SUCCEED: A MULTIPLE UNIVERSITY COLLABORATIVE APPROACH TO SYSTEMIC CURRICULUM CHANGE

Tim Anderson[1], Marc Hoit[1], Richard Felder[2], Rebecca Brent[2], Carl Zorowski[2], David Ollis[2], Matt Ohland[3], and Howard Phillips[4]

Abstract ¾ ***SUCCEED*** *(Southeastern Universities and Colleges Coalition for Engineering EDucation) was one of the U.S. National Science Foundation's Engineering Education Coalitions and consists of eight public colleges of engineering located in the southeastern United States. Now in its ninth year of operation,* ***SUCCEED*** *has transformed itself from an incubator of educational innovations to an organization whose mission is to institute a sustainable version of its curriculum model on each of its member campuses.*

A curriculum model was developed by ***SUCCEED*** *that proposes specific changes in the curriculum content and structure and, importantly, the implementation of processes by which the curriculum is delivered and managed. The key change elements in the curriculum content and structure are early and multidisciplinary design, explicit success skill development, and exposure to professional practice. Our curriculum model incorporates processes and systems to enhance student learning through the use of technology-based delivery systems, faculty development, and the establishment of support systems for transitions into and out of college, and the promotion of learning outcomes assessment and continuous curriculum renewal. This paper reviews the major directions taken by the* ***SUCCEED*** *coalition in the faculty development and student transitions areas.*

Ten years ago the National Science Foundation formulated strategies that would lead to the systemic reform in engineering education at the undergraduate level. Part of this strategy was to fund a small number of coalitions of colleges of engineering to take a holistic approach to curriculum reform. **SUCCEED** (Southeastern Universities and Colleges Coalition for Engineering EDucation) was one of the National Science Foundation's Engineering Education Coalitions and consists of eight public colleges of engineering (Clemson University, Florida A&M University-Florida State University, Georgia Institute of Technology, North Carolina A&T State University, North Carolina State University, University of Florida, University of North Carolina at Charlotte, and Virginia Polytechnic Institute and State University) located in the southeastern United States. Now in its eighth year of operation, **SUCCEED** has transformed itself from an incubator of educational innovations to an organization whose mission is to institute a sustainable version of its curriculum model on each of its member campuses.

Curriculum Model

The **SUCCEED** curriculum model is based on the desired attributes of graduates for the next century as specified in ABET Engineering Criteria 2000. Among other things, graduates are expected be technically competent, critical and creative thinkers, life-long learners, effective communicators, team players, and globally aware. They are expected to understand process and systems design and integration and appreciate the global and societal implications of engineering decisions. The success of our model is measured by the extent to which our students have acquired these attributes.

Our curriculum model proposes to achieve these qualities in our graduates through specific changes in the curriculum content and structure and, importantly, the implementation of processes by which the curriculum is delivered and managed. The key change elements in the curriculum content and structure are early and multidisciplinary design, explicit success skill development, and exposure to professional practice.

While the desired attributes of engineering graduates and the need for curriculum change are recognized by many educators, it is primarily a lack of processes to effect and sustain change that has limited curriculum reform. Our curriculum model incorporates processes and systems to enhance student learning through the use of technology-based delivery systems (e.g., multimedia, electronic delivery, electronic advising and mentoring), faculty development (e.g., workshops on effective teaching, course design, and mentoring and supporting new faculty members), the establishment of learning support systems for transitions into and out of college (e.g., pre-enrollment bridge programs and student mentoring), and the promotion of learning outcomes assessment and continuous curriculum renewal. The approach taken to two aspects of the curriculum model, namely faculty development and student transitions, are summarized below. A more complete discussion of these and the other areas is given in the cited references.

[1] University of Florida, Gainesville, FL 32611, USA; [2] North Carolina State University, Raleigh, NC 27695, USA; [3] Clemson University, Clemson, SC 29634, USA; [4] University of North Carolina, Charlotte, NC 28223, USA

Faculty Development

No matter how effective reforms in teaching, advising, or assessment may be, they can never be sustained unless a large segment of the faculty is persuaded to try them and is equipped with the knowledge and skills needed to implement them. One of SUCCEED's core strategies to implement the curriculum model is to develop and institutionalize faculty development programs that have the dual goals of persuasion and training. To this end Richard Felder, Rebecca Brent and coworkers have developed a model for a sustainable engineering-based faculty development program. The model involves a combination of learning opportunities for experienced faculty members, new faculty members, and graduate students; incentives and rewards for effective teaching, teaching scholarship, and mentoring; and linkages to campus-wide teaching and learning centers and other faculty development programs.

Each of the eight **SUCCEED** campuses now has implemented and partially institutionalized a variant of the SUCCEED faculty development model. Workshops on effective teaching, orientation to teaching for new faculty and graduate students, teaching first-year students, teaching with technology, mentoring and supporting new faculty members, and effective faculty development in engineering and the sciences have been presented on SUCCEED campuses and elsewhere. Engineering teaching leaders have been identified and provided with training in organizing and leading faculty development programs. Learning communities, mentorships, and collaborations between the engineering teaching leaders and campus faculty development staff have arisen on the SUCCEED campuses, and arrangements are being made for at least some of these programs to continue with local campus funding when SUCCEED no longer exists.

As one of its key milestones, **SUCCEED** proposed to engage 60% of the faculty in faculty development programs. Prior to the initiation of the faculty development program in 1996, fewer than 10% of the faculty had ever participated in a program related to teaching improvement. Current faculty development statistics shown in Table I below demonstrate that the coalition is now approaching the 60% participation target.

Student Transitions

The formal transitions into and out of engineering education are crucial to undergraduate and career success, respectively. The shift from a general education (high school or community college) to a professional degree, college or university track, or from the latter into the work environment or graduate school represents not only a change of formal performance expectations, but also presents a transition to an environment not previously experienced.

History teaches that competent introductions to each new environment can make a crucial difference in retention and success, both in the university and on the job. Data on student success indicate that the short period (one-two semesters) following a transition in environment (high school to university, community college to university, university to workplace, or undergraduate to graduate) is a critical one. Success in these transitions is less dependent upon technical intellect than broader experience and the skills of critical thinking, listening, communication, teamwork, time management, and professionalism.

SUCCEED has had considerable success in improving the retention of minority students and community college transfer students, and, to a lesser extent, women students (see Table II below). This success may be attributed to active intervention programs, explicit skill development coupled with clear statements of expectations, creation of peer support structures, early introduction to engineering, and improved teaching. The **SUCCEED**-initiated programs that facilitated the transition of students to University life during their first year on campus and expanded design and practice played a significant role in importing and implementing these approaches.

SUMMARY

A model to guide curriculum renewal has been developed by the **SUCCEED** engineering education coalition over the past 9 years. The effectiveness of the tested components of this model depended on the institutional setting, administrative support, cost, and importantly the local champion for the innovation. In particular, a comprehensive faculty development program and a structure to help incoming students adjust to the University environment and to excite them about engineering were found to be critical elements of the model. A bibliography containing some key findings of the coalition's research is given below and the **SUCCEED** website [http://www.succeednow.org/] can be visited for additional information.

TABLE I

School	Participating Engineering Tenure-Track Faculty	Total Engineering Tenure-Track Faculty	Percentage
A	72	135	53%
B	44	77	57%
C	166	376	44%
D	37	74	50%
E	128	221	58%
F	136	298	46%
G	56	97	58%
H	240	291	82%
Totals	**879**	**1569**	**56%**

TABLE II

Comparison of SUCCEED to Adjusted National*
Engineering Enrollment and BS Degrees Awarded Statistics

Enrollment (1989-1997)				
	% increase in SUCCEED	Percent of all SUCCEED	% Increase in Adjusted National	Percent of all Adjusted National
African American	40%	15%	13%	6%
Hispanic	59%	3%	54%	9%
Native American	152%	0.46%	78%	0.68%
Women	20%	22%	18%	20%
BS Degrees Awarded (1990-1998)				
	% increase in SUCCEED	Percent of all SUCCEED	% Increase in Adjusted National	Percent of all Adjusted National
All Students	13%	N/A	-2%	N/A
All Minorities	84%	17%	66%	11%
Women	41%	21%	29%	18%

* - Adjusted National (all U.S. Colleges minus SUCCEED Schools)

Bibliography

1) Crittenden, John Barrett; Academic Success Without the Use of Tests, Session 2253, pg 1-4
2) Branoff, Theodore J., Connolly, Patrick E.; The Addition of Coordinate Axes to the Purdue Spatial Visualization Test- Visualization of Rotations: A Study at Two Universities. North Carolina State University/Purdue University
3) Wyatt, Timothy Robert; Arduino, Pedro; Assessment of A Virtual Laboratory for Geotechnical Engineering. Session 1620, pg 1-13. Georgia Tech/University of Washington/Georgia Tech
4) Clark, Aaron C., Seales, Alice Y.. A Barometer for Engineering and Technical Graphics Education. Session 2438. Pg 1-9, North Carolina State University
5) Brawner, Catherine; Anderson, Timothy; Zorowski, Carl; Serow, Robert C., Demery, James. Closing the Loop: Using Qualitative Assessment in the Continuous Quality Improvement of the SUCCEED Coalition. Session 3431. Pg. 1-11. UF/NCSU.
6) Vergilese, Kurvilla; Peplow, Douglas. Collaborative Learning in Small Groups in a

Mathematics Intensive NE Course. Session 2177. Pg. 1-7. North Carolina State University.
7) Doster, Michael J. Complex System for the Time Dependent Simulation of Nuclear Power Systems. Session 2477, pg. 1-4. NCSU
8) Loganathan, G. V., Greenberg, Bill, Holub Lorraine, Moore Graig. The Deflected Beam in Differential Calculus: Bringing Engineering into the mathematics classroom. Session 3565, pg. 1-12. Virginia Tech.
9) Haik, Yousef. Design-Based Engineering Mechanics. Session 2625. Pg. 1-8. FAMU-FSU
10) Zhou G. Tong, Lo, Hong-Jing. Developing Java-Based Virtual Laboratory Tools for an Undergraduate Random Signals and Noise Course. Session 3232. Pg. 1-8. Georgia Tech.
11) Gloster, Cley; Doss Christofer. A Distance Education Course in Computer Engineering at NC State University. Session 3220. Pg. 1-10. NCSU.
12) Hayes, Monson; Harvel Lonnie. Distance Learning Into the 21st Century. Session 2532, pg. 1-9. Georgia Tech
13) Mathews, Cherian P., Candia, Adrianne, Kader, Waleed. DSP Implementation of an Amplitude Modulation Transmission System: A Capstone Design Approach. Session 2525.pg. 1-7. UFHaller, Cynthia R.; Gallagher, Victoria J,; Weldon, Tracey L.;Felder, Richard M. "Dynamics of Peer Interaction in Cooperative Learning Workgroups," *J. Engr. Education*, 89(3), 285–293 (2000).
14) Najafi, Fazil T.; Maalouf, William M. Effective Educational Delivery Tools Using Multimedia and Distance Learning. Session 3460. Pg. 1-8. UF
15) Delfino, Josef J. Effects of Global Change on Water Quality. Session 3151. Pg.1. UF
16) Anderson, Robert M Jr; Cheek, Eric A Sr. Electric Circuits via the Internet: Sharing and Extending. Session 3232. Pg. 1-14. NC A&T University
17) Lucena, Juan C.; Downey, Gary Lee. Engineering Cultures: Better Problem Solving through Human and Global Perspectives. Session 1461. Pg. 1-12. Virginia Tech
18) Thueson, Gerald J.; Sullivan, William G. Engineering Economy A Historical Perspective. Session 1639. Pg.1-8. Georgia Tech/Virginia Tech
19) Wagner, John R. Evolving Industry Expectations for Engineers – The Impact of Global Manufacturing. Session 3522. Pg. 1-6. Clemson University.
20) Asgill, Austin. Expanding the Impact of Terminal Degree Requirements on Engineering Technology Programs. Session 2248. Pg. 1-6. FAMU
21) Arce, Pedro. Group Projects-Based Final Exams. Session 2213. Pg. 1-10. FSU
22) Lesko, Jack;, Duke, Jack; Holzer, Seigfried; Auchey, Flynn. Hands-on Integration into an Engineering Mechanics – Statics Course: Development and Scaling. Session 1368. Pg. 1-7. Virginia Tech
23) Tang, Guoquing; Ram, Bala; Shah, Milin. Incorporating Engineering Applications into Calculus Instruction. Session 3565. Pg. 1-11. NC A&T
24) Dagget, Deena; Alptekin, Sema. Industrial Engineering Made Simple. Session 3257. Pg. 1-8. Georgia Tech.
25) Shani Francis, Schimmel, Keith/Pellis, Neal R. Integrating Research into the Undergraduate Curriculum – NASA's Microgravity Bioreactor. Session 3613. Pg. 1-9. NC A&T
26) Blanchard, Susan M et al. Introducing Biomedical Engineering Content into Biological Engineering Courses. Session 1608. Pg.1-5. NCSU
27) Wang, Shih-Liang. Introducing Fundamentals of Computer Graphics Using MATLAB. Session 2520. Pg. 1-8. NC A&T
28) Porter, Richard. Introduction to Engineering Problem Solving – A New Course for 1100 First Year Engineering Students. Session 2353. Pg. 1-10. NCSU
29) Parsona, John E. The Introductory Sophomore Course in Biological Engineering at North Carolina State University. Session 1308. Pg. 1-13. NCSU.
30) Bragg, Julian A. Java Programming for Engineers: Developing Courseware for a Computer-Enhanced Curriculum. Session 2532, pg. 1-4. Georgia Tech.
31) A. Michel, R.M. Felder, J. Genzer, and H. Fuller, "Student Use of Instructional Technology in the Introductory Chemical Engineering Course," *2000 ASEE Annual Conference Proceedings*, ASEE, June 2000.
32) R. Brent and R.M. Felder, "Helping New Faculty Get Off to a Good Start," *2000 ASEE Annual Conference Proceedings*, ASEE, June 2000.
33) R. Brent, R.M. Felder, T. Regan, A. Walser, C. Carlson-Dakes, D. Evans, C. Malave, K. Sanders, and J. McGourty, "Engineering Faculty Development: A Multicoalition Perspective,"

2000 ASEE Annual Conference Proceedings, ASEE, June 2000.

34) C. Brawner, R.M. Felder, R. Brent, T.K. Miller, and R. Allen, "Faculty Teaching Practices in an Engineering Education Coalition," *1999 Frontiers in Education Conference Proceedings*, ASEE/IEEE, November 1999.

35) N. Al-Holou, N.M. Bilgutay, C. Corleto, J.T. Demel, R.M. Felder, K. Frair, J.E. Froyd, M. Hoit, J. Morgan, and D.L. Wells, "First-Year Integrated Curricula: Design Alternatives and Examples," *J. Engr. Education, 88*(4), 435–448 (1999).

36) R.M. Felder, "Success through Integration," *Success 101*, Issue #7, Fall 1999, p. 7

37) C.E. Brawner, R.M. Felder, R. Brent, R.H. Allen, and T.K. Miller, *Faculty Survey of Teaching Practices and Perceptions of Institutional Attitudes toward Teaching*: 1997–1998, ERIC Document Reproduction Service Report ED428607, 1999.

38) R. Beichner, L. Bernold, E. Burniston, P. Dail, R. Felder, J. Gastineau, M. Gjertsen, and J. Risley, "Case Study of the Physics Component of an Integrated Curriculum," *Phys. Ed. Research, Am. J. Phys. Suppl. 67*(7), S16-S24 (1999).

39) R. Brent, R.M. Felder, D. Hirt, D. Switzer, and S. Holzer, "A Model Program for Promoting Effective Teaching in Colleges of Engineering," *1999 ASEE Annual Conference Proceedings*, ASEE, June 1999.

40) R.M. Felder and R. Brent, "How to Improve Teaching Quality," *Quality Management Journal, 6*(2), 9–21 (1999).

41) R. Brent and R.M. Felder, "It's a Start," *College Teaching, 47*(1), 14–17 (1999).

42) R.M. Felder, R. Brent, T.K. Miller, C. Brawner, and R. Allen, "Faculty Teaching Practices and Perceptions Of Institutional Support For Teaching At Eight Engineering Schools," *1998 Frontiers in Education Conference Proceedings*, ASEE/IEEE, November 1998.

43) R.M. Felder, G.N. Felder, and E.J. Dietz, "A Longitudinal Study of Engineering Student Performance and Retention. V. Comparisons with Traditionally-Taught Students," *J. Engr. Education, 87*(4), 469-480 (1998).

44) R.M. Felder and R. Brent, "Getting Faculty Buy-In to Innovative Teaching," *1998 ASEE Annual Conference Proceedings*, ASEE, June 1998.

45) R.M. Felder, "A Longitudinal Study of Alternative Approaches to Engineering Education," *1997 Frontiers in Education Conference Proceedings*, ASEE/IEEE, November 1997.

46) S.P. Beaudoin and R.M. Felder, "Preparing the Professoriate: A Study in Mentorship," *J. Grad. Tchng. Asst. Development, 4*(3), 87–91 (1997).

47) "Closing the Loop: Using Qualitative Assessment in the Continuous Improvement of the SUCCEED Coalition," C.E. Brawner, T.J. Anderson, C.F. Zorowski, R.C. Serow, and J. Demery, Proc. ASEE Ann Conf. (1999).

48) "The Quality Management Support Model: Using Qualitative Assessment to Support Quality Processes in an Engineering Education Coalition," C.E. Brawner, T.J. Anderson, C.F. Zorowski, and R.C. Serow, Accepted in Quality Prog.