The Partnership Between the Science and Technology Wing and the School of Engineering and Applied Science: An Experiment in Living and Learning

Jorge J. Santiago-Aviles, Department of Electrical Engineering
M. Krimo Bokreta, Academic Programs and Residence Life
John C. Parker, Science and Technology Wing
University of Pennsylvania
Philadelphia, Pennsylvania 19104

Abstract — *This paper discusses an innovative new partnership between the Science and Technology Wing (STWing), a residential living-learning program and the School of Engineering and Applied Science (SEAS), a school within the University of Pennsylvania. The experiment will run for two years, at the end of which time it will be evaluated and used as a model for future partnerships with other schools and institutions at the University.*

Introduction

The Science and Technology Wing is a new tool for science education. It has been our experience that a well-presented, exciting, and challenging series of activities related to science and technology can complement and enhance the best-delivered classroom lectures and laboratory experiences. This is one of the ideas behind Penn's Living-Learning programs, of which the Science and Technology Wing, or STWing, is the oldest and best-established. In eight years, the program has grown from 12 students to 200. Students from all disciplines have sought affiliation with STWing because of the phenomenal opportunities it has continually provided for its members. The in-residence facilities of the program include an electrical engineering laboratory, an audio-visual laboratory, and a substantial computing facility as well as a biotechnology laboratory which is currently in the planning stages. These facilities have been the birthplace of numerous research projects designed by the members, and in many cases, these projects have gone on to become senior design projects or the topics of senior theses.

Among the goals of the Science and Technology Wing are:

- To promote science education, the use of technology, scientific research, intellectual rigor, and the discussion of contemporary issues in science and technology.
- To provide a forum/environment where first-year and upperclass students feel motivated to interact with graduate students and faculty outside of the classroom.
- To promote the development of a healthy support structure in which upperclass students serve as mentors and peer educators for first-year students.
- To create a culture which fosters intellectual curiosity and enhances acadmic achievement.
- To promote a sense of ecumenism, community involvement, collaboration, and participation with the Penn community and Philadelphia at large.
- To promote a residence infrastructure that supports these goals.

Although there is no single paradigm for how a student might participate in the program, the nature of STWing lends itself to the students' individual fascinations and schedules. By living in an open atmospere among colleagues who share common interests, members are presented with a nearly endless supply of ideas on which their curiosity can feed. Combined with the research facilities within the dorm this atmosphere has been the foundation of countless research projects. Recently completed projects from this framework include a digital clearinghouse, a system of stock market analysis tools, a virtual cell representation, and a nationally-acclaimed email reminder service. Several of these projects were presented as senior design projects upon graduation, and it is not uncommon for students to hold a dinner discussion for their colleagues for a less formal presentation of their work.

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Table 1: *Current Student Projects*

Radioisotope Production	Martin Zalesak
True Size Foot Contours	Gretchen Walz
Distributed Operating Systems	Stuart Eichert
Design of Rocket Decoys	Attila Mihayli
Remind UMail: Email Reminders	Blake Mills
GraphNet: Stock Market Analysis	Gregory Angrist
Research Interests Database	Walter Rice
Solar-Powered Computer	Ian Kaplan
STWing Education Agenda	Amanda Reyes

Faculty-Student Interaction

It has been suggested that for an institution to enhance student learning, it must "cultivate an ethos of learning" [1]. Among the qualities that are embodied by such an environment is an ample supply of opportunities for the students to independently explore the topics that fascinate them outside the classroom. The Science and Technology Wing has been overwhelmingly successful in creating such a learning environment, and we feel that this success would complement the SEAS environment nicely. This partnership is a unique experiment and may be an answer to the calls made by many higher education organizations on collaborations and partnerships between academia and student affairs to strengthen student learning [2].

We believe that the collaborative ties between STWing and and the Engineering School will strengthen both programs. The University administration has encouraged and supported our endeavor to enhance the intellectual and social contacts and interactions between students and faculty. Programs such as STWing are known to serve as an effective vehicle to this end, but until now we have counted on only the good will of the faculty members for their participation. Most faculty members are unaware of the efforts of STWing along these lines, and a formal coupling between STWing and SEAS will improve the visibility of these efforts. The SEAS faculty in particular offer some of the motivation for STWing members to engage in the disciplinary and inter disciplinary fields of engineering, applied science and its connections to biological sciences, business, social sciences, and the humanities.

In the past, the interaction between STWing members and faculty has proven quite valuable. The opportunities for interaction have ranged from informal dinner discussions in the residence to small, specially-organized workshops catering to the particular needs and interests of the STWing members in attendance. In the past, projects incorporating intricate and complicated engineering knowledge have been undertaken by the members thanks to the time spent by faculty to train the students in the disciplines necessary to complete such tasks. Currently, for example, a group of students are designing a power supply for a personal computer to be run completely off of sunlight. This would not have been possible without a series of workshops on modern circuit design and the physics of solar energy systems.

It is also common for professors to attend informal dinner discussions during which they give a presentation of their current research (Table 2 lists a few examples). These discussions have proven not only to be a fascinating resource of knowledge for the members but have also provided the professors with a pool of eager, intelligent students — valuable assets as research assistants. These opportunities have given STWing a reputation as a research and leadership laboratory where many students have enjoyed a great deal of success in research and are now serving as leaders in other student organizations, imparting the experience they gained to others.

Table 2: *Recent Dinner Discussion Topics and Speakers*

"Neural Networks"	Jan Van der Spiegal
"Fractals and Chaos Theory"	Dwight Jaggard
"Engineering Exchanges"	David Pope
"Science Education"	Joseph Bordonia
"Physics of Music"	Walter Wales
"Interdisciplinary Education"	Bill Graham
"Artificial Intelligence"	Mark Steedman
"Fish Vision"	Nader Engheta
"Modern Robotics"	Richard Paul
"U.S. Technology Priorities"	Judith Rodin
"Perspectives on Solar Energy"	Martin Wolf
"Discovery of the Top Quark"	Hugh Williams
"Cryptography and Other Stuff"	Michael Larsen
"A Tour of Nano-Electronics"	Charlie Johnson

This history of profitable interaction has encouraged us to seek, as part of the partnership, a formalization of this process. By establishing a core of faculty affiliates, we hope to keep both STWing members and the Engineering faculty up-to-speed on the accomplishments and opportunities in both organizations. The cooperation and mentorship of faculty to foster the skills, attitudes, and enthusiasm required of each student by a science and engineering curriculum, or any technology-related curriculum, is the key. We are working towards establishing a program with SEAS that familiarizes the student with the joys, satisfaction, difficulties, and rigors of scientific research, including the acquisition of skills such as experiment design, observation and data collection, experimentation technique, the conception and use of theory in analysis, presentation of results, and the fundamentals of writing proposals. We would also like to see the current levels of faculty-student interaction continue to blossom

as it has in years past. In particular, we hope to see many of our freshman gain hands-on experience assisting professors and/or graduate students in research.

As another aspect of the partnership, the Engineering School and the Provost's Office are sharing the expense of an engineering graduate student to serve as the STWing/SEAS Fellow. She/he will act as a liaison between STWing and the Engineering School, assist and advise on the maintenance of in-residence lab facilities, and facilitate workshops for the members. The purpose of this technical advisor/facilitator is to enhance the coupling between STWing and SEAS by helping the students arrange for the best possible faculty participants in weekly dinner discussions and to efficiently supervise the operation of our lab facilities. It is imperative that the students remain up-to-date on the research being performed by SEAS faculty since it is the desire of STWing members to engage in undergraduate research and to possess an ample selection of topics for senior design projects and senior theses. The STWing/SEAS Fellow will also be able to assist in the arrangement and development of STWing's usual sortie of activities such as:

- Participation in University Science/Technology celebrations (such as the ENIAC celebration and the celebration of Supernova 1987A)
- Publications and presentations of STWing (magazines, projects, theses, etc.)
- Panel discussions and seminars on relevant issues in science and technology (information technology, current research, etc.)
- Weekly dinner discussions with faculty
- Presentation of STWing at annual Academic Fair
- Visits to national laboratories and museums
- Seminars on information technology, research symposiums, etc.
- Senior design projects and senior theses

Sharing Resources

As is the case in any research-oriented group, STWing requires financial assistance in order to continue providing the exemplary oppportunities that it has in the past. In addition to the student program fee and the support provided by the Office of Housing and Residence Life, STWing has sought funding from external sources for our most pressing needs such as computing and telecommunications resources. The workstation used by the students, as well as the related software and support, was acquired through a funded proposal written by the members a few years ago. Through STWing's formative years, the University of Pennsylvania 21st Century Project and the Council of Undergraduate Deans have also supported the program. As part of the partnership we would like to seek the support of the Engineering School in submitting proposals to the National Science Foundation and other foundations embracing educational agendas, in order to expand the STWing program. This will entail one of our members serving as a development intern in the Engineering School's Development Office to facilitate these fundraising opportunities for STWing.

In addition, with the assistance of the Engineering School, STWing will be able to greatly enhance the already advanced technological opportunities given to the members. By operating and maintaining its own time-sharing server, STWing has been able to allow its members considerably more latitude with computing resources than the individual schools are able to provide for their students. In the past this computing latitude has enabled members to experiment with otherwise inaccessible computational tasks. Indeed, many past projects were only possible because of the freedom offered by STWing's independent computing facilities. With the assistance of SEAS, STWing will be able to continue this trend of superior technological opportunities by continually providing its members with the advanced tools required by modern research. It is also in the best interests of the Engineering School to expose its faculty and students to these modern technologies. As it has in the past, STWing will serve as an effective and useful tool for testing and implementing these new technologies. It was on STWing that the Office of Housing and Residential Life first introduced ethernet to the on-campus residences.

The Engineering School can also take advantage of the unique and effective new methods of learning that have been devised and used within STWing. The STWing Education Agenda, a mission to endow members with a set of minimum basic skills, has successfully exposed a large proportion of the membership to many of the tools and skills not currently a part of any curriculum. These have included the fundamentals of Unix, utilitarian programming, and problem solving — and the list grows as the incoming classes inject a fresh knowledge base into STWing. This peer-to-peer sharing of skills has proven an effective way of disseminating knowledge [3] by teaching students skills they would not otherwise acquire through the classes required by their major. STWing has refined this agenda to a very efficient level, and we are eager to see these opportunities extended to other groups on campus.

Summary

Although the STWing/SEAS Partnership had not become formalized until this year, examples of how it will benefit both STWing and SEAS have already been seen in prior engagements such as the Engineering School's ENIAC Celebration. The projection of SEAS onto the university community was greatly served by this celebration, and a group of STWing members representing a diverse collection of backgrounds and intellectual inclinations aided in this commemoration by producing a magazine, which has since become synonymous with the celebration, as well as volunteering for a number of prepatory tasks. During this time, STWing members had the opportunity to cultivate their communication and marketing skills, and the Engineering School's image was greatly enhanced as a result. By taking advantage of the vast resources which can be found within the University residences and particularly within STWing, the Engineering School has greatly enhanced its ability to reach nearly all groups at Penn. Through this Partnership, this can only be improved. The Partnership will, among other things, help SEAS build a better working relationship and familiarity with the needs and inclinations of their students. In addition, it will give the Engineering School a central resource of computer literacy, communication skills, undergraduate researchers, and opportunities for faculty-student interaction. It will help to build a stimulating environment in which well-rounded "renaissance" students can thrive. Finally, it will give the Engineering School an invaluable pool of academic support and advising on the peer-to-peer level for the incoming classes [4].

The STWing/SEAS Partnership will be in operation for the next two years, at the end of which time it will be evaluated. The evaluation criteria will qualitatively depend on the number of activities generated, level of publicity, attendance, diverse location of activities, number of published popularization articles in campus and city press, and the level of financial support obtained for the partnership. We will also investigate the impact of this approach on the students, school admissions and retentions, faculty, and administrators.

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