The world we live in today is much different from the world that existed several decades ago. Advances in communication and transportation link nations together. Finance and trade are conducted in a global marketplace. Due to developments in education and technology, other nations have progressed dramatically. These developments have alarmed government and business leaders who have expressed concern that America is being outpaced economically.

Then, too, advances in technology have changed society dramatically. One place this is most evident is in the workplace. Because jobs have become more high-tech, they now require more education. As a result, the public has charged those of us who work in higher education to prepare students to live in this technological environment.

We in higher education have seen other developments as well. During the past several decades the student population has increased dramatically. The faces of the student population have also changed as women, students of color, and non-traditional students joined the ranks of those attending college. Each group, with their particular needs, has posed new challenges.

Currently, all sectors of higher education are being asked to educate all students to a very high level. Society depends on us to produce quality graduates who, as employees, can meet the needs of business, in so doing, ensuring that our nation remains a viable contender in the international competition of the 21st century. In addition, our graduates are expected to have the skills necessary to solve the host of social ills that plague society. Coming up with solutions to hate, violence, family instability, crime, drug abuse will require that our students are well prepared.

How are we to produce the quality graduates now needed by society? Can we? These are questions those of us in all sectors of education, including engineering education, are asking, and not without reason.

Over the past two decades numerous reports have focused specifically on the quality of higher education. These reports, all highly critical in nature have expressed sharp concerns about higher education's ability to meet the needs of society as well as respond to the needs of students. Such perceived inadequacies have led to recommendations that the entire educational system be overhauled in order to "put learning first." According to advocates of what has been called "the learning revolution" the benefits to be gained by this overhaul are tremendous. By placing learning first, organizations have the potential to increase graduation rates, change faculty roles and responsibilities, better satisfy employers, eliminate unproductive layers of bureaucracy, get rid of outdated curricula, remove ineffective services, and create expanded and improved student learning opportunities.

Included in this call to put learning first has been the recommendation to adopt a new system of instructional delivery. This recommendation, too, is not without merit. As it turns out, (based on current advances in research on learning) our traditional delivery system which emphasizes lecturing, competitive grading, and individual effort is ineffective when it comes to promoting learning and to supporting skill and attitudinal development. On the other hand, new learning-centered instructional approaches which incorporate...
discussion, experiential, and cooperative learning, do have the potential to produce the outcomes we now demand of our graduates. Numerous studies have documented the validity of this claim.

Given the mounting evidence in support of learning-centered approaches as well as increased pressures demanding that we overhaul our entire approach to education, one might expect that engineering classrooms would look dramatically different from those of several decades ago. Ironically, however, this is not the case. By and large the old way of doing things in the classroom still dominates. That is, the majority of engineering professors still lecture; homework still consists of assigned exercises at the end of traditional texts; and assessment of student outcomes is still, for the most part, ascertained by the administration of standardized tests.

Why the paradox? Why do we say one thing and do another? Why haven’t we made any headway with instructors? Why do they cling to old methods? Why the resistance on the part of faculty to join the “learning revolution”?

Undoubtedly there are many reasons, lack of time being among the top contenders. The teaching and learning enterprise does not happen in a vacuum. While calls for improved teaching and learning may have gone up, calls for research have not gone away. Both endeavors take time. Doing top notch research with all that it entails (e.g. writing proposals, securing funding, supervising graduates, designing and conducting research, analysis and dissemination of results, etc.) is a full time job. So, too, is teaching. Planning lessons, selecting meaningful activities, finding ways to engage students with the material, finding ways to engage students with each other, creating an atmosphere in which learning can occur, dealing with the myriad of problems that undoubtedly happen when working with students, assessing student outcomes, developing curriculum are all time-consuming endeavors. Given current demands on their time, is it little wonder that few take kindly to accusations that they are not producing enough?

This question becomes particularly pressing when taking into consideration the conditions under which faculty work. Calls for change have gone up at the same time departmental budgets are being cut. Student numbers are going up at the same time when faculty and staff numbers are going down. And as if it was not hard enough to hold down two jobs (teaching and research), accountability demands require more and more reporting.

Not helping matters any, of course, is the current reward structure. Why should faculty work on their teaching when they are told outright that they might not get tenure if they devote time to their teaching? Why should they work on their teaching when doing so results in a loss of respect from their colleagues?

All things considered, it is somewhat amazing that faculty would look into new methods at all. Yet many do. And for that reason, we offer this article.

Over the past six years we have spent many hours working with faculty to improve their teaching and to enhance student learning. We have found this experience gratifying. Based on survey responses and ongoing discussion, so, too, have faculty. Of equal importance is the fact that our program has had long term impact. (Years after leaving the program faculty tell us they continue to use strategies they learned in the program.) Also noteworthy is the case that the scope of our efforts has broadened. (For instance, we are currently working with several engineering faculty in efforts to apply learning-centered strategies to other college initiatives.)

If our work has taught us anything it is this: now is an important time for faculty developers and for those on campus charged with the important work of improving student learning. Many are looking for models and ways to become more effective change agents. Because of this need we have chosen to write about the model we use and the impact it has had in the College of Engineering at Iowa State. We do not hold our approach to be the ultimate “solution.” On the other hand, this method has worked for us. We offer it here, in the hope that it will provide ideas for those struggling with similar issues.

So, where do we start? How do we go about helping faculty to be successful in bringing about student learning?
There is no doubt that institutional culture is a major obstacle to learning. So, too, is a lack of knowledge on the part of professors about teaching and learning. While professors are experts in their disciplines, they have not been trained as teachers. Indeed, many professors lecture because they don't know anything else. They were taught by lecture, therefore they teach by lecture. Breaking through this pattern is where we begin our efforts.

At Iowa State, we have designed a faculty development program that helps faculty to see and experience an alternative to traditional teacher-centered environments. Put another way, we have designed a program that creates a learning-centered environment for faculty. In this environment, we as developers, help faculty learn about learning and reflect on their beliefs about teaching. We accomplish this goal by designing activities to help them develop an understanding of how people learn.

We use this approach for specific reasons. First, this method is an effective one for accomplishing our purpose: that of linking student learning to faculty development. Second, it sends a message to professors that we believe they need to hear: their efforts to improve student learning are valued.

In the remainder of this paper we describe: 1) the approach we use (background, mission, implementation) and 2) specific examples of how faculty have used their experience in our program to promote improved student learning opportunities in the College of Engineering.

I. Background

In 1994, convinced that they could do a better job of preparing their graduates for industry, a handful of Mechanical Engineers formed a partnership with a professor from the college of education in order to learn more about educational strategies. Little did they know at the time where that first step would lead.

This small group spent the first year discussing issues that troubled them. They bounced ideas off of one another. They explored educational literature. They talked about their own discipline. They tried out strategies. They evaluated their efforts. Others took note.

By the second year, two more groups were formed. By the third year, other colleges on campus were involved. By the fourth year, the program had grown in numbers from 18 participants to 200 and had spread outward from faculty in one department in one college to include faculty representing nearly all colleges on the Iowa State Campus. By the fifth year, other institutions and sectors of higher education (e.g. community colleges) had heard about the program and subsequently inquired about the possibility of forming partnerships. Now, well into its sixth year, Project LEA/RN™ (Learning Enhancement Action/Resource Network) provides support and leadership to many efforts both on and off campus.

Participant enthusiasm for the program continues to be a strong driving force in our success story. From day one the program was designed to be faculty-led and implemented. It has not been mandated or institutionalized. Administrative support, has been sought in response to faculty expressing their needs. (Currently, the program is supported by the Colleges of Engineering and Education, the Center for Teaching Excellence and numerous contracts and grants.) We believe the bottom-up orientation and attentiveness to faculty needs are key factors contributing to the program's success. Another critical factor is the program's emphasis on learning.

II. Mission

Although we refer to LEA/RN™ as a program, it would be more appropriate to speak of it as a process that challenges faculty to discover new ways of thinking about teaching, about learning, and about learners. We believe this process of discovery to be fundamentally important because it is this deeper search for understanding that provides for a higher probability that changed practice will actually take place.

Project LEA/RN™, therefore, is not about easy answers to education's problems. We are not about the business of offering "tips and techniques" or twelve point plans guaranteed to deliver success. We believe that faculty need to know why certain strategies work. They need to understand what about the strategies makes them work (or not work). They need to be aware of the dispositions students must have that
contribute to making these strategies work and how to develop these dispositions. We believe that these
understandings only occur if faculty work hard at understanding the learning process. Without this critical
examination of their own practice and their understanding of that practice, student learning will not occur.
Moreover, we are also concerned that "tips and techniques" workshops that introduce faculty to new
methods without a critical understanding of what makes them work (and that fail to provide faculty with
the support system required in order for this critical understanding to happen in the first place) while well
intended, potentially serve to bring new methods - which many consider "soft" in the first place - further
into disrepute.

Lastly, we are not about "converting" faculty. (No one can make a teacher change his or her practice.)
Rather we believe that professors have a wealth of untapped knowledge that we seek to draw upon. We
seek to use their experiences to create alternative ways of thinking and acting; to provide opportunities for
professors to raise issues with their colleagues and to help participants evaluate a wide range of teaching
strategies to determine their appropriateness or inappropriateness for specific purposes. We believe this
approach allows faculty to develop the skills necessary to frame a practice that supports student learning.
This guiding philosophy is operationalized in the project’s key features.

III. Program Implementation

Structure. Program participants (professors, administrators, teaching assistants, staff) meet bi-weekly for
two hours throughout the course of the academic year in large group sessions (15-20 members) led by a
staff facilitator. Beyond these large group sessions, participant learning is furthered in several ways
including individual practice in the classroom, utilization of learning partners, and collaborative inquiry
into educational literature.

Content. In a sense learn participants never graduate. Many professors have been involved for many
years. Others come back because they have new issues to explore. Because of the diversity of audiences
and needs we have developed many curricular foci. For each group of faculty we work with we have
particular outcomes we hope to achieve. In all cases the content is designed to be meaningful to
participants. It is also important to note that while we emphasize learning theory, we also realize that for
many professors educational theory is “jargon.” That does not mean that we stay away from it. It does,
however, mean that we try to keep the content practical and the ideas easy to implement.

Process. In helping faculty develop alternative ways of thinking and acting we pay careful attention to the
activities we pick. For each activity there is a purpose. Some are designed to expose faculty to general
information about strategies. Others are designed to prompt deeper reflection about how people learn.
Some require integration and synthesis. Others are designed to challenge commonly held beliefs about
traditional practices. Others require collaborative problem solving. Others, yet, are designed to draw
attention to the very issue that we are being so purposed about the activities in the first place.

Teaching is a purposeful act. Helping faculty to see that there are specific things that they can do
to raise the probability that students will get out of instruction that which faculty intend is an important
outcome. Not only does having such knowledge improve faculty morale and increase job satisfaction
(which it does) but it also helps instructors create effective learning conditions for students that
ultimately result in increased student learning.

IV. Outgrowths of Participation

In working with faculty one of the things we seek to do is to provide the opportunity for them to extend
and refine their knowledge by applying it to new settings. We believe this focus is paying off in the
college of engineering in exciting and important ways. We, of course, can not take total credit for faculty
involvement in college and departmental programs. On the other hand, we do know that we contribute to
these efforts. We know this because faculty over the past several years have increasingly asked us to
provide leadership and support in many of these efforts. By way of illustration, we offer several examples.

Employer satisfaction. We spend a great deal of time in our program challenging faculty to be purposeful
about what they do. Along these lines, we work on setting objectives followed by careful scrutiny of
individual lesson plans to ensure that stated objectives are reached. Faculty, in turn, have used the
knowledge they gained through these faculty development experiences and have put them to use in the classroom, in effect, producing classroom learning environments for students that produce the quality outcomes employers seek. Because employers of engineering graduates seek students who have a good understanding of engineering science fundamentals, who know the basics of design and manufacturing processes, who have a basic understanding of the context in which engineering is practiced, who have the ability to think both critically and creatively, etc. it is important for professors to plan and design learning opportunities that produce these outcomes.

As a result of participation in the project, many professors have revamped their courses to provide these kinds of learning opportunities. Engaging students in a mock bid letting experience was the way one professor achieved this aim. The night prior to the bid letting, students reserved and stayed in the same hotel as the actual subcontractors and suppliers. They contacted and negotiated with the actual subcontractors and suppliers to incorporate the quotes into their proposals. This was grueling work (keeping the students up between the hours of midnight and 9 am on the morning of the bid letting). Yet this mock bid letting experience paid off. It provided students with the opportunity to experience the real context in which they might be working. It required them to think critically and creatively. They also had the opportunity to practice building self-confidence. The tenacity of these students and the quality of their work also impressed the Iowa DOT officials who participated in the mock bid letting experience. (Interestingly enough, the experience was so grueling that the DOT officials feared that the activity would discourage students from wanting to participate in actual bid lettings as construction engineers. Students however saw the matter differently. For them, this experience led to a deeper commitment to the construction engineering field than they had previously held.)

New applications of information technology. All teachers have bad days when things don’t go well. This is to be expected and no amount of planning can prevent it from happening. On the hand, there are also those times when professors get that sinking feeling that "things are not working as they should." This was the experience of a Mechanical Engineering professor who, having become convinced of the benefits of using cooperative learning in the traditional setting (i.e. a classroom) decided to employ these same methods in a distance education setting. Unfortunately, on his first attempt things did not work out as he had anticipated. He knew it. Students knew it. Focus group information verified it. So now what?

As with many engineers, he was not willing to give up his original goal, simply because his first attempt at reaching it had not gone well. Rather, he determined to make the next time better. Today, he and two Project LEA/RN™ facilitators are engaged in a collaborative effort designed to find effective ways to put cooperative learning into distance education classrooms. In addition to conducting focus groups with students, they have carefully begun to think about how new advances in learning can be combined with networking technology to produce improved and expanded learning environments for students.

Expanded and improved learning opportunities for students. Technology is only one of several ways in which the college of engineering has sought to expand and improve learning opportunities for students. Student learning communities are another.

Not all participants in our program are interested in the same thing. Some have been drawn to assessment issues. Others to questioning strategies and lesson planning. Others yet, have expressed interest in finding better ways to engage students with course content. For some professors in this latter group this interest has outgrown the classroom and they have now become involved in working with learning communities.

This expanded interest on the part of professors to expand and improve learning opportunities for students has resulted in new partnerships. For example, we are currently involved in a collaborative effort with a Computer Engineering professor and two graduate students designed to create the best learning opportunity possible for students in a freshman learning community.

In this case, this effort grew out of one professor's commitment to active learning. Several years ago, this professor joined a LEA/RN group. As a result, he became very interested in how faculty could design learning-centered environments for students. And he worked do to so himself. This interest resulted in a total overhaul of how he involved students in learning about the work of a computer engineer. In particular, his focus is on the development of better security systems. Along these lines he found that LEA/RN activities provided the knowledge he needed to better engage students with the content, to introduce them to technological innovations, and to engage them in the ethical issues involved in breaking computer security systems. He now seeks to bring about these same outcomes in his learning
community. (A freshman experience designed to provide students in the program with a greater awareness of computer engineering, hands-on experiences, knowledge and skills for successful teamwork and enhanced problem solving skills.)

V. Concluding Remarks

This is a critical time for engineering education reform. The rapid pace of change is taking its toll on society in complex, encouraging, and frightening ways. Unless we enlarge our capacity to learn well and to teach well, we as a nation may suffer severe consequences both culturally and economically. In our search for solutions, however, let us not settle for quick fixes or easy answers. May we also keep in mind a truth that we often overlook: faculty are the greatest resource for learning an institution has. Though we revamp our curricula, revise our strategic plans, and restructure our organizations, if we have not provided the opportunity for faculty to learn about themselves as teachers or about their students as learners, true reform is unlikely to be achieved.

Bibliography


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