Institutionalizing a Prototype Freshman Year – The TIDE Program

David Cordes¹, Joey Parker², Jim Richardson³ and Charlie Haynes³

Abstract

The TIDE (Teaming, Integration and Design in Engineering) program is a new first-year curriculum for engineering students at the University of Alabama (UA). This curriculum incorporates the strengths realized by the Foundation Coalition’s (FC) prototype curriculum, and develops a path through the freshman year that is available for all entering engineering students. As discussed in this paper, the TIDE program builds on the FC freshman year and incorporates the recommendations found in the report submitted by the College of Engineering's Foundation Coalition Review committee. Thus, this curriculum:

• incorporates the benefits realized by the prototype FC curriculum,
• addresses the concerns about the FC noted by the review committee, and
• is accessible to all entering freshmen engineering and computer science students.

The Foundation Coalition Review Committee

The Foundation Coalition (FC) has offered a freshman year curriculum since the Fall of 1994. Thus, five iterations of the FC freshman year have been taught, although in slightly different forms¹,²,³,⁴. During this time approximately 300 students have participated in the FC freshman year. Initial results (student interest, retention rates, and grade point averages) appeared to indicate benefits to this approach to the freshman year.

To formally examine these claims, in December of 1996 the Dean of the College of Engineering (CoE) convened a committee consisting of one individual per engineering department to review the progress of the FC’s first-year curriculum. These committee members did not have previous involvement with the FC. This committee submitted its findings to the Dean in February of 1998. The full text of this report is available on the TIDE website at www.foundation.ua.edu/TIDE.

The report’s executive summary “strongly endorses the FC freshman year philosophy.” It also recommended that, “until fully prepared for institutionalization, the FC program should continue to be operated in parallel with the conventional education pathway.” The TIDE curriculum proposed in this document realizes these desires, implementing a curriculum that is based on the FC freshman year philosophy that is capable of operating in parallel with the traditional engineering curriculum.

Specifically, the TIDE curriculum maintains the strong FC characteristics of teaming and active learning within the curriculum. As stated in the review report, “The impact of teaming, active learning, and cooperative learning cannot be overstated. Conversations with students in all FC classes indicate that this is indeed one of the truly significant accomplishments of the FC freshman year.” This is especially true within the FC's

¹ Department of Computer Science, The University of Alabama.
² Department of Mechanical Engineering, The University of Alabama.
³ Department of Civil and Environmental Engineering, The University of Alabama.
engineering courses, where the committee noted that “The environment provided in this classroom is obviously contributing greatly to the student’s perceptions, and it is felt to be critical factor in the success of the freshman year.”

As the committee reviewed the FC’s first-year program, one of the issues it examined was that of student workload. The committee found that “It was generally recognized by students and faculty that the workload in the FC program is greater than that in the traditional freshman year courses in mathematics, chemistry and physics… Traditional first-year courses in the sciences do not have assigned (and graded) homework, which is standard for the FC.” However, the faculty involved with the instruction of the FC first-year program felt that this homework contributed greatly to the students understanding of the material. In addition, the committee found that “the integrated nature of the FC freshman year actually provides a mechanism to control and regulate the student workload. In summary, the committee felt that “Exposing the students to the rigors of engineering education as freshmen should not be viewed as detrimental to their educational process.”

The FC freshman program utilized engineering faculty in the instruction of first-year courses, a situation that is somewhat rare in the traditional UA curriculum. While the staffing of these courses is an obvious resource concern, the committee found that “The workload associated with teaching an FC engineering course in the freshman year does not appear to be significantly different from teaching a traditional engineering course.”

The review committee also performed an examination of student performance data in the FC curriculum versus the traditional curriculum. The committee expressed concern with the lack of data provided by the FC, but all data examined by the committee (FC provided data and data collected by the committee itself) indicates benefits in the FC curriculum. Questionnaires circulated to faculty indicated that “the general perception is that FC students are better prepared than conventional students.” Both retention rates and grade-point averages for FC students are consistently higher than those of traditional students.

In summary, the committee found that the following positive developments were realized by the adoption of the FC freshman year:

- a feeling of community among students,
- contact with CoE faculty members earlier in the students’ careers,
- team activities introduced earlier in students’ careers,
- computer exposure introduced earlier in students’ careers,
- retention rate increases, and
- cooperation between CoE and Arts & Science faculty.

In its conclusion, the report noted that “the committee strongly endorses the FC freshman year philosophy.” It went on to suggest that a plan be developed for institutionalization that included:

1. a timely conversion to an FC-based freshman curricula, maintaining two parallel tracks until the conversion is complete,
2. an expansion of the Assessment and Evaluation efforts within the FC, specifically with respect to the freshman year,
3. the formation of a College-level task force on institutionalization to mold the existing FC freshman year into a freshman year that is available for all students,
4. the development of standards and structures that are conducive to continuous improvement so that the College will not have to completely revamp its curriculum again in another twenty years, and
5. the CoE should identify faculty incentives for faculty that participate in the freshman year programs, especially with respect to tenure and promotion.
The framework of the TIDE curriculum

Using the Foundation Coalition Review Committee’s report, a team of faculty and representatives from the CoE Dean’s office and the A&S Dean’s office developed a plan for “timely conversion to an FC-based curricula.” The specific goal of this committee was to develop a new, parallel track through the freshman year for entering freshman-engineering students that is based upon the principles of the Foundation Coalition. Using the review committee's report as a guideline, the committee addressed the following issues as it worked to develop a freshman year curriculum that was available to all first-year engineering students, and could be operated in parallel with the existing first-year program:

- address the needs of students in pre-calculus mathematics courses,
- maintain cohorts of students as the curriculum increases in size,
- incorporate other courses into the curriculum (English),
- address concerns over a consistent approach to freshman chemistry,
- explore novel approaches for the instruction of freshman physics,
- standardize the first engineering design course.

Each of these issues is now examined in greater detail.

Address the needs of students in pre-calculus mathematics courses

The distribution of UA CoE entering freshman engineering students by first math class over the Fall ’95 – Fall ’97 time period is shown below in Table 1. The committee used this data to determine “design” class size percentages for estimating class sizes in the TIDE curriculum.

Using the design percentages for an entering class of 400 students, there would be 160 students that are calculus-ready, 80 that are one-semester from calculus (MATH 115), 80 that are two semesters from calculus (MATH 112), and 60 that are three semesters from calculus (MATH 100). These are the class sizes around
which the committee designed the new TIDE freshman program. The review committee felt that it is important
to provide a path through the freshman year curriculum for all entering engineering students, not just those
that were ready for Calculus (or one semester away).

The committee also recognized the perceived student benefit to a mathematics course that includes a separate
recitation session. The Mathematics Department has agreed to provide special sessions of MATH 115 and
MATH 112 (for engineering students only) that include a weekly recitation session. It is hoped that, assuming
positive results with the MATH 115 and MATH 112 courses, this will be extended to MATH 100 in the future.

Table 1. Distribution of Entering Freshmen by First Mathematics Course

<table>
<thead>
<tr>
<th>Math class</th>
<th>Actual Data</th>
<th>“Design” Values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall 95</td>
<td>Fall 96</td>
</tr>
<tr>
<td>Calculus I</td>
<td>40%</td>
<td>41%</td>
</tr>
<tr>
<td>Pre-cal- MATH 115</td>
<td>21%</td>
<td>17%</td>
</tr>
<tr>
<td>Pre-cal- MATH 112</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>College Algebra: MATH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>15%</td>
<td>19%</td>
</tr>
<tr>
<td>Other</td>
<td>4%</td>
<td>7%</td>
</tr>
</tbody>
</table>

Maintaining cohorts of students as the curriculum increases in size

One benefit that was recognized by the review committee is the establishment of student cohort groups.
Participating students and faculty repeatedly cited these student groups as an extremely positive aspect of the
FC freshman program. The committee worked to ensure that the student cohort groups (groups of students who
are all in the same block scheduling) were maintained in the TIDE curriculum. The development of student
cohorts has been demonstrated to be beneficial both on our campus and across the coalition as a whole.

Given this, the TIDE curriculum constructs the freshman year using blocks of 20 student cohort groups. These
groups take the same engineering course, English course, mathematics course and recitation, physics course,
physics laboratory, chemistry course, and chemistry lab. The number twenty represents a compromise reached
between mathematics, physics, and chemistry. This number is acceptable for both physics and chemistry
laboratory sessions, and is also acceptable to mathematics in their recitation sessions. Moreover, the lectures
associated with the freshman year can all be taught using multiples of twenty as the class size (60 for GES, 80
to 120 for Chemistry, 60 for Physics, and 40 for Mathematics).

Incorporation of other courses into the curriculum (English)

Many of the other original FC campuses (Arizona State, Texas A&M, and Texas A&M at Kingsville) incorporate
English in the freshman year with uniformly positive results. The committee included English in the TIDE
curriculum as a way to improve student communication and critical thinking skills and because it will
strengthen the student cohorts. Also, students who have participated in the FC first-year have expressed an
interest in getting the English Department involved in the first-year program.

Discussions with the English Department have led to an agreement in which the English Department will
identify specific sections of EH 101 (an mandatory English composition course) that are blocked off for
engineering students only. Thus, the curriculum will be able to maintain cohorts of students across math,
chemistry, physics, English, and engineering. Also, the English instructors will meet weekly with the other
freshman-year teachers. It is expected that this communication, with guidance, will lead to incremental
improvements in the content and delivery of freshman English. Eventually, English may be able to customize a
freshman English course designed specifically for the needs of engineering students, and taught using all of the
FC methods (teaming, active learning, technology and assessment).
Address concerns over a consistent approach to freshman chemistry

A concern has been expressed regarding the content in the CH 131 course. The FC chemistry teachers have included topics thought useful to engineers (e.g. material science topics). While this apparently benefited many of the engineering majors (Mechanical, Civil, Aerospace and Industrial Engineering majors, for example), there was a perception that it did not provide an appropriate background in the fundamentals of the discipline for Chemical Engineering majors. In fact, during the past few years, Chemical Engineering has been enrolling students who participate in the FC freshman year in CH 101 instead of CH 131.

Based on discussions with the Chemistry Department and the FC first-year-teaching faculty, the TIDE curriculum takes a different approach to freshman chemistry than did the FC. Specifically, the TIDE curriculum provides a CH 131 that is functionally equivalent to CH 101. That is, the content contained in CH 131 is the same as the content in CH 101. The difference is in instructional pedagogy. CH 131 is taught using teaming and active learning, and integrates with the rest of the first-year-engineering curriculum.

The second chemistry course in the freshman year differs depending upon a student’s major. Students in Chemical Engineering are encouraged to take CH 102, which leads into the remainder of the Chemistry courses in the Chemical Engineering curriculum. Students in other engineering disciplines are encouraged to take CH 132, which provides a terminal chemistry course that focuses on properties of materials and other topics appropriate to the discipline of engineering.

Explore novel approaches for the instruction of freshman physics

The Physics Department is interested in exploring the adoption of studio physics at UA. In studio physics, the lecture and the lab are merged into one. Students listen to short (10 to 20 minute) lectures then turn to work at desk-top experiments. While there is an initial start-up expense associated with migration to studio physics (the cost of the equipment needed in the classroom environment), the need for separate laboratory resources (equipment and GTAs) is eliminated. The committee feels that the adoption of studio physics into the TIDE curriculum would significantly enhance the freshman engineering program.

Standardize the first engineering design course

The FC review committee recognized that the first engineering design course, GES 131, was an extremely important component of the freshman year. However, the FC taught two different versions of the first freshman engineering course, one designed for calculus-ready students (GES 131) and one designed for pre-calculus students (GES 123). The review team recommended that a single, common freshman-engineering course be considered.

Following this recommendation, the TIDE curriculum provides a common GES 131 course. This course, equivalent to the GES 131 taught previously in the FC first-year program, will be taken concurrently with the first calculus course by all students.

Because not all students arrive on campus calculus-ready and because the committee feels that maintaining contact with these students prior to their enrollment in calculus is vital, a GES 100 class has been added to the TIDE curriculum. This one-hour course is designed to achieve the following results:

- maintain contact with engineering students who are not yet in calculus,
- maintain interest in these students through the use of one-day design projects, and
- explore basic issues of interest and use to these students (e-mail, study skills, time management, etc.)

GES 100 is a one-hour course that meets twice a week for the first ten weeks of the semester. By offering the course two days a week for the first part of the semester only, the typical ineffectiveness of “one-day-a-week” courses is reduced.
Problems and Plans

Several different problems were encountered during our initial activities associated with institutionalization of the TIDE program. Each of these will be discussed below:

- costs of full implementation of TIDE program,
- recruiting engineering professors for the freshman GES (engineering) courses,
- the cohort registration process, and
- space and equipment needs.

Cost of Program

A full implementation of the TIDE program requires a substantial investment in faculty, graduate teaching assistants (GTA's) and undergraduate teaching assistants (UTA's). Faculty from the College of Arts and Sciences teach most of the freshmen level courses (mathematics, English, chemistry, and physics). These faculty are not likely to continue to teach courses with extra time demands (weekly meetings, summer orientation workshops) that also incorporate “new” teaching methodologies (active & collaborative learning, technology in classroom, teaming) without some compensation. Our modest proposal to provide a $500 per course incentive is meant primarily to acknowledge that more is expected from a TIDE course. Even this cost must be funded from some source. The largest single expense in the TIDE program is for the GTA's in the calculus-level math courses. Since traditional math courses have no GTA support (and no graded homework or recitations), adding these resources to the TIDE math courses is a large incremental cost. Finally, the UTA's are a relatively low-cost source of high-quality tutors and mentors, but still add up to a substantial cost. Due to the late start in planning, the College of Engineering provided all of the funding for the startup of the TIDE program in the Fall 1999 semester. Plans for the near future include identifying sources of funds (including industrial sponsorship of 20 student cohorts) for our TIDE program.

Faculty Recruiting

Most engineering programs at UA do not currently teach any freshman level courses, so there is no readily available “pool” of faculty available for the GES 100 and GES 131/132 courses. Engineering graphics and FORTRAN programming are the only freshman level engineering courses taken by most engineering students. Due to personnel and classroom size constraints, there is not enough engineering faculty time currently invested in the freshman year to “pay” for the TIDE engineering courses. While there are many high-quality, dedicated engineering faculty members interested in teaching freshman, there is currently no process in place that encourages these faculty (or their department heads) to make them available for TIDE courses. The new Dean of Engineering has proposed several possible methods for solving this problem, but it currently remains a serious impediment to full implementation of the TIDE program for all entering freshmen. Finding means to identify and appropriately reward freshmen engineering professors will be another important step to full implementation of the TIDE program.

Cohort Registration

The cohort registration process used during the summer of 1999 required a large amount of manual intervention into the student records system, which was very time-consuming and labor intensive. A more streamlined process is needed for creating student cohort schedules. The basic problem is having sections available for TIDE students that other students cannot access. One solution may be to simply “hide” the course ID numbers by not publishing them in the widely available course listing. This process is currently used with many of the honors' sections of courses. Another related problem is that the TIDE cohort size of 20 students does not match the typical size of an English 101 section (24 to 26) or a chemistry lab section (26). During the Fall 1999 semester there are non-TIDE students in most of the EH 101 and CH 131 lab sections. The presence of these students complicates efforts in curriculum integration. A smaller, but not insignificant problem is that
some of the pre-calculus students qualify for the honor’s section of English (EH 103), but not enough of them to create full 20 student cohort. During the Fall 1999 semester these students were placed in a non-cohorted section of English. Further discussions and planning with the university's registration personnel should generate an acceptable solution to the cohort registration problem.

**Space and Equipment**

At the present time there are two classrooms equipped with student computers, tables, and computer projection systems. These rooms can accommodate up to 60 students working in groups of four. Even if only 160 new students enter the TIDE program during the Fall 2000 semester, it will be difficult to schedule all of the courses in these two rooms during the normal 8:00 AM – 5:00 PM time frame. If the TIDE program expands to 240 or 320 students next year, even more classrooms and resources will be needed. This will require a substantial one-time investment of up to $50K - $100K per classroom. Identifying a source for this funding will also be required during the next year.

**Conclusion**

In summary, the new TIDE program developed at UA retains the advantages realized by the FC review committee and also addresses a number of problem areas associated with the original FC curriculum. Specifically, the TIDE curriculum:

- is appropriate for all engineering majors, regardless of their entering mathematics level,
- encourages the development of faculty/student and student/student relationships with the emphasis on student cohort groups,
- incorporates the majority of the courses in the freshman year,
- addresses the issues associated with the instruction of chemistry in the FC curriculum,
- provides an enhanced experience for students in freshman physics, and
- provides a common framework for the introductory engineering course.

**References**


2000 ASEE Southeast Section Conference

David Cordes

David Cordes is an Associate Professor in Computer Science at the University of Alabama, where is he also currently serving as Department Head. He has been involved with the Foundation Coalition since 1993, and is currently serving on the National Management Team as Strategy Director for the Sharing Initiative. He received his B.S. degree in computer science from the University of Arkansas in 1982, his M.S. degree in computer science from Purdue University in 1984, and his Ph.D. in computer science from Louisiana State University in 1988. His research interests include software engineering (component engineering) and networking.

Joey Parker

Joey Parker is currently an Associate Professor of Mechanical Engineering at The University of Alabama, where his teaching responsibilities include control systems, instrumentation, and senior capstone design. He has been involved with the Foundation Coalition effort at Alabama since 1993, and currently serves as the TIDE program coordinator. He received his B.S.M.E. degree from Tennessee Technological University in 1978, and his Master's and Ph.D. in Mechanical Engineering from Clemson University in 1981 and 1985, respectively. His research interests include electro-mechanical actuators, microcomputer applications, and industrial automation.

Jim Richardson

Jim Richardson is currently an Associate Professor of Civil Engineering at The University of Alabama, where his teaching responsibilities include structures and structural design. He has been involved with the Foundation Coalition effort at Alabama since 1995, and currently serves as the FC Participating Institute Coordinator. Dr. Richardson was named the Engineering Educator of the Year by the Alabama Society of Professional Engineers in 1996. He received B.S. in Civil Engineering from the University of California, Davis in 1978, and his Master's and Ph.D. in Civil Engineering from the University of Nevada, Reno in 1982 and 1988, respectively. His research interests include bridge design and structural dynamics.

Charlie Haynes

Charles D. Haynes is currently Associate Dean for Academic Programs and Professor of Civil and Environmental Engineering at The University of Alabama, where his teaching responsibilities include construction estimation, mineral property appraisal and subsurface formation evaluation. He has been involved with the Foundation Coalition effort at Alabama since 1996, and currently serves as an instructor in the TIDE program. He received his B.S. degree in mining engineering from The University of Alabama in 1962, his M.D. degree in mining engineering from Penn State in 1964, and his Ph.D. in Petroleum Engineering from the University of Texas in 1971. He was an executive in the oil & gas industry prior to joining the Alabama faculty. His research interests include petroleum production enhancement, mineral-related environmental studies, and financial aspects of mineral properties development and operation.