experienced scientists who can lead authentic research projects, mentor students, and enrich the scientific discourse in the SOS, while the faculty member retains continuity in meaningful professional activity.

In closing, it is fair to say that a sense of community grounded in trust and mutual respect characterizes the SOS. The words of Helen Keller guide the Leadership Team and, in turn, the SOS: "Alone we can do so little, together we can do so much." As a whole, the leaders, faculty, staff, and students feel supported, cared for and well-prepared for both the present and the future. This sense of security, in large measure, can be attributed to the formal and informal mentoring networks that have grown into an infrastructural web that supports and sustains the School of the Sciences and, in turn, the entire University community.

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Table 1. Profile of Stevenson University Student Population (Fall 2009 data)

Student Profile	University	School of the Sciences
Full-Time Enrollment: Traditional Undergraduate	2,619	671
Part-Time Enrollment: Traditional Undergraduate	557	259
Total Undergraduate Enrollment	3,176	930
Females	70.1%	87.2%
Males	29.9%	12.8%
Underrepresented Minorities	26.5%	30.5%

Table 2. Distribution of Majors in the School of the Sciences by Department (Fall 2009 data)

Department and Degree Programs	Number of Majors	Percent Female		Full-Time (671)			Part-Time (259)	
				Males	Females		Males	Females
Biological Sciences:								
Biology	169	70%		48	115		2	4
Biotechnology	22	68%		7	14		0	1
Medical Technology	34	82%		6	24		0	4
Sub-Total:	225	72%		61	153		2	9
Chemistry and Physical Sciences:								
Chemistry	112	80%		22	89		0	1
Mathematics:								
Applied Mathematics	16	38%		9	5		1	1
Nursing:								
Nursing	577	96%		14	318		10	235
School of the Sciences:								
Totals	930	87%		106	565		13	246

Table 3. Distribution of Faculty in the School of the Sciences by Department (Fall 2009 data). Numbers do not include academic administrators (defined as program coordinators, department chairs, or deans).

Department	Total Number of Faculty	Percent Female Full-Time	Percent Female Part-Time		Full-Time (SU = 89) (SOS = 24)			Part-Time (SU = 238) (SOS = 51)	
					Males	Females		Males	Females
Biological Sciences:	28	57%	86%		3	4		3	18
Chemistry and Physical Sciences:	21	60%	44%		2	3		9	7
Mathematics:	15	75%	18%		1	3		9	2
Nursing:	11	88%	100%		1	7		0	3
School of the Sciences:	75	71%	59%		7	17		21	30
Stevenson University:	327	54%	50%		41	48		119	119

Table 4. Initiatives in the School of the Sciences* at Stevenson University (2002-2010).

Year	Initiative
2001	Developed and offered a **freshman seminar** solely for science and mathematics majors in order to better prepare them for the challenges and opportunities offered by these disciplines.
2002	Creation of the **Leadership Team** (Director, Department Chairs, Program Coordinator).
2002	Approved **bachelor's degree in Applied Mathematics** awarded by the Maryland Higher Education Commission (MHEC).
2002	Established an external **Advisory Board** for the Division comprising leaders from local industry, government, and academia.
2002	Piloted the College President's ***Career Architecture***^{SM} initiatives in the division.
2002	Established **websites** for our division and departments.
2002	Created a resource booklet to guide faculty and departments in understanding, developing and implementing **assessment plans**.
2002	Refined and administered **assessment surveys** designed to provide useful feedback to faculty for each class taught every semester.
2002	Established and enforced a **feedback loop for assessment** that requires faculty and administrator participation.
2002	Established and published guidelines for students and faculty in the division. Set **standards** for performance and expectations for behavior. Included a graded **"Professionalism"** component for students in every science and mathematics class.
2002	Piloted **Supplemental Instruction** program in the division (an academic support initiative).
2003	Initiated **program reviews** in the Departments of Biological Sciences, Chemistry & Physical Sciences, and Mathematics.
2003	Initiated an annual process of nominating qualified students and faculty for membership in **Sigma Xi**: The Scientific Research Society.
2003	Secured institutional membership in the **Council on Undergraduate Research** (CUR).
2004	Renovated classroom space to create **two new research laboratories** in the Science Center.
2004	Approved **Master's Degree in Forensic Science** awarded by MHEC.
2004	Established and funded a new **Summer Science Scholars Research Program** (S^3RP).
2004	Established the new **research course** in biology and chemistry to allow a formal laboratory research experience for students prior to their senior year.
2004	Selected to serve as a **PKAL Leadership Initiative Institution**.
2004	Integrated both **inquiry and research** into the undergraduate biology, chemistry, and applied mathematics curricula.
2005	Designed and delivered a now annual two-day **forensic science program** for middle school girls from the Garrison Forest School (a nearby independent school for girls).
2005	Chartered Kappa Mu Epsilon Mathematics **Honor Society**, Maryland Epsilon Chapter.
2005	Approved **bachelor's degree in Medical Technology** awarded by MHEC.
2006	Hosted a **POGIL** (Process Oriented Guided Inquiry Learning) workshop on campus for science and mathematics faculty.

2006	Awarded a grant from the National Institutes of Health (NIH) (1 G11 HD052358-01) that has funded the establishment of an **Office of Research Development** at Stevenson University, which in turn has yielded increased scholarly research and significant grant-writing activity on the part of the faculty.
2006	Established a **monthly seminar series** to engage faculty and students in networking and dialoging with scientists from other institutions, agencies, etc.
2006	Awarded a grant from the Maryland State Department of Education (MSDE) establishing Stevenson University as the Maryland Affiliate University for the national **Project Lead The Way® Biomedical Sciences℠** program.
2007	Established a **Departmental Honors** degree option in the Department of Biological Sciences.
2007	Redesigned and expanded the **summer science camp** program for middle school boys and girls.
2008	Adopted three faculty initiatives: **Faculty Job Description**, **rank expectations** documents, and **Faculty Mentoring and Evaluation Committee** (FMEC).
2008	Received the first of three grants from the MSDE to lead a Common Course Syllabus project for establishing an **Academy of Health Professions** in Maryland public high schools.
2008	Became the only Maryland University to offer the national **Expanding Your Horizons** STEM career exploration event for middle school girls.
2009	Chartered Beta Beta Beta **Biological Sciences Honor Society**, Nu Sigma Chapter.
2009	Launched **New Faculty Orientation Program**.
2009	Chartered Gamma Sigma Epsilon **Chemistry Honor Society**, Gamma Zeta Chapter.
2010	Designed and delivered **Maymester**, a 3-week STEM and college exploration program for 8th grade students at The Crossroads School (an urban charter school in Baltimore).

* From 2001-2008 the academic unit was organized as the Sciences and Mathematics Division.