
Interfaces Between the Foundation Coalition Integrated Curriculum and Programs for Honors, Minority, Women, and Transfer Students

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Abstract:

The Foundation Coalition includes seven institutions: Arizona State University, Maricopa Community College District, Rose-Hulman Institute of Technology, Texas A&M University, Texas A&M University-Kingsville, Texas Woman's University, and the University of Alabama. All of these institutions are in the process of developing an engineering curriculum that incorporates the integration of courses, the utilization of active and cooperative learning in the classroom, and the use of technology in the classroom to enhance the level and sophistication of content and problems approached. During the 1994-1995 academic year all of these institutions piloted a freshman curriculum that involved various levels of integration of the courses that students take. Typically, this involved the integration of Physics, Calculus, English, Engineering Design Graphics, Chemistry, and Engineering Problem Solving over both semesters of the freshman year. In addition the students took Humanities or Social Science electives. One of the goals of this Coalition is to increase the enrollment and support of women and underrepresented minorities. This paper describes several conflicts which the integrated approach created for students in special programs in the College of Engineering, such as those for Honors, Minority, Women, and Transfer students. Most of these programs have existed for many years in the College, and have activities with proven records for enhancing the educational experience and retention in Engineering. These conflicts are described and some of the initial strategies for resolving the conflicts are presented, as well as plans for assuring that these programs work together effectively as the integrated program expands and becomes institutionalized. Resolving these conflicts is a challenge the integrated curriculum must meet in order to be effective for a large number of students at a public institution.

Introduction

The Foundation Coalition, FC, has a primary goal of revising the freshman and sophomore-year curriculum for all engineering majors by incorporating the concepts of active learning, in-class technology enhancement, and the integration of courses. The FC involves seven institutions: Arizona State University (ASU), Maricopa Community College District (MCCD), Rose-Hulman Institute of Technology (RHIT), Texas A&M University (TAMU), Texas A&M University Kingsville (TAMUK), Texas Woman's University (TWU), and the University of Alabama (UA). During the 1994-1995 academic year all of these institutions piloted a set of courses that involved the three thrusts mentioned

above.

The institutions in the FC differ in the characteristic and size of their student bodies, and the focus of their faculty. Most of the institutions have an emphasis on research as well as teaching, but this is most pronounced at ASU, TAMU, and UA. TAMU has a large engineering program, with approximately 1600 new freshmen every year, while MCCD and TWU have only pre-engineering offerings at their institutions. During the last academic year (1994-1995) TWU served an all-female undergraduate enrollment, while RHIT served an all-male undergraduate enrollment. TAMU serves a predominantly Hispanic population, and is experiencing significant growth in the enrollment of engineering students. Each institution had a unique approach in piloting a new freshman curriculum, even if the major thrusts of change were the same.

This paper will present the pilot programs at TAMU and ASU and their interfaces with the special programs in the Colleges for Honors, Minorities, Women, and Transfer students. The value in this is the observation that the conflicts between these programs represent most of the leading reasons why it would be difficult to institutionalize the piloted program from the student perspective. Certainly funding for technology, training for faculty, and motivation and evidence to inspire faculty to change are also barriers to institutionalization. However, until the conflicts that arise with special student programs are addressed it will be hard to convince faculty the program is meant for all students. The freshman pilot program will briefly be explained, and then the conflicts and opportunities that special programs bring to these pilot programs are presented and discussed.

The Freshman Pilot Program

The TAMU pilot involved the enrollment of 100 incoming freshmen in a set of integrated courses that covered the same material required for all freshmen in the College of Engineering. For the Fall and Spring semesters this included the first and second Calculus courses, a calculus-based Physics course, Chemistry, English Composition, Engineering Design Graphics, Engineering Problem Solving, and Computer Programming. Students also chose either Humanities or Social Science electives. In the pilot program two math, one physics, one chemistry, one English, and two engineering instructors worked to combine the courses. The program truly integrated the courses, similar to a RHIT integrated freshman year curriculum that had been developed in previous years [1]. Syllabi were woven together to cover major concepts and topics in an integrated fashion. Weekly lectures were scheduled to assure the best topic order and emphasis on the information. For example, during one week the focus might be on Math and Physics, while in the following week English and Engineering, utilizing the same Math and Physics concepts, might be the focus.

In addition to integrating the content of freshman courses, the TAMU pilot utilized active learning concepts and technology in the classroom to enhance the curriculum. Team training was part of the curriculum, and the students worked on problems and projects in assigned teams. The testing of concepts in the class was done by using both individual and team tests. In the classroom each team of four students had two computers at their work area. (The faculty also had a computer for presenting information to the students.) The students at both TAMU and ASU had 486-based personal computers equipped with word processing, spreadsheet, symbolic math, and CAD packages, as well as a full complement of networking capabilities (i.e., e-mail access on campus as well as Internet access). Other tools were available, but these were the primary tools used for course assignments.

At ASU, the coalition-sponsored pilot class had 31 beginning freshman students take 15 hours of core

engineering together. Physics, Calculus, English and Introduction to Engineering Design were taken together in an integrated manner in a 15 hour block, although separate grades were earned for each subject in the block. The course pedagogy featured active and cooperative learning. These 31 students bonded strongly as they teamed, studied, and took these classes together. Twenty-four of these students continued in this special curriculum for the spring semester with Physics, Calculus and English, but added a Chemistry class to replace the Engineering Design. During the first semester of the ASU pilot program one math, two physics, two English, two engineering and one psychology professor (for team training) worked together to deliver the program. An additional engineering professor and a chemistry professor joined the team during the second semester. (For more information on the ASU integrated curriculum, see Reference 2.)

At TAMU and ASU the goals of the pilot programs were: to use the integration of course materials to deepen the understanding of the concepts covered; to use the active participation of students, individually and in teams to enhance their current learning and to begin to develop life-long learners; and to use technology in the classroom to enhance problem-solving abilities by focusing on more complex and realistic problems. This paper will not present the results of the pilot program; however, since it will include some of the difficulties in implementing such a program, it is important to understand why TAMU and ASU and the other coalition schools are committed to proceed with this program. Initial indications show that the students in the pilot program, when compared to a similar group of students in traditional course offerings, can handle concepts covered in the freshman year as well, and usually better, than their counterparts. This has been demonstrated in common questions on exams, as well as on special calculus assessment tests. In addition, the students are more capable, on the average, of utilizing computers to solve complex problems, and of developing ideas in a written form. It appears these students are more advanced in working in teams and more accountable for their own learning environments. TAMU has decided to continue the pilot program in the 1995-1996 academic year by expanding it to 200 or more students. ASU will continue to refine their program with another class of 32 students, but will add more faculty so that future scale-up will be smoother. As the student increase begins, the conflicts for students in the program, as well as for facilities and faculty for the courses, become paramount in the consideration of institutionalization. This paper will focus on some of the conflicts for students and how they might be addressed by focusing on several interfaces for student programs which already function successfully in the College of Engineering.

Special Programs for Coalition Students

The Foundation Coalition courses are open to all students. However, special efforts were made at ASU and TAMU to include a good representation of women and at ASU to include several underrepresented minorities in the course. This effort was done through the Office of Minority Engineering Programs (OMEP) and the Women in Applied Sciences and Engineering Program (WISE) at ASU. Nonetheless, at ASU the proportion of women and underrepresented minorities in this special class was small. Since a goal of the coalition is to increase the retention of women and underrepresented minority students, a question to be answered is whether or not special activities and programs should be conducted for the women and underrepresented students in this specific integrated class.

Numerous studies have shown that minority and women's programs can increase retention. It would be nice to be able to assume that including women and minority students in a special group of 31 students, who team together, would automatically satisfy a sense of belonging. Studies have shown that many women who drop out of engineering are doing well academically, but due to loneliness

without a critical mass, decide to leave. For example, the ASU graduation rate (for the class of 1987) for native freshman (students enrolling with less than 12 transfer hours) in the College of Engineering and Applied Sciences (CEAS) is only 33% for women, but an additional 21% graduate from other colleges at ASU. The men in this same group graduated in the CEAS at the rate of 37%, with an additional 14% graduating from other ASU colleges. Although it might appear from these statistics that the women are retained at almost the same rate as the men, it should be noted that only 19% of the students in CEAS are women. Only 9% of the American Indians students graduated from CEAS and none graduated from another college. The black students graduated at the rate of 13% both from the CEAS and other ASU colleges. As a minority group, the Hispanic students fared the best, with 28% graduating from the CEAS and an additional 17% graduating from other ASU colleges [3]. Without any special attention being given to the women and minority students in this group, it would appear likely that some of these students would drop out of school. In addition to the special academic integration, since the numbers of women and minorities in the class are low, it would appear that an integration to the many other women and minority students in the school of engineering should be encouraged. Otherwise, these students are actually being isolated at a disadvantage. It would seem that the best way to proceed is to provide special programs for the women and underrepresented minorities in the coalition program.

Another factor to consider is that after one semester some of the students may choose to leave the special curriculum group. If a woman or underrepresented minority student chose to leave this special group of 31, the student may know very few other engineering students. If the student has been connected with other women and minority students in the college during the time that they were in the special group, a good support group would be available to help them in this transition. Following this line of thinking, at least a part of the supportive programs provided for women and minorities in the special curriculum should be with the larger group of women and minority students in the engineering college to broaden and to expand their critical masses of support. We are partially addressing this problem by offering cluster housing for freshman engineering students on a selected floor of an ASU dorm.

An additional concern is that providing special programs, especially ones directly related to the special core of courses, will alienate women and minority students from the rest of the students in the special coalition program. The women and minority students could become the objects of resentment from the non-minority students in the class, since it would appear that the "team spirit" had been broken to give a "special advantage" academically through activities and support for the women and underrepresented students. Therefore it may be better to have special women and minority programs that include the coalition students, but is not tied directly to the coalition.

Honors Programs

The honors program for engineering students at TAMU offers students whose academic record places them in the top 5% of their class an opportunity for enhanced academic opportunities. For incoming freshmen this status is determined by high SAT (or ACT) scores and graduation in the top 10% of their high school class. The students are given the opportunity to take special honors classes, which require more work, but offer more depth in the courses. Students in the honors program typically take honors courses in English and Engineering Problem Solving, as well as in Humanities or Social Science courses. In addition, many honors students have received Advance Placement or testing credit for one or more of the courses that are being integrated together in the Foundation Coalition pilot program. Thus there are three obstacles for the integrated program with respect to the honors program. First,

the students in the pilot program cannot get honors credit for the English or Engineering Problem Solving course. Second, the students may not be able to arrange Humanities or Social Studies honors courses into their schedule since the integrated courses have only one schedule and there are a limited number of honors courses available. Third, the students who already have credit for the Calculus, English or Sciences in the integrated program have to forego this credit to enter the FC program.

Addressing these issues was not entirely possible during the pilot program at TAMU; however, as the integrated program becomes more common, some of the issues could be addressed. As more sections of the integrated program are offered, scheduling other courses around the honors sections of courses offered would be more likely. It is envisioned that at some point there would be a set of integrated courses beginning every semester, instead of just in the Fall, thus students could enter the program at different stages. So incoming students with AP credit could start with students who are entering the second semester of the freshman year. In the mean time the English program did work with those; students who entered with credit for the first composition course by giving these students credit for the second composition course. However, the second composition course serves as an elective, not a required course in the engineering curriculum at TAMU.

Although these problems existed at ASU, it seemed not to be a large issue. In the Fall of 1994 out of 678 students admitted to the CEAS, 109 had some AP credit. However, only 14 had AP credit in English 101, 8 in Chemistry 113, 3 in Chemistry 115, and 1 in Physics 121 and 131. Surprisingly, only 72 students had credit for MAT 270, the first course in Calculus. At ASU, some Honors students and students with AP credit in the coalition block chose to take the course for which they had AP credit. An inherent problem for some of the students doing this is that they tended to coast during the first part of the course and then found themselves in some trouble toward the end of the semester when the material became more sophisticated. Some students who had AP transfer credit for the first English course were allowed to enter the pilot without registering for English. This was not true for Calculus, however, as the "Harvard Reform" Calculus was used in the freshman pilot and this approach to the subject is very uncommon in high school. The consensus of the students was that they were glad that they had repeated the Calculus.

Multi-Ethnic (Minority) Programs, MEP

The MEP program has worked for years at TAMU to aid under-represented ethnic minority students to adjust as rapidly as possible to the college majority environment. Many of the programs focus on making sure these students have an opportunity to network as much as they desire with other students from similar ethnic backgrounds. One of the most successful programs involves Supplemental Instruction for sections of courses which have a larger than average representation of minority students. This involves targeting certain sections of Math and Sciences so that instead of only 3% African American or 10% Hispanic, the course would have two to three times this percentage of minorities. For these sections of courses the instructors are aware that the MEP program hires a graduate, or upper-level student, usually an underrepresented minority, to attend all lectures. This student will then hold two weekly sessions for the students in the class. (All students may attend, but advertisement is particularly focused on minority students.) In these sessions the student aide may lead discussions on information discussed in class, discuss homework (if the instructor has approved such discussions), and work on advanced problems with the student groups. These academic workshops, which are student-led, help the attending students with course content as well as aiding with the development of study skills and group study sets. It is important to recognize that all students can benefit from such workshops, but students who find themselves as severely underrepresented as some

of the minority students may especially benefit from this organized approach to helping them find connections on campus. The program has a history of increasing the likelihood of retention in engineering, as well as increasing the grades of the students who attend most of the workshops. Students and parents are told of these course sections and workshops when the incoming freshmen register for their courses.

The FC pilot program was not able to offer Supplemental Instruction for the sections of courses that had been integrated. This was due to the fact that the schedule of the integrated courses was not as set as the traditional courses. That is, in traditional courses a student leader may attend a Calculus class every Monday, Wednesday and Friday from 9:00 to 10:00. In the integrated courses, Calculus was covered on the days and times when it made the most sense to have the concept or topic presented. Thus no student aides could easily block out a period of time to sit through the entire class. In addition, no graduate or upper-level students had previously experienced the style of course offering that the pilot program presented, and therefore, could not rely on their own experiences to aid the new freshmen.

To help with this, the Foundation Coalition instructors at TAMU paid attention to ethnicity and gender when they made their first team assignments at the first of the Fall semester. They also required groups of students, called focus groups, to meet with faculty on a regular basis to discuss course or campus issues. They made sure the students knew about other programs offered by the honors, minority, and women's programs (for example, National Society of Black Engineers, Society of Hispanic Professional Engineers meetings). All students were aided, by the MEP office, in finding tutors if they needed them throughout the freshman year. Since a set of students has now finished the pilot freshman year program, they can be hired in future semesters to aid in the academic workshops for FC students, although the logistics of this will still remain more difficult than for the traditional courses. Most of the instructors for the pilot program attended a voluntary workshop before the Fall semester which included discussion of issues for ethnic minorities on a majority campus. Thus their awareness of issues and stresses on underrepresented minority students was addressed. The faculty used this awareness to help focus on signs of stress on these students and often worked with the MEP staff to resolve issues early.

A similar program was developed at ASU. It was the fear of breaking the "team spirit," and also the desire not to "single out" the women and minority students in the special curriculum, that an Academic Excellence workshop, which included all of the students in the coalition class at ASU was developed for the second semester. The workshops were called Academic Excellence Workshops in order for the program not to appear to be a remedial program for the weaker students. All of the students in the class were invited, but the workshops have been attended primarily by the minority students. A few of the minority students were urged to attend through their contact with the Office of Minority Engineering Programs. These students found the workshops helpful and urged other minority students to attend.

The workshops include special helps, but focus on supplemental exercises provided by the instructors of the introductory Engineering course that aim to develop a deeper understanding of the material just covered. It is recognized in the literature that the participation by one of the instructors could be intimidating. A student may not wish the instructor to know just how much help is really needed on a particular topic. One of the instructors, who is very supportive of this workshop, was invited to attend by the students, and so stopped by occasionally and helped the students. The workshop has been greatly improved in participation and functionality by the addition of a minority upperclassman as a facilitator for the group. It was difficult to identify a student that could be a facilitator for this group

since there were no students existed who had already been through the program. However this minority upperclassman was a good facilitator and also served as a much-needed mole model for the students.

A student from this year's coalition class has already been identified to serve as a facilitator for the Academic Excellence workshop this fall. This year's facilitator will work with the MEP office to develop Academic Excellence workshops for some of the other subjects taken by the coalition students.

Women in Engineering Programs

The Women in Engineering, Science, and Technology Programs (WEST) at TAMU is newer than their Minority program. The women in engineering often find themselves greatly underrepresented, and often it is the first time they have been in such an environment. Women have access to all of the programs, as do all students, offered by the MEP programs. Thus the women in the pilot program were able to participate in teams, groups, and tutorials offered by the WEST and MEP programs. A main objective for the women in the FC pilot was to make sure that they knew of the structured offerings and that they knew of special opportunities made by WEST and the Society of Women Engineers. Another WEST program allows women in dorms on campus the opportunity to be clustered with other engineering women in the same dorm. The women in the FC pilot program had much less in common with the women in the traditional classes, which may add to the feeling of isolation.

The FC faculty at TAMU worked diligently to assure the integrated courses had a student enrollment of approximately 25% women, which is the same as the overall enrollment of women in the College freshman class. At TAMU the women in engineering often do not begin to see how underrepresented they are until they reach upper level engineering courses. (Fields such as Chemical Engineering are over 33% women throughout the undergraduate years, while Mechanical or Electrical Engineering programs are nearer to 10% women at the upper levels.)

The primary activity for women in relation to the pilot program was to assure that they were informed of the program at the time of registration and encouraged to participate. In addition, many of the coalition faculty attended a voluntary workshop on gender issues in the classroom. In this workshop the faculty developed strategies for making their course better for all students with special attention paid to factors that might affect women.

The WISE office at ASU was established in 1993. The program is supported by a director and a half-time program coordinator, and is housed in a four-office suite with a women's center room across the hall. The room is equipped with two computers and a printer, a microwave, a refrigerator, and an honor snack bar. The room is available to all women students in the College for study, teaming and socializing. Men, when accompanied by a woman, usually as a class team member, are also welcome to use the room. Throughout the year WISE presents workshops and speakers to encourage and to aid women students in career field choices, resume writing, interviewing, stress management, and other related topics. The WISE office encouraged freshman women to register for the coalition course.

As WISE sought ways to support the women in the coalition class, a difficult issue emerged. A general condition that has been imposed on any coalition-funded women or minority program is that a

majority of the participants will be enrolled in the special coalition curriculum. As we seek to increase the enrollment of women and underrepresented minorities, various bridge programs for these groups come to mind. For example, a summer program for high school women is held to interest them in engineering. This is a three day commuter program that includes 13 labs from all of the major areas in the College. During the program the women are involved in teaming projects. They are informed that these teaming activities will also be a part of their engineering curriculum. They are told of the Foundation Coalition curriculum and encouraged to enroll in the special course. They are also encouraged to live in an engineering hall in one of the dorms on campus. This same type of program could also be held for minority students. Through these special programs we should be able to increase the underrepresented minority and women enrollment in the coalition class by informing potential engineering students of the curriculum, having the Director of the Coalition speak to them and having students who have gone through the special curriculum encourage them to enroll. However, there is no way that any guarantee can be made that a majority of the students attending any program will enroll in engineering at ASU, let alone enroll in the special coalition course.

Transfer Student Programs

In many ways the transfer students present the most complex problem for the pilot program. Similar to students who have advance placement credit, these students may have completed various pieces of the pilot program's integrated curriculum. As before, offering more times to enter the integrated programs throughout the year may aid in some of these concerns. It is also important to identify what the students who have not participated in an integrated program have missed. The instructors for the integrated programs found they were able to cover the topics from the traditional courses more efficiently and more deeply. To address this issue a transfer bridge program is planned at TAMU for this summer. The idea is to spend one to two weeks with students who did not go through the freshman pilot program, so that these students may start with this year's FC freshmen in a sophomore integrated pilot program. The focus of the bridge program is to work on teaming and technology utilization for students. In addition, any course content not traditionally covered will be introduced, and a plan for how and when students may get aid in these topics will be clearly set forth. Finally, it is important that the new students are familiar with the type of integrated questions that the pilot program has prepared students to handle. Thus all of the exams from the previous year and many of the homework assignments with integrated course concepts will be covered in the bridge program. In the long run it is not clear what type of funding will be available for such a bridge program. However, the very development of the bridge program highlights for the Community Colleges some of the concepts and skills they may want to work into their curriculum.

In addition, the Foundation Coalition has a very active Community College District (MCCD) which is piloting the same ideas at the Community College levels. Because many Community College students are not full time students, they are exploring ways to get the integration of concepts and topics presented to students in a different format than the program at TAMU and ASU. ASU receives many transfer students to the CEAS from MCCD. During the Fall of 1993, CEAS had 450 entering native freshman, 157 lower division transfers (defined as one transferring in 12 through 35 hours), and 247 upper division transfers (defined as one transferring in at least 36 hours) [3]. ASU will offer a 17 hour integrated curriculum for sophomores in the Fall of 1995 and a seven hour program for Spring 1996. ASU will have five faculty members present the integrated sophomore curriculum: two engineering, one mathematics, one statistics, and one economics professor. ASU expects that about half of its second year integrated curriculum students will not have had the first integrated year. Special team training will be done with the class during the first week with all of the students. Several sessions

outside of class will be given on software for the students new to the coalition class. During this pilot for the sophomore year, ASU will develop a method or special program, as needed, to get the new students up to speed.

Conclusion

At TAMU and ASU the faculty involved with the pilot freshman year offered by the Foundation Coalition, are convinced that the integrated, active courses utilizing technology offer the best way to present course material to students. They are prepared to explore how a campus such as TAMU or ASU can offer this program to all or most freshmen. This year the freshman coalition program and a pilot sophomore integrated curriculum will be presented at both TAMU and ASU. The experiments are not completed, but are underway so that the program can be expanded to more students. Many of the issues mentioned above are best resolved when the program is available for more students. In making these plans the Coalition team is working closely with the Honors, Minority, Women's, and Transfer student programs to find proper interfaces and opportunities for these students. In doing so the program is enhancing the access and quality of the Coalition program for all students in the College of Engineering.

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Wed Oct 4 16:57:46 PDT 1995