Curricular Integration, Faculty Norms, and Entropy: How can we Sustain Change?

Since 1988 a major component of reform in undergraduate engineering education has been curricular integration. What integration means and what form it takes varies from institution to institution, and some efforts have been more successful than others. In the Foundation Coalition (FC) several forms of curricular integration were implemented, but over time the degree of integration has shrunk, sometimes to zero. Integrated curricula are more structured, or ordered, than traditional curricula. Here, as elsewhere, the second law of thermodynamics stipulates that the total amount of disorder in a system increases. Without intentional, sustained efforts to maintain an integrated curriculum, curricular structure and student's understanding of disciplinary connections and curricular coherence deteriorate over time.

From a qualitative study of the change processes used by FC partner institutions to institutionalize innovative freshman and sophomore curricula, we found several factors that may have contributed to increasing "curricular entropy:"

- In order to maintain integration across courses and different disciplines; teaching faculty needed to coordinate syllabi, tests, and homework. Ongoing coordination placed an additional burden on faculty, an increase in workload many faculty members were not willing to accept
- Some courses in the integrated curricula were interdisciplinary, requiring faculty to "come up to speed" in areas outside their disciplinary expertise
- Team teaching or working collaboratively was difficult for some faculty who preferred working independently, preserving their primacy in the classroom.
- Over time, the original faculty members who developed and first taught in the new programs were rotated out. Training for new faculty members was inconsistent. Preparation varied from observing others teach the course to team teaching the course with experienced faculty members, to no more preparation than what would be normal for teaching a traditional course. Although some of the newer generation maintained integration, others, whatever their prior preparation, often fell back to what was familiar.
- In most cases, there were few textbooks or course guides to help maintain topic integration. Instead, faculty members passed down notes to successive generations and the notes were often not sufficient to maintain structure of the course.
- Integration between engineering, mathematics, and science, which are often located in two or more different colleges, was more difficult to sustain because of the organizational barriers.
- Integrated curricula often take the form of "course packages" created to maintain connections between courses. However, individual students may, for various reasons, need or want to take one or more courses within a package. Allowing this addresses the needs of the students, but weakens connections among the courses.

In this paper we will describe the experience of faculty in the FC in sustaining integration. Using the findings from our study as well as the literature on curricular change both within and outside engineering education, we will offer suggestions on how some of these barriers might be successfully negotiated in order to maintain curricular integration.