INCLUSIVE LEARNING COMMUNITIES AT TEXAS A&M
MAKING SYSTEMIC CHANGES IN THE CLASSROOM

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In the Fall of 1998, the Dwight Look College of Engineering at Texas A&M University institutionalized a new way of doing the business of educating engineers. We call this new model, Inclusive Learning Communities (ILCs). Our working definition is: ILCs are groups of students, faculty and industry with common interests who work as partners to improve the engineering educational experience. ILCs value diversity, are accessible to all interested individuals, and bring real world situations into the engineering classroom.

HISTORY

Texas A&M University conducted a pilot program for four years funded by the National Science Foundation, Foundation Coalition (FC) program. The purpose was to discover and implement new curriculum and pedagogy for engineering. We participated in this grant with six other institutions: Arizona State University, University of Alabama, Texas A&M University at Kingsville, Maricopa Junior College, Texas Women's University, and Rose Hulman University (Frazier, et al., 1997).

Texas A&M made the decision to focus on the first year curriculum (Morgan, 1997 and Moran and Bolton, 1998). The second year curriculum at A&M had been integrated several years before the FC pilot, so the first year was our target for the pilot program. The courses that were integrated were: physics (8 hours), calculus (8 hours), chemistry (4 hours), engineering (5 hours), and English (3 hours). Along with course integration, a change in pedagogy also was initiated. The first year, 100 students participated, 200 the second year, and 300 the third and fourth years.

There is no doubt that neither the course integration nor the “new” pedagogy is truly new. Research and extensive pilot programs exist that prove these changes are significant in increasing the learning of students, especially women and minorities. Gabelnick, et. al. (1990), presents a primer on “learning communities.” The value of curriculum restructuring and the combination and nature of course and coursework links, have been specifically circumscribed by these authors. Astin (1987) and Palmer (1987) also subscribe to the collaborative versus competitive and communal versus individualistic models of education.

Female students are not the only under-represented group in engineering that research tells us course integration and clustering of students, helps. Nieves-Squires (1991) states,
"cooperation and group cohesiveness are very important values in Hispanic culture. The competitiveness of academia, with its strong emphasis on individual achievement, can be a source of conflict for Hispanic students. They may need a period of transition before they can tackle individual and competitive projects. Professors can help by permitting students to do some group projects." Besterfield-Sacre (1994) concurs by reporting African-Americans and Hispanics enjoy working in groups more than the other ethnic groups in engineering first year courses.

INCLUSIVE LEARNING COMMUNITIES

For Fall 1998, the Look College of Engineering applied what it had learned from the four year pilot program and extensive literature, to completely change the curriculum all first year students (approximately 2100). We offered clusters of courses, a new integrated engineering course, and new pedagogy. The course clusters addressed the needs of pre-calculus, calculus I, and calculus II students. Below is a listing of the course clusters.

<table>
<thead>
<tr>
<th>Pre Calc Cluster</th>
<th>Calc I Cluster</th>
<th>Honors Cluster</th>
<th>Calc II Cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-calculus</td>
<td>Calculus I</td>
<td>Calculus II(H)</td>
<td>Calculus II</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Physics I</td>
<td>Engineering I</td>
<td>Physics II</td>
</tr>
<tr>
<td>Engineering Seminar</td>
<td>Engineering I</td>
<td>Engineering II</td>
<td>Engineering II</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Chemistry)</td>
<td></td>
</tr>
</tbody>
</table>

Placement in math is determined by the student's math SAT score and scores in trigonometry and algebra from a math assessment test given at the University during summer freshman conferences. Placement in math determines the student's placement in an engineering course.

Students were registered in course clusters in groups of 100 each. This means that the same 100 students were in the same engineering, science, and math sections. This intentional clustering builds the academic community. This community of learners is an especially effective model for the retention of women and ethnic minorities.

The pedagogical changes included active/cooperative learning and teaming in the classroom. The teaming portion of the course is about 25% of the student's grade. The students have teaming exercises, team projects, and a teaming portion on tests. A significant change in how information is delivered in the classroom is through active/cooperative learning. Faculty no longer use lecture as the main mode of information transfer. Both the teaming and active/cooperative learning have been significant changes for most of the faculty. To help in this transformation, faculty workshops are conducted each year. The faculty who teach first and second year courses are strongly encouraged to attend, with all other faculty in the college invited. About 85% of the first and second year faculty have attended the workshops. Faculty who were involved in the pilot program lead the workshops. These workshops offer peer learning opportunities. Also as part of the change in faculty communities, a monthly lunch is held for the first year faculty. The course details are discussed, different ways to present course material is presented, and speakers are invited to present a discussion on areas of
interest identified by faculty. The purpose of these faculty meetings is both community
building and communication.

Another change in the classroom is technology. Each engineering classroom is equipped
with computers (usually 1 for every 2 students). Software programs appropriate to the
course are presented and demonstrated in the classroom instead of a lab session that is
disconnected from the faculty and the main classroom. This helps learning and
application, especially for students who need to see and apply as they hear new
information. “Connected learners,” largest portion being women, want to know why
things are important and why they make a difference. They are drawn to knowledge that
emerges from first hand observation rather than abstract “out-of-context” learning. They
respect others for their minds and ideas and listen to understand each person’s
experiences (Belenky, 1986).

In the Fall 1998, every student in Engineering I took a behavior profile. These profiles
were taken in class, discussed in class, and assignments were given that applied the
differences in behavior to student teams. This is an effort to help students recognize their
own behaviors and those of other people. It also helped students work effectively in their
teams.

Another exciting change in the classroom for Engineering I was the inclusion of industry
case studies. In every section of Engineering I (16 total in the fall 1998), a company
came to the class and presented an engineering case study. The case studies had as their
goals to demonstrate what engineers do in the “real” world; demonstrate teaming and
reinforce it’s validity to engineering; and to demonstrate problem solving skills. Each
company was given one two hour class period. After companies wrote the case study, it
was delivered to students for them to read before class. During the class period, the
industry team (ranging from one to eight members) discussed the engineering problem;
then had the students break into their teams and generate solutions to the problem. Near
the end of class, a discussion was held. Possible solutions the students generated and the
solution the company selected were discussed. Then the industry members shared with
the class why the company selected the solution it did. This was a great opportunity for
students to understand a little about what engineers really do and that engineering
problems do not usually have one “right” answer. We had eight companies participate in
1998-1999 with twelve signed up for 1999-2000. Students’ comments included:

“I liked learning about and working on technical problems that are occurring right
now in industry.”

“I didn’t realize how much compromise an engineer had to make in order to
satisfy other aspects of the product. I understand better how they are considered
and weighed.”

Part of the definition of ILCs is diversity. This encompasses many aspects of valuing
people, not just race and gender, but differences in learning styles, communication styles,
presentation styles, etc. The behavior profiles helped open this conversation. Another

MOVING BEYOND INDIVIDUAL PROGRAMS TO SYSTEMIC CHANGE
1999 WEPAN National Conference
effort at dialogue around diversity, was company led Diversity Workshops. Exxon Chemical offered us their diversity manager for these workshops. We offered three workshops to the first year students in Engineering I and Engineering II. The workshops were announced in the Engineering I course, were listed on the syllabus, and 5 points on a homework assignment were offered. We had about 275 students attend the workshops. The evaluations were outstanding with interesting comments such as:

“This is the first time I’ve thought about diversity in this way.”

“This was a great workshop, but two hours just doesn’t give the subject and conversation justice.”

Our plan is to make this the opening to a five-year discussion in the Look College of Engineering.

EVALUATION

The real question to be answered is “Are all these changes better for underrepresented groups in engineering and does it help the retention in engineering?” We asked these questions plus the questions: is learning enhanced; is time to graduation faster; and have we developed “life long learners”. The retention data from the pilot clearly shows us that women and ethnic minorities retain at a higher rate and that majority men maintain about the same retention rate. In addition, the additional attrition found in later years is eliminated.
Other measures can be a bit harder to quantify. Nevertheless, results of standardized tests show that students participating in the pilot project performed at significantly higher levels at the end of the year than did the comparison group (Willson, et al., 1995).

<table>
<thead>
<tr>
<th>Test</th>
<th>% Gain Greater than Traditional</th>
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<tbody>
<tr>
<td>Standardized Critical Thinking</td>
<td>16%</td>
</tr>
<tr>
<td>Force Concept Inventory</td>
<td>15%</td>
</tr>
<tr>
<td>Mechanics Baseline Test</td>
<td>10%</td>
</tr>
<tr>
<td>Calculus Concept Test</td>
<td>10%</td>
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In focus groups with students, these comments were made:
"We learned a lot about ourselves and about teaming and trusting."
"It gives you a good foundation to build on once you get to upper classes . . ."
"Learning the concepts has helped me to conceptualize, and that's how I approach the classes that I am in now."
"It taught you to really utilize the technology to improve your solutions, and I think that is something you can take to industry when you finish."

CONCLUSION

The Inclusive Learning Communities in the Dwight Look College of Engineering at Texas A&M University, are the systemic change effort in engineering education. This effort is not just for the students, but is for the faculty and for industry. We believe we will educate a better prepared engineer who can change and solve the problems of the future.
REFERENCES


