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ASEE Abstract

The Total Learning Environment

of our Freshman Engineering Students

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In building our freshman-engineering curriculum we have come to appreciate the importance of and are continuously searching for ways to enhance the living and learning environment that helps our students succeed in their first year of college life. The elements that make up our efforts to facilitate learning are: learning communities where like-minded students live and study together, proactive advising/mentoring where we discuss with each student their academic progress and career goals on a regular basis rather than waiting for the student to come to us for advice, workshops dealing with campus living issues, real career mentoring, and a technologically enhanced living and learning environment.

The learning community concept was introduced on our campus two years ago. The idea is to have students with similar academic interests and classes (including class schedules) to be near each other in the dormitories so that they would have the opportunity to form study groups, be a support group for each other, and develop a sense of community which is especially helpful for Freshman in acclimating to their first year at college. We have expanded our Freshman student advising activities to include career advising and networking (every student is matched with an alumni advisor) proactive advising (each academic advisor is the student's instructor in the Introduction to Engineering class and receives progress reports from all other non-engineering instructors), and multiple one-on-one progress interviews with the students (the advisor gets to know the students better so that potential problems are identified early and remedied) . Additionally, we are experimenting with a flexible technologically enhanced classroom that combines the features of a standard classroom environment with a computer laboratory, multimedia environment to expand our teaching capabilities without increasing the need for additional classroom or laboratory space.

This paper presents our experiences in making the learning environment richer and more supportive for our students and providing them with the means they need to succeed in their studies as they adjust to college life and advance their career goals.

I. Introduction

We are taking a multi-pronged approach in providing an environment that supports and enhances the learning process. As an institution we have gone from teaching a part-time, commuter student body with minimal facilities and student support to a full-time resident student body with maximal facilities and student support. The infrastructure that supports and promotes student learning has changed dramatically. Dormitories are no longer just living spaces but learning centers as well. The blackboard and chalk classroom is giving way to the multimedia center with interactive learning facilities for local and distance learners. The faculty is engaged with their students inside and outside of the classroom in the process of learning the material of their chosen fields and the context in which that material is relevant. In the school of engineering we are using the changes taken place on campus to enhance our own programs and in some cases are part of the driving force for campus change. We continue to look for ways that will make our students better engineers upon graduation. Critical to the learning process is the learning environment that supports that process. What follows is a presentation of what we consider to be important areas affecting student learning and the environments we have created in those areas to facilitate learning.

II. Living and Learning Spaces

The learning community[1] concept has been around for about fifteen years (about two years on our campus). A group of students with some special interest form a community to pursue that interest. The interest does not have to be exclusively academic or specifically tied to their field of study but as the name implies does involve learning. For example, a group of engineering, business, and communications students may wish to get together and learn more about how their chosen fields of study eventually interact in the workplace. There may be no formal classes to learn about such interactions so the students learn through social interactions and self-guided research within their group. The learning community encourages inquiry and exploration, which augment the learning experiences of the classroom. The learning experiences gained in such a community contribute to developing the skills for life-long learning, an important ability for the professional engineer.

The initial experiment with learning communities on our campus consisted of 'clustering'. Under the supervision of the College's Residence Life Department, students were housed (when the space allowed) by 'compatible' major. For example, a freshmen floor in a dormitory could have a mix of engineering, math and science majors but sections of that floor could contain rooms with only engineering (or math or science) majors in them. The idea was that similar majors would have similar workloads and study schedules so that the living environment had a tempo more in harmony with the needs of the students in that environment. The School of Engineering's experience with clustering has been for the most part positive. Those freshmen students (usually from a particular floor or dorm) that consisted of a homogeneous grouping (gender, background, etc.) formed friendships early that helped them to quickly form a sense of community and persist beyond their freshmen year. Our present juniors still have the same study groups they formed as freshmen. Those students who for various reasons ended up 'outside' of the afore mentioned group tended to need more support from the faculty and staff to get acclimated and tend to be the 'loners' now. The concept of learning communities involves more than just housing like-minded people together. There is supposed to be more of an active learning component than simply providing the opportunity for study groups to form. That is, groups of individuals (not necessarily living under the same roof or sharing areas of study in similar majors) come together (for variable lengths of time) to explore some topic of common interest that may be multidisciplinary in nature and not carry college credit. The exploration can extend beyond the classroom and involve learning in nontraditional academic settings. For example, a group could be interested in learning about engineering challenges in the theater but the college has no offerings or expertise on the subject. That group can form a learning community to explore the topic (with college supervision) using off-campus resources and expertise. The activity would be for the sake of learning and not for college credit (although elements of an activity could be linked to college credit where appropriate). The College is now moving away from strictly clustering and towards the true learning community concept. It remains to be seen how learning communities will impact the way engineering freshmen acclimate to their living and learning environment.

The School of Engineering has provided its own learning spaces for its students. A portion of its laboratory spaces has been set-aside as study areas. The spaces have been arranged so that there is minimum interference between the laboratory and study functions for those spaces. The spaces can be accessed sixteen hours a day, six days a week and are supervised. Supervision is usually by upper classmen who are willing to provide tutoring assistance to freshmen and sophomores in addition to their normal duty as laboratory supervisors. Also, the School has provided its own 'specialty' learning groups in the form of design teams associated with the freshmen course, Introduction to Engineering [2]. In the process of learning how to work on a design team in that course, the students form study teams that they use for other courses. As with the dormitory experience, many of the design/study teams formed in the freshmen year have persisted into the present junior class.

III. Classroom Environment

The College's freshmen engineering courses have been redesigned to employ a strong, interactive learning component. On average, about a third of the allotted class time is spent on lecture. The remaining time is spent in some form of 'hands-on' learning activity that involves laboratory-type activities with a LEGO-DACTA kit or design/analysis work on a computer (such as working on engineering graphics problems, writing reports, creating presentations, participating in classroom discussions, performing engineering design work). Also, since these courses involve multiple sections, tight coordination between section instructors and instruction assistants is necessary.

The LEGO-DACTA kit uses a ROBOLAB hardware and software system to construct autonomous robots that are controlled by programs written in the ROBOLAB programming environment. We use this system to teach engineering design principles and to have the students practice those principles. Each design team is assigned a kit at the beginning of the course and has access to it inside and outside of the classroom for the duration of the course. In this way their learning of the design process is not limited to just the classroom and can accommodate self-paced learning (constrained by 'targeted deliverables'). A typical activity consists of a short lecture, followed by a demonstration, and concluding with an exercise started in class and finished by the student design team outside of class. Once a team has developed enough proficiency they are left more 'on their own' and use the faculty as 'consultants' as they proceed with their designs. Using some of the class time for supervised design activity helps the student to stay on task and do more in-depth design work. It also helps the teaching staff to see how well the students are learning and to provide the extra help and incentive to those who need it.

This year we integrated laptop computers into three classrooms making them multi-functional rooms. In the past we had to schedule sections of the course in such a manner as to allow all five sections of the course access to two computer labs. The integration of the laptop computers allowed us to overcome the computer lab bottleneck and provide the instructors and students with a flexible environment. The laptops were brought out when the lesson called for them; otherwise the computers were secured in a cabinet in the rear of the classroom where the batteries also charged. Wireless web hubs were added to each room giving the students the ability to easily move the computers as needed. At times each student had a laptop and at other times a team had one or two laptops in use for running experiments. The classrooms were also equipped with a multimedia projection system so that the instructor could project their laptop screen for the entire class to see.

Since laptops are more mobile and present a greater risk of theft we kept ours in a secure cabinet in the classroom and controlled student access. Each student was assigned a laptop that they were responsible for while in the classroom. The laptops were only used for the particular class; the students were not allowed to take the computers with them. However, any software they worked with in the classroom was installed in the traditional computer laboratories in the engineering building so that work started in the classroom could be finished outside of the classroom. The computer software used during the freshmen year includes ROBOLAB, SolidWorks, MS Office Suite, Matlab, and Mathcad.

Beyond, individualized attention in the classroom from faculty and undergraduate teaching assistants, tutors were provided in traditional computer laboratories outside of class time to provide additional assistance if needed. The experiment was a success. The laptops provided the needed technology in the classroom with a minimum of disruption to other 'normal' classroom activities. Most students benefited from the experience and learned the computer-based material well enough not to need the extra tutoring that was being offered to reinforce the classroom work.

To ensure a uniform learning experience across all course sections the teaching staff met weekly to exchange information on how lectures and laboratory experiences were proceeding in their classrooms and when appropriate, to discuss ways to make course 'corrections' to insure that no one section got too far ahead or behind. Student performance expectations were the same for all sections. Tests and quizzes were common. Grading criteria was the same for all sections. A student from any section could get help from any instructor or instruction assistant of any other section.

IV. Advising

Western New England College, like its colleague institutions, recognizes that first-year students have unique needs and require special attention in order to properly adjust to college life and become successful students. The Office of Freshmen and Transfer Students coordinates the efforts to help students adjust to life on our campus. The offices of Resident Life and Student Services are part of the coordinated efforts. First-year students get assigned a peer advisor (an upper classmen) who provides assistance in getting oriented to the layout of the campus, shows what campus services are available and where they are located, and periodically checks up on their advisees to see how they are doing. The peer advisor works out of the Office of Freshmen and Transfer Students and is part of our 'early warning system'. The peer advisor can see a problem developing for a new student before faculty or staff do and either help in overcoming that problem directly or let more experienced campus staff know what is going on so that they can provide the proper help early enough. Each first-year student also gets assigned a member of the faculty to be that student's academic advisor. In the school of engineering the faculty that teach the introductory engineering courses are also the faculty advisors to the students they teach. Those students who have declared their engineering major get a faculty member from that major to be their academic advisor. The faculty advisor also teaches a section of the introductory engineering course and will get his or her advisees in that section. Thus, students have ready access to information related to their field of interest. The number of declared students for a particular major and the classroom capacity for a section of the course do not always match up so a particular class section could end up with a mix of majors (there are also undeclared engineering students). Since the content of the introductory course is not major specific and the instructors of the course tightly coordinate their efforts a student can still get the advising help he or she needs and does not have to feel that he or she is in the 'wrong section'.

The faculty advisor to the first-year engineering student does more than just give advice on what courses to take each semester. The faculty member is also part of the support system coordinated by the Office of Freshmen and Transfer Students and part of the school of engineering's mentoring program. Advisors have access to funds set aside specifically to pay for special advisor-advisee activities. A faculty advisor works with more than one peer advisor in providing any help that may be needed and will coordinate efforts with the Office of Freshmen and Transfer Students. Because the faculty advisor works with his or her advisees in a classroom situation there are more opportunities to get to know the advisee better and to give more personalized attention when needed. Prior to having academic advisors teach their own advisees an advisor would not know what kind of difficulty an advisee was in until a drop slip appeared on the advisor's desk or the advisor got a mid-semester progress report with poor or failing grades in it. Now, advisors schedule periodic, one-on-one 'progress and information sessions' with their advisees to find out how things are going inside and outside of the classroom. During these sessions our faculty have been able to help students with a variety of academic and non academic problems including: finding a calculus or physics tutor, helping to resolve roommate or dormitory problems, mentoring students who would like to change majors or colleges, and advising students to seek counseling for a variety of issues. Students become comfortable enough with their faculty advisors to voluntarily stop by their office and let the advisor know how things were going. Advisors also get progress reports from all courses an advisee is taking. In addition to progress reports the advisor gets early warning of failure notices. We have created many opportunities to 'salvage' a student if that student is serious about getting an education.

The engineering faculty who teach freshmen engineers are expected to be more than teachers, they are expected to be mentors as well. Not only do we teach what an engineer does, we help our students do what an engineer does. To a certain extent the student is also the apprentice… learning by doing. The curriculum is structured so that there is a component of learning by exploration. The faculty provides guidance in how and what to explore. The faculty also talks about engineering, presenting the different opportunities that exist and explaining their significance. Since our entire faculty has industrial experience that component is brought into the learning environment. A student is not just told what the steps to completing a design project are, a student does all the steps and must justify and defend what was done. To enhance this industrial connection we have recruited engineering alumni from industry to serve as mentors for our freshmen engineering students and created the Alumni Mentoring Program (AMP)[3]. The program pairs freshman-engineering students as protégés with recent engineering alumni as mentors to provide regular opportunities for interaction. The principal focus of the AMP is to assist first year engineering students in getting a practical look at their area of career interest, establishing a point of relevancy for their studies, and building personal and professional contacts for their professional future.

V. Mentoring

Engineering alumni were recruited so that every student could be paired with a mentor. In order to foster regular communication, a virtual classroom was established (using Manhattan[4], virtual classroom software developed at Western New England College) which allowed for posting of training materials for mentors, discussion topics and interview guides for protégés, program announcements and other materials particular to the needs of either protégés and/or mentors. In order for the mentor and the protégé to understand their roles and have the appropriate expectations training workshops were conducted and position manuals were distributed. Essential elements for the mentor were:

a. The role of the alumni mentor is one of establishing a partnership with a currently enrolled student.
b. Mentors offer opportunities to their assigned protégés to test ideas, discuss life options, consider challenges, and develop specific and attainable goals for the immediate and distant future.
c. Mentors provide information, not prescription. Decisions need to be left to protégés.
d. Mentors offer advice, not rules.
e. Mentors celebrate student success and assist protégés in self-identification of strengths and skills.
f. Mentors share life experience both as a student and practicing professional.
g. Mentors prompt protégés to evaluate and document experiences and decisions.
h. Mentors are alert to occasions when protégés may be sponsored in networking and career development.

Essential elements for the protégé were:

a. Protégés seek to develop a partnership with a more experienced alumnus who can identify with student lifestyle and life decisions.
b. Protégés commit to sharing of relevant life opportunities made available by mentors.
c. Protégés actively solicit the advice and perspective of mentors.
d. Protégés show interest in the lives of assigned mentors, especially that which pertains to lifestyle and career options.
e. Protégés seek to accept the invitations of mentors to events and opportunities for self-improvement.
f. Protégés invite mentors to share their lives in college through attendance at campus events.

To a certain extent AMP is a work in progress. The work schedules and demands of the mentor and the protégé make it difficult to have 'real time' communications when it is needed. The demands of the workplace and the changing perspectives of the student may make long-term relationships impractical or undesirable. How will rapid turnover of mentor and/or protégé affect the efficacy of the program? There is always the question, "Is there a better way of doing this?"

VI. Conclusions

Based on feedback from students in the form of assessment questionnaires and personal interviews conducted by the school of engineering and the Office of Freshmen and Transfer Students as well as observations by the faculty who teach the first-year engineering students the following information has been collected on our learning environment.

a. Housing students who have similar career goals and study demands in the same proximity was preferable (by the students) to mixing students with a diverse set of interests and levels of commitment.
b. Although not the sole reason for student persistence and academic achievement, peer mentoring and tutoring works based on the results of an annual assessment of the campus-wide process by the Office of Freshmen and Transfer Students.
c. About 50% of the relationships formed during the design team experience persist beyond the freshmen year and become study group and social relationships.
d. Most students report that they prefer less lecturing and more 'hands-on' in staying engaged in the learning process and in retaining information. We are still working on what is the 'optimal mix' for the type of material we are trying to teach our students.
e. Students report that the freshmen design course is a valuable mechanism for helping them determine whether or not they really want to be engineers as well as providing a firm foundation in the continued study of engineering.
f. At least in the freshmen design course, the use of laptops and multimedia technology in the classroom seems to be enhancing learning. Preliminary evidence for this is essentially no change (or slight improvement) in student grades even though there has been about an 80% increase in the course's information content over what was taught prior to the use of the new technology. We are investigating this aspect of the learning environment further.
g. Students consider consistency between sections of a course important. Maintaining that consistency (without discouraging initiative and inventiveness) using faculty with diverse teaching styles and educational philosophies remains a constant challenge.
h. Students and faculty agree that taking a personal interest in an advisee's progress is essential in keeping that student on track and being successful. Having an advisor teach advisees helps to promote that personal interest.
i. Most students reported that AMP was a positive experience. Their mentors helped them get a better perspective on what the engineering profession is all about and what is expected of them to become engineers.

The environment we have created (and are refining) seems to have the elements we need to facilitate student learning. The vast majority of freshmen students completing their engineering courses report that their learning experience was positive; they had to work harder in those courses than in their non engineering courses but did not mind the 'extra' effort because they were confident they knew what they were doing and could get the job done. Since our learning environment and freshmen engineering courses are still works in progress our evaluation procedures have been evolving too. We are in the process of devising metrics that will allow us to better identify and evaluate those elements of the learning environment that get our students where we want them.

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