A Hands-On Curriculum for Christian Engineers

By Dr. David Vader, Chair, Engineering Department

The Collaboratory for Experiential Learning, an initiative of the Engineering Department at Messiah College, fosters student scholarship that serves real needs today while building character and lifelong commitment of students to serve Christ and his Kingdom. This collaboration-laboratory is a place where students, faculty, and community partners representing multiple academic disciplines engage contemporary needs and issues. We are providing learning and mentoring opportunities not readily achieved in the classroom, such as a hands-on introduction to engineering design, management of real projects, work on a team, proposing and testing creative alternatives, and developing leadership abilities.

These new opportunities have become so significant to achieving the goals that we have for our students that the department is proposing an innovative new curriculum for the Bachelor of Science in Engineering (BSE) that will make collaborative learning available to every engineering major. Our purpose is to further extend the discipline of study in engineering at Messiah College from the realm of “What must I know?” to “What does it mean?” and from “What does it mean?” to “What is required of me?”

We desire that students seeking the BSE degree at Messiah College will first seek to answer the question, “What must I know?” This is so that they may practice their discipline with exceptional ability, a first requirement for all who would honor God through their work. The educated graduates, however, are also prepared to answer the question, “What does it mean?” They will bring into the world a deep understanding of how the truth and methodologies of their major area of study

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intersect with the truth and methodologies of other disciplines, and how these disciplines speak collectively to the pressing problems of our day. For such persons, the Joys of scholarship and application are fully realized only when the fruits of those labors are in harmony with everything else that God is doing in the world. Knowing "What does it mean?" is a prerequisite for all who would live and work with exceptional love and skill.

Finally, however, knowledge not appropriated in life is self-indulgence. Engineering students at Messiah College are therefore called to respond to the question, "What is required of me?" They will graduate with a deep sense of vocation, their gifts and talents dedicated to Jesus. Discipling relationships with educators and peers will have prepared them to work for things that matter to God.

The present academic curriculum explores the limits of conventional instruction to achieve the department mission.

We already provide students at all levels with course-based opportunities to test and develop theory by way of application. Senior engineering students complete a capstone project course of study, which we are told is exemplary. These efforts have advanced Messiah's engineering program well beyond the narrow and theoretical course of study familiar to so many engineering students of past decades. Even so, confined to the semester and to the classroom, curricular projects are not well-suited for consideration of real-world problems. In response to this need, the Department of Engineering is developing a course of study that will provide engineering majors with credit-bearing opportunities to explore theories in the context of a real problem or need that belongs to an off-campus project partner. We are recasting the academic credits now allocated to selected courses in the present curriculum, possibly Introduction to Engineering (ENGR 102), Junior and Senior Seminar (ENGR 391/493), Senior Project I & II (ENGR 491/492), and the Engineering Topics Elective Seminar (ENGR 495), into a series of courses that will parallel and support the work of student project teams. The instructional content of these courses will include study of the engineering design process, instruction, and experiences to develop the project management, teamwork, creativity, and leadership abilities of students, and readings and discussions designed to help our students envision opportunities for service, leadership, and reconciliation in their engineering practice.

When a student registers for one of these courses, he or she will be both enrolled in a class and assigned to a project team. At least one course in the sequence will reside in each year of study, so the teams will be composed of students from each year. In addition to faculty-student advising and mentoring, we envision substantial peer mentoring between the more experienced team members and new members. Senior engineering majors will assume "chief engineer" responsibilities, while management and leadership responsibilities will be assigned based on gifting and past performance. No longer will student projects spring into existence ex nihilo in the fall of the year, or be required to achieve final closure by the end of the academic year. We envision projects and teams that span several semesters or even years, enabling them to grapple with more substantial problems and achieve tangible and useful results. A few individual students will join or leave the team each semester, while continuity of oversight is provided by the faculty advisor. This is the model we have used for several years now in the Collaboratory, only now the opportunity will be available to more students.

Another feature of past Collaboratory work that we will carry into the new curriculum is an interdisciplinary approach to problem solving.

Engineering is a process by which ideas are brought into material being. The artifacts so created are commonly known as technology. Engineers are people uniquely qualified by their technical literacy and craft to make technology. Deciding what technology should be brought into reality, however, is a fundamentally interdisciplinary process that must be owned as much by the community in which the technology is to reside as by the creators of that technology. Real technology is best designed and always adopted (or rejected) by persons who have social, political, cultural, environmental, economic, and human-empowerment issues in view as well as technical and commercial ones. The Department of Engineering is exploring the possibility of a general education course that will work in partnership with project teams, just as our project-related courses for majors do. This will permit persons from any major to contribute to a Collaboratory project. We will also continue to support students from other majors who want to earn practicum or capstone project credit by working on a Collaboratory project.

The mission of Messiah College is holistic and radical.

It is holistic for positing maturity of character, faith, and intellect as attributes of an educated person, and radical for anticipating that graduates respond to what they know. Graduates of Messiah are expected not to merely know about character, faith, and the subjects they have studied; rather they are called to live out what they know in lives of service, leadership, and reconciliation in church and society. We expect of ourselves an assessment of knowledge that leads to truth, truth that can direct a person to do certain things while refraining from others. Many projects and partnerships are possible for and available to the Collaboratory, even as various career paths may present themselves to our graduates. Not all possible projects, however, are Collaboratory projects—only those judged to work with and not against God's work in the world and in our lives.

Experiential learning provided through the Collaboratory and curricular enhancements will undoubtedly provide our students with outstanding preparation for engineering practice of any kind. We seek also to strategically provide project activities that will enhance the vocational vision of our students. What are the pressing problems of our work that Christian engineers ought to care about? Are potable water for the poor, the elimination of landmines from farmers' fields, and assistive technologies for the disabled among these priorities? We think so. What other technological needs and challenges do you think should be priorities for the people of God? If you know, please help us to develop this vision for our Collaboratory and the new curriculum. We would love to hear from you.
Update From Mahadaga
By John Meyer, Shop Supervisor

This past summer I was able to accompany a group of four engineering students to Mahadaga, Burkina Faso, West Africa. Our purpose was to continue work that was started in this village by Dokimo Ergatai (DE) in 1997. This interdisciplinary service organization, started as an initiative of the Department of Engineering, has sent six student teams to Mahadaga in the hopes of building long-term relationships with the SIM missionaries and villagers that live there. The main focus of this summer’s trip was to conduct maintenance and repair work on solar power and pumping systems that provide electricity and water to the SIM-operated medical clinic. The team also collected performance data on projects implemented in past years at a handicapped training center in the village.

The work in Burkina Faso has not been without its share of problems. Our desire to provide simple, reproducible technologies and reliable solar electric and water pumping system has not always turned out exactly as planned. We’ve had chronic failures of our DC solar pumps due to a number of manufacturing and design flaws. When the pumps did work there were reports of frequent water shortages. Last year’s team reported that the workers in the handicapped garden preferred to irrigate with the solar pump rather than the hand-powered pumps we installed at the wells. A large turnover of missionary and national staff has left us without a knowledgeable person to oversee and maintain the solar power plant that provides electricity for the medical clinic. This has led to a great deal of wear on our large battery storage pack.

However, through it all, God is faithful, and one of the privileges of being

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involved with a project long term is that you get a chance to see God's faithfulness unfolding over time.

Here's a little of what we learned this past summer. Several years of poor rainfall had lowered the water table in the garden enough to render some of our hand-powered pumps inoperable. Solar pumping was only used when the wells were too dry for hand pumping.

Furthermore, the craftsmen at the Handicapped Project are now building the pumps and there are two local individuals interested in buying these pumps for their own gardens. After many repairs and design modifications, it looks like we may finally have a reliable DC solar pump; all indicators are that the retrofitted pumps installed this summer are running well. There has been a sufficient supply of water, even during extended periods of cloudy weather, ever since the team located and repaired two very large leaks in the medical clinic water distribution system. The team had the opportunity to conduct extensive solar energy training with missionaries and hospital staff, and one of the national staff has agreed to take responsibility for the operation and care of the solar electric system.

When asked if we should continue our partnership in Mahadaga, one of the SIM missionaries, François Pedeau, replied: “You must continue. Life has been better for us here since you’ve come to work alongside us.” The work goes on and we give the glory to God who makes it all possible.
Update on Landmine Action Project

By Dr. Don Pratt

Since 1995, Messiah College has been working in the area of Humanitarian Demining, mainly through Senior Engineering Design Projects, Independent Study research, and summer internships. In the fall of 2001, the Messiah College Landmine Action Project (MCLAP) was created to bring together students and faculty from a variety of departments to begin an interdisciplinary approach to the landmine problem. One of the main reasons for creating MCLAP was to bring unity and continuity to the landmine work, as an initiative of the Collaboratory for Experiential Learning.

During the fall semester, student leaders crafted a mission statement, which states that MCLAP will educate and equip the Messiah Community and collaborate with like-minded humanitarian groups to facilitate multidisciplinary projects that address the real world needs of mine action. As a result, the landmine work has branched out to include not only technical projects, but also educational activities such as presentations by students and guest speakers, Mine Awareness Week on campus, and an informative website: www.messiah.edu/acedpt/dept/home/ engineer/Projects/mclap/

Mine Awareness Week was held the third week in September as a consciousness-raising activity involving posters, a simulated minefield, and an alternative chapel. The simulated minefield was a taped-off area near Lottie Nelson dining hall where some 30 "dummy" mines, built by students, were buried. These mines contained no explosives, but stepping on one activated an air horn at the perimeter of the field. Students, faculty, and staff tried their luck at crossing the field, and while no one lost a limb in the process, we hope that all who experienced the surprise of stepping on a simulated mine came away with a deeper appreciation of the plight of those for whom such fields are a part of their daily life.

As a result of Messiah's work in this area, Dr. Don Pratt was asked to participate in a Humanitarian Demining task force last April in Washington, D.C., sponsored by the U.S. Department of State. During this meeting, Don had the opportunity to discuss the possibility of taking a group of MCLAP students to a mined country, under the auspices of the State Department. We are hoping that this trip will take place during the spring semester of 2003.

more photos follow on page 6...
Aaron Dahlstrom '03 setting up the minefield at Eisenhower

Dr. Ray Norman, Dean of the School of Management, Engineering, and Business, navigating through the minefield

Students from across campus carefully navigate through the minefield
Merger Unifies Two Campus Engineering Organizations

By Earl Swope, EE Technician

In the past few semesters student interest in professional societies has decreased dramatically. To counter this decrease, the Messiah College Society of Engineers (MCSE) and the Engineering Community Development Committee (ECDC) have decided to merge into one group. This new group will also include the members of the Engineering House and student members of Engineering Professional Societies. This merger will enable these now separate groups to pool resources and eliminate overlap.

Currently, the engineering community at Messiah College has four separate organizations to which students can belong: MCSE; American Society of Mechanical Engineers (ASME) and Institute of Electronic and Electrical Engineers (IEEE) student chapters; the Engineering House; and the ECDC. All four of these groups exist to develop community and create ties among engineering students and between engineering students and engineering faculty. Also, specifically, MCSE and ECDC are designed to uphold and advance the mission and objectives of the Messiah College BSE program. The professional societies and the Engineering House share the task of connecting the engineering community to the world outside of campus. Recently, the ECDC has taken up the task of raising a standard of professional engineering, a task that is also assigned to the professional societies. It is observable that there is a lot of overlap between these four groups. Merging all four groups into one will help erase the overlap.

To accomplish this important task of merging the groups, MCSE and ECDC have begun meeting together as one group with common goals for this semester. Both groups also have separate goals for this semester. The end result will be a collaborative group of engineering student organizations. The unified group will work to develop and nurture community relationships within the engineering community, including relationships between students and the outside world.

The specific semester goal of the ECDC is to refine an engineering-specific code of honor for the Messiah College engineering program. Last year, the ECDC decided that five principles apply to every member of the engineering community. These five principles can best be summed up in the following statement: "Each member of the engineering community will: (1) Take full responsibility for the education process; (2) Learn from and work with others; (3) Use talents and skills appropriately; (4) Respect self and others; and (5) Seek growth in Christlikeness." The task before the ECDC this semester is to answer the following four questions. First, what support can be found for the principles either in the Bible, the mission, and goals of Messiah College or the mission and goals of Messiah College's BSE program? Second, how do these principles specifically apply to engineering students? Third, how do these principles specifically apply to engineering professors and technicians? Fourth, what procedure should be followed if these principles are violated? In Matthew 18:15-17, we read, "If your brother sins against you, go and show him his fault, just between the two of you. If he listens to you, you have won your brother over. But if he will not listen, take one or two others along, so that 'every matter may be established, by the testimony of two or three witnesses.' The ECDC is striving to become the "one or two others."

The MCSE is busy planning fun activities for the entire engineering community to take part in. Some ideas include a pizza party, a volleyball tournament, field trips and a hayride. These events will be designed so the participates have fun, but they will also be instrumental in creating ties within the engineering community. By attending these fun events, students will become more aware of what is happening within the engineering community as well as becoming more aware of exactly who makes up the engineering community. It is the desire of the MCSE that friendships develop between engineering students that last a lifetime. Also, when students are aware of who is in the engineering community it is easier to develop a project team in the junior and senior years.
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Both groups have a set of common goals. Their goals are connected with the current initiatives within the engineering community. The MCSE and the ECDC will work to reestablish the Engineering House and to raise the interest in that organization. These two groups may work with the Department of Engineering in assessing community opinion about a problem/client-based curriculum and how best to implement it. Also, these groups may develop celebrations for the sophomore and junior years to complement the First Year Picnic (normally held in early September) and the Senior Celebration (normally held in early May). Finally, these two groups will work with the engineering faculty to raise student interest in professional engineering societies. The most important common goal is the reestablishment of the Engineering House.

To accomplish these specific and common goals the MCSE and the ECDC will sponsor joint activities such as hosting meals and inviting those who are interested in either of the groups and professional societies. By the end of the year, a group of students will emerge that are dedicated to the advancement of these groups. These students will be encouraged to seek housing together and thus reestablish the Engineering House. This group will live together and work together to develop community and to nurture and advance the mission and goals of the Messiah College BSE program.

For more information or to submit comments, questions or suggestions, contact ECDC@messiah.edu or go on the web, www.messiah.edu/acetdept/depthome/engineer/org.html.