

Gateway Engineering Education Coalition ~ Past Experiences and Future Insights ~

Eli Fromm
Roy A. Brothers, University Professor
Drexel University
Philadelphia, PA 19104 USA

Abstract:

The “Gateway” Engineering Education Coalition is a collaboration of 7 academic institutions¹, supported by the Engineering Directorate of the National Science Foundation, representing a diversity of institutional structures and cultures. The Gateway model is to alter engineering education from a singular focus on course content to one inclusive of the development of human resources and the broader experience founded on a multidisciplinary, integrated curriculum. As intellectual threads, the introduction of engineering “up-front”, the integrative aspects of the engineering process, the development of professional competencies, multidisciplinary emphasis, assessment and continuous improvement, and instructional technologies are woven together into a seamless educational fabric. This environment is achieved, in part, through innovative cross-institutional programs that diminish the barriers among institutions as well as within institutions.

Gateway Coalition’s goal is to change the way we conduct the engineering educational process. That is, engineering education reflected not only in innovative curriculum development but also in how faculty interact with students, how students learn, and how emerging technologies are imbedded into the educational environment. As we alter the educational landscape, we address how we teach as well as what we teach, informed by a continuous quality improvement process with the discipline of asking ourselves who our audience is, what our objectives are, how we will know when we have achieved those objectives, and what tools are necessary to make sustainable systemic change.

In doing so, we strive to develop an emerging engineering professional who possesses a broad set of competencies because we have introduced him or her, from the very first day on campus, with an understanding of the context as well as the content of their academic program and their professional endeavor. This is further achieved by making the student a collaborative contributor to the learning process through an integrated curriculum and program where faculty and institutional leaders help the students make the connections; synthesize as well as analyze; develop a sense of open ended inquiry, and do so through a learning environment that fuses experiential learning with the fundamental scientific and technical principles, all within the engineering context. The six primary focus areas of Gateway include Curriculum Development & Implementation, Professional Development for faculty and students, Underrepresented Populations, Instructional Technologies, and Assessment. In addition the Coalition has a program to link, and share with, schools within and external to the Coalitions.

Today’s technologies offer the possibility of making materials available in a format that is timely, widely accessible and helpful to a broad range of users. The Gateway Coalition is working to provide the engineering education community with a full range of products and processes that can be readily adapted and applied. This product realization process results in the Gateway Web Repository which will remain as a long term legacy of the work of hundreds of faculty over a nine year period.

The presentation at ICEE 2002 will review the programs, processes, and decisions made by the Coalition which lead us into its concluding phase of bringing the products to realization and to life in a form useful to the broader community via the Gateway Web Repository.

Coalition Strategies:

¹ Member institutions of the Gateway Coalition are Columbia University, Cooper Union, Drexel University, New Jersey Institute of Technology, Ohio State University, Polytechnic University, and the University of South Carolina.

While the several different Engineering Education Coalitions may have begun with rather focused objectives, most often centered on curriculum issues, all ultimately realized that to institute sustainable systemic changes required much more. The most influential factor for sustainable change was recognized to be a fundamental culture change in the educational process. Furthermore, the dissemination of the results of this work or the diffusion through multiple channels became not only an important functional objective for sharing with others and providing the fruits of these works to others but it also becomes one additional vehicle toward sustainability. A larger critical mass of institutions incorporating the functional details of curricular, professional development, outreach, technology, and assessment changes the greater the probability that those changes will become imbedded as part of a new mainstream. The participants of this panel will each be leading a dialog on the several topics important to the Coalitions efforts. This participant will be addressing the issues of dissemination and culture change.

Dissemination:

Dissemination of the outcomes (products and results) is diffused through a number of different channels. Some channels are interpersonal while others use mass media. Typical of the former are professional conferences, interactive workshops, and institutional partnerships. Mass media channels typically involve publications (journals & books), electronic media (CDs, digital books, etc.), and digital repositories. While all channels have been used, each coalition has tended to favor one or two over others (driven by leadership vision, institutional competencies, & available resources). A Great deal of Coalition diffusion efforts has focused on interactive workshops and the creation and distribution of digital media. Each of these has their distinct advantages and challenges. The interpersonal channels of conferences and workshops offer the opportunity to reach a targeted audience, have direct contact and interactive exchange between innovators and adopters, or focus in depth on a topic or issue (e.g. implementation). This is a relative active activity in which information, debate and practice leading to individual or specific institutional interest/concern can be addressed. In partnerships, innovations can be tested with visible results. The challenges to this type of diffusion include that fact that quite often the presenter is “preaching to the choir” and that there may not be sufficient critical mass of fellow institutional attendees to transfer the learning as a sustainable change at one’s institution. Mass media diffusion has the advantages of Advantages mass exposure to the breadth of resources that exist, it supports community of users, promotes interdisciplinary collaboration, supports integration of broader knowledge acquisition links, and reaches broad audience for global dissemination. The challenges to this mode of diffusion are that it is a relatively passive activity with information, rather than personal interaction, flow only. There is no direct relationship of the information provided within the context of the recipient’s own institutional or classroom setting for adoption or implementation. As noted previously, the Coalitions have used all of these channels but some more than others. The Gateway Coalition has joined with the others in a regional/local workshop initiative but is placing a heavy emphasis on the establishment of a Web Repository as a vehicle to provide a long term legacy and resource of the many works and products that have evolved from the Coalition’s programs. Each product will have an explanation of its intent and use as well as the ability to download for implementation or adaptation.

Culture Change:

Culture change, the second focus of this panelist’s assignment, is essential for sustainable systemic change. Culture change is not just one thing but combination of actions. It involves both faculty and student professional development, a better understanding of how students learn as well as the content of what is learned. It involves making use of technologies that will help make the educational experience more interesting, exciting, and effective. Curriculum is in itself not the culture change but the vehicle through which we implement change. Finally, assessment provides the means to appreciate the magnitude of effects on the educational enterprise and the opportunity to have continuous updating through the feedback process. Metrics play an important role in this process of culture change. It forces us to identify what parameters to measure and to clarify objectives. Metrics improve communication among all the parties, provides the mechanism to monitor progress and facilitate forward planning, and serves as the means to demonstrate results in support of culture change. Some example metrics that the Gateway Coalition, and others, have used to illustrate the institutional changes include:

- The degree to which we have moved engineering up-front with freshman engineering experiential learning and design.
- How much integration have we achieved in integration of humanities and professional development issues (e.g. oral & written communication skills, ethics) into the engineering program and courses?

- To what extent have we integrated interdisciplinary course offerings into the undergraduate program?
- To what extent are cooperative learning techniques being used in the classroom?
- Are an increasing number of senior faculty teaching in lower division courses?
- The extent to which faculty are attending and/or participating in educational centered conferences.
- The extent to which faculty are publishing their scholarly work in educationally centered articles.
- Whether faculty are using new media technologies in classroom.
- Degree to which outcomes assessment at program and course level has been developed, used, and implemented?
- Program effects on students, retention & graduation rates

Note that these metrics address curriculum content and organization, teaching and learning styles, faculty culture, and the willingness to examine or measure the results and effects of our work. All of these are important facets in demonstrating the effects of the work at the many Coalition schools and in determining the degree to which the work has become part of the mainstream and thus sustainable.