The Impact of Interdisciplinary Faculty Teams on Engineering Technology Curricula

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Introduction

Industrial leaders[1,2,3] continue to emphasize the change occurring in the workplace and the need for a better educated workforce for US industry to be competitive in the world market place. Employers need a pool of highly qualified, technically sophisticated, and versatile engineering technology graduates. These new technicians must be team players who communicate well but are independent problem solvers who can integrate concepts from many disciplines. When employers are asked to prioritize the competencies engineering technology graduates need, they place communication and teamwork at the top of the list. Their message is clear, technicians must have interdisciplinary skills which include both technical and not-technical competencies that enable them to analyze, problem solve, communicate effectively, and learn continuously as the work place changes.

The sixteen technical colleges of the South Carolina Technical College System have undertaken the task to meet this educational challenge with a state-wide systemic initiative to re-engineer the college's engineering technology programs. This re-engineering must include not only curriculum content to make it relevant to the demands of the workplace, but it must also implement new pedagogy and current instructional technologies. However, before a reform curriculum can be developed and taught, there must be a reform-ready faculty to develop and teach the curriculum. These faculty must reflect the interdisciplinary needs of the workplace in the classroom and model workplace practices. To facilitate an interdisciplinary approach to curriculum development, the South Carolina Technical College System has begun to develop interdisciplinary teams of mathematics, science, communications, and technology faculty from each college.

Traditional engineering technology curricula are based on a compartmentalized, discipline-based curriculum, delivered in a passive, teacher-centered instructional approach. The traditional curriculum is not designed to easily foster the cross-fertilization, synthesis and application of material from different disciplines to solve real problems, or to develop student communications and collaboration skills. Educational research[4,5,6] has shown that the majority of the students entering the technology colleges do not learn as effectively in the traditional lecture teacher-centered instructional mode as they can learn in a contextual, student-centered active learning environment. Also many[7] have shown that the learning styles of the students are varied and, therefore, require various teaching methods to create an effective learning environment.

Faculty Development

With the aid of an NST-ATE (DUE 9553740) the South Carolina Technical College System has embarked on a three-year faculty development project South Carolina Advanced Technological Excellence (SC ATE) to create a cadre of faculty to develop and teach a new engineering technology curriculum. This Exemplary Faculty project has completed the first year of a three-year project to prepare faculty to develop and teach a re-engineered engineering technology curriculum. Seventy-nine faculty (26% mathematics, 18% science, 23% communications, and 32% engineering technology) were selected from the colleges to receive instruction on educational reform issues, inter-disciplinary teaching strategies, use of instructional technology, and partnerships with industry. The project began a series of faculty development activities to create on each campus an interdisciplinary faculty team to develop and implement a new and reformed curriculum. The first step in the process was the selection at each campus of exemplary faculty from the disciplines of mathematics, science, communications and technology.

The first year concentrated on encouraging and empowering faculty to work together and with their peers across traditional departmental and institutional boundaries. The activities challenged the faculty to rethink their teaching methodologies and to design new, interdisciplinary active learning approaches for the classroom.

This process began with a retreat and then proceeded with three three-day Chautauqua workshops. The retreat's purpose was to increase the exemplary faculty's understanding of national and local need for change and to orientate them to the change process planned in the curriculum reform efforts. The Chautauquas then provided the opportunity to learn and practice interdisciplinary active learning approaches for instruction.

Presenters at the retreat and the Chautauquas discussed the need for multi-disciplinary faculty teams to review and redesign both the content and methods of instruction. Through this process, the faculty have developed a shared vision for reform. They have developed strong interdisciplinary campus teams and have investigated and utilized the concepts presented at the workshops.

Because industry places a high premium on teaming, the Chautauqua workshops began with team building not only to develop the interdisciplinary faculty groups into functional teams but also to demonstrate the process for teaching teaming in the classroom. In fact, subsequent Chautauqua programs used teaming as part of the instructional process. For example the workshops on integrated curriculum and active learning employed teaming as an educational strategy as well as showing it as a workplace skill to be practiced. Another Chautauqua dealt with how students learn and process information as developed by Gardner[8] in his concepts of multiple intelligences. The last Chautauqua included active learning strategies and student assessment. Table 1 gives the content of the workshops.

	Topic	Presenter	Affiliation
Chautauqua I	Team Building	Don Evans	Arizona State University
	Integrated Curriculum	Jeff Froyd	Rose-Hulman
Chautauqua II	Instructional Technology	Logal	Logal Hardware/software
	Multiple Intelligences	L Shirley	Clemson Dropout Prevention Center
Chautauqua III	Active Learning	R Felder R Brent	NC State University E Carolina University
	Student Assessment	L&D Eubanks	Clemson University

Table 1

Summer Activities and Curriculum Development Impact

Following the retreat and the three Chautauquas, the exemplary faculty teams embarked on summer interdisciplinary development projects. The teams were asked to apply and test the concepts and use the tools learned in the Chautauquas. Many faculty teams developed interdisciplinary modules to teach an engineering technology concept involving teaming, integrated approach, and active learning. Eight of the 16 teams worked on curriculum modules and the other eight attended workshops to enhance skills in one of the areas initiated in a Chautauqua. A fall retreat allowed the faculty teams to share lessons learned from the summer activities. Table 2 gives a list of the curriculum development modules.

College	Project	Activity	Delivery
Aiken Technical	DC/AC Circuits	Integrated communications, mathematics, physics and electronics	Team taught
Central Carolina Technical College	Modules for environmental course in heat and mass transfer	Integrated mathematics, engineering, science, environment, and communications	Team teaching with student teams
Florence-Darlington Technical College	Introduction to Engineering Technology	Integrated disciplines to teach team building, communications, graphing calculator and problem solving	Team taught
Horry-Georgetown Technical College	Active Devices Course	Integrating science, computers and communications into technology course	Team taught & internet
Midlands Technology college	Modules in surveying and modification of graphics course	Integrating mathematics into surveying, Integrating communications into graphics	
Tri-County Technical College	Modules on conversion of electrical energy into heat and heat removal	Integrated module four disciplines. Focus on technical reporting of laboratory activities	Team taught

Trident Technical College	Preparation for Engineering Technology Course	Team Process Student Portfolio Obtaining and using Laboratory Data	Team taught by all four disciplines
York Technical College	Modules in Photonics	Integration of disciplines with the use of interactive multimedia material	Team taught emphasis on computers , critical thinking and problem solving.

Table 2

In the coming year the campus faculty teams will share with campus colleagues information and lessons learned in the first year activities. They will then begin to enhance faculty development on their own campuses.

Impact Outside the Project

In a recent Chautauqua the Exemplary Faculty met in discipline peer groups to share classroom changes initiated by the project. Table 3 shows Chautauqua topics and the impact on classroom instruction.

	Mathematics	**Science**	**Communications**	**Technology**
Teaming Skills	Increased use in classroom Began joint projects and discussion sessions	Increased use in laboratory courses	Used in all courses	Initiated study groups teams. Involved teaming in laboratory courses
Learning Styles	Using graphing calculators to meet needs of visual learners. Adding writing exercises	Modified presentations to include learning styles other than auditory and visual	Assessed students to tailor instructional strategies. Adapted kinesthetic activities into classes	
Active Learning	Formed homework check teams Developed cooperative learning modules	Began to include student activities in the class time		Developed studio (combined lecture/lab) type classes.
Instructional Technology	Used peer group listserv to discuss course content Increased use of graphing calculators Incorporated MathCAD into lessons	Used peer group listserv to discuss course content Use of computer software in labs	Used peer group listserv to discuss course content	Used peer group listserv to discuss course content Computer simulations for lab Created low cost multimedia cart. Developed computer tutorials

Table 3

Cultural Change of Faculty

In this project we have been monitoring the changing attitude of the behaviors of the faculty . Preliminary results to date demonstrate that the exemplary faculty are highly committed to the goals and objectives of the SC ATE initiative and to changing their instructional and professional practices to improve the quality of education and career preparation of engineering technology students. Faculty are now communicating and collaborating across discipline and departmental lines to develop an integrated instructional system. The cultural change that occurred can be illustrated by the comment of one faculty member made after a workshop: "...faculty had been moved out of their boxes and they could not be placed back into them if anyone wanted to."

Conclusion

The Exemplary Faculty Project is encouraging new approaches and collaborative work practices in curriculum development, pedagogy, and use of technology in the classroom. Interdisciplinary faculty teams are now experimenting with new forms of organizations and interaction in researching , planning, developing, delivering and evaluating instruction. The faculty are becoming leaders of change and have developed a knowledge base that empowers them to lead. The result will be a curriculum that will meet the needs of industry and increases student learning.

1. Emerson, Russ, (Torrington Plant Manager, Laurens, SC), SC ATE Chautauqua January 1996.
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3. Spalding, William (NISE East), SC ATE Chautauqua, April 1996.
4. Hull, D. and Souders, J., "The Coming Challenge: Are Community Colleges Ready for the New Contextual Learner." **Comm. Col. J.** Oct/Nov 1996.
5. Redish, E., "Implication of Cognitive Studies for Teaching Physics." **Am. J. Phy.** 62(9), Sept. 1994.
6. Yager, R. E. and Lutz, M. V., "Integrating Science: The Importance of 'How" Versus 'What'." **School Science and Mathematics** vol 94(7) November 1994.
7. Felder, Richard," Matter of Style " **ASEE Prism** December 1996.
8. Gardner, H., The Mind's New Science: A History of Cognitive Revolution, Basic Books, New York 1987.

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