The ASEE Chemical Engineering Summer School for New Faculty - A Model for Other Disciplines to Consider

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Abstract

The Chemical Engineering Division (CHED) of the American Society for Engineering Education held the 13th in a series of Chemical Engineering Summer Schools during the summer of 2002 at the University of Colorado. This Summer School, which is currently offered every five years and dates back to 1931, is unique among the various engineering disciplines. It provides extensive educational resources to aid in the development of new faculty who have joined their departments since the previous Summer School. The Summer School was staffed by established faculty members, representatives from governmental agencies, and industrial participants. Each academic department in Chemical Engineering in the US was invited to send at least one new faculty member, preferably hired within the last five years. Support is typically obtained from government, foundations, and industry to defray most of the on-site expenses for participants. In the summer of 2002, some 160 young Chemical Engineering educators and about 50 Summer School faculty gathered in Boulder, Colorado for six days of plenary lectures, presentations, workshops, mentoring activities, poster presentations, and casual socializing among all participants. CD-ROM's and a web site were used to widely disseminate all the instructional materials from the Summer School to the academic community within Chemical Engineering.

This paper will provide an overview of the purpose, organization and operation of the Summer School. It is hoped that this paper/presentation will encourage other engineering disciplines to organize similar programs that will significantly contribute to the development of new faculty as they start their academic careers.

INTRODUCTION

The Chemical Engineering Division of ASEE has organized 13 Summer Schools for Engineering Education since 1931. This is the only such Summer School that is regularly scheduled for the many disciplines within the fields of engineering. The Summer School is organized and conducted by dedicated faculty and industrial practitioners who recognize the critical need to assist the new faculty who are just beginning their academic careers. This activity is pursued with the hope that the truly significant benefits are enabled to our chemical engineering students and their educational programs and experiences.

Purpose of the Summer School

The main purpose of the Summer School for Chemical Engineering Faculty is to disseminate innovative and effective teaching methods to a wide spectrum of primarily new chemical engineering faculty who will be teaching courses and laboratories in undergraduate programs. Additionally, the Summer School introduces new faculty to a number of promising research areas in which concepts, principles, problems, and laboratory experiments can be incorporated into undergraduate coursework. The Summer School also brings new faculty together with mid career and senior faculty to discuss educational methods and educational delivery and to provide tested educational materials directly to new faculty for use in a variety of courses. Workshops are typically planned in many areas that receive NSF and EPA research support. During the 2002 Summer School, these areas included molecular modeling, bioengineering, green chemical engineering, safety, effective use of computers, professional ethics, and the latest educational technology. Some of the most fruitful discussions occur informally among participants during the Summer School week when they are living together in a university residence hall and participating in the many activities that are provided.

The recent Summer School was planned during an especially auspicious time, as the interest in teaching was greater than it has been in the last twenty-five years. The chemical engineering curriculum was being revised in most departments in response to the new ABET criteria, and knowledge is rapidly changing in a number of important areas. The downsizing so prevalent in industry is affecting universities as well. The presenters willingly share their experiences, ideas, and educational materials with the new faculty who will be teaching similar courses or laboratories in the near future. This sharing and exchange permits the effective transfer of ideas to new faculty from across the country in a collegial and supportive manner that is not possible in other conferences. Additionally, it enables the effective development and dissemination of educational materials in important new technologies such as those whose research is funded by NSF and other governmental agencies. Past participants report that the ideas, techniques, enthusiasm, and materials they gained at the Summer School were rapidly incorporated into their teaching and that of their colleagues at their home institution.

The Summer School attempts to support the attendance at least of one new faculty member from every school in the United States that awards chemical engineering B. S. degrees. One of the goals is to pay expenses of every participant with support from grants solicited from governmental agencies, the chemical and pharmaceutical industries, and educational foundations. The most recent Summer School materials regarding educational techniques and extensive course and laboratory materials were widely distributed via CD-ROM"s and the Internet to the entire chemical engineering educational community. It is reasonably hoped that the Summer School will have a positive impact on every single B. S. graduate in chemical engineering as early as the next graduating class, as well as all those graduates that will follow.

Co-Chairs for the Summer School

Most previous summer schools have had a single chair, but in 2002 three co-chairs shared the organizational duties. These individuals are academics that have typically been highly involved

with the Chemical Engineering Division of ASEE in several administrative capacities and have strong connections throughout the disciplines involved in Chemical Engineering. For the recent Summer School, two co-chairs handled the conference organization, programming, registration, and funding while the third from the host institution handled the local arrangements. This separation of duties seemed to work quite well and is being planned for the next Summer School. Site selection is determined by the co-chairs and the Chemical Engineering Division.

Unique Features of the Summer School Added in 2002

Each Summer School allows for the evolution of previous programming and the development of new activities, and this was particularly true in 2002. Innovations included the following:

A. All participants were required to bring an IBM compatible laptop computer with a CD-ROM drive and AC power supply to the Summer School for use during the presentations and workshops.
B. Most of the handout materials for all sessions were provided in electronic form via a Pre-Summer School set of two CD-ROM's that were prepared about 6 weeks prior to the Summer School and distributed to all participants upon arrival.
C. A Post-Summer School set of two CD-ROM's containing all of the materials including the actual presentations, software, and other useful materials was produced from all the presenters during the three weeks after the Summer School. The CD-ROM set contained educational software, educational materials (lessons plus home problems), and other items that were immediately utilized by many participating faculty at their home institutions. This set was produced and copies were widely distributed to all participants. A set was also sent to each of the accredited Chemical Engineering departments in the US, and copies of the CD-ROM set were made available for purchase at duplication costs.
D. A web site containing of the Post-Summer School CD-ROM materials was created and loaded with all the conference materials. This web site was fully functional approximately three months after the Summer School after presenter were able to submit and review their materials. This access to Summer School presentations and related materials via the Internet encourage the utilization by faculty throughout the US and beyond who were are not able to participate in the Summer School. Access to this site is controlled with a User Name and Password so that search engines and students cannot access the materials that are restricted to faculty use only.
E. Special Summer School activities were provided that promoted personal interactions between the new faculty and more experienced faculty who served as informal mentors. Among the experienced faculty were many previous department heads. Pre-dinner social hours were held each afternoon to further encourage dialogue and discussions among participants and mentors. Also tables were arranged for mentors and attendees to discuss topic of mutual interests.
F. A pub-styled social period was organized each evening from 9:45 to 11:00 PM to encourage networking among the participants, particularly the new faculty. Refreshments were provided.
G. Poster sessions were conducted each evening in the same room as the pub-styled social. Participants contributed posters in the following areas:

- Learning Styles, General Approaches & Outreach
- Strategies for Lecture Courses
- Computer-Based Strategies
- Strategies for Laboratory Courses

The posters were judged each evening by a team comprised of seasoned mentors, and prizes were awarded.

H. Arrangements were made to have the prize-winning posters published in the Chemical Engineering Division Journal, **Chemical Engineering Education**.

I. A **Who's Who** compendium of biographies from all participants was made which included their photographs, their particular interests, and their professional contact information.

J. Individual scheduling of desired workshops was done in advance in order to assure adequate space and facilities for the workshops. Repeated workshops were offered in response to high demand. Workshop scheduling utilized priorities identified by the attendees.

K. E-mail was used for all correspondence, and registration was facilitated by a web site that contained complete information and registration forms. (http://www.engin.umich.edu/~2002/)

Summer School Format

A typical day at the Summer School is outlined below.

Daily Format

8:15 AM	Plenary Lecture or Panel Discussion
9:15 AM	Organized Coffee Break
9:45 AM	Four Parallel Session on Educational Topics
12:30 PM	Lunch – Topical Seating Optional
1:30 PM	Free Time, Choices
	Computational Laboratory
	Recreational Activity
	Hiking
	Biking
	Reading
	Napping
	Educational Enrichment Activities
4:45 PM	Social Period with Mentor Discussions
5:30 PM	Dinner
6:45 PM	Four Parallel Sessions on Technical Topics
9:45 PM	Poster Session and Social Hour

The typical daily format shown above starts each morning with a Plenary Lecture or Panel Discussion. One discussion usually includes a panel of industrial Chemical Engineers addressing the needs of industry in Chemical Engineering graduates. Another presentation typically addresses the important developing research areas supported by the National Science Foundation. The morning sessions that follow typically focus on educational methods and

technologies, innovative laboratories, and career planning for new faculty. For example, methods to develop critical thinking and creative problem solving will be presented along with the effective use of instructional technology in the classroom. The afternoon provides opportunities for the participants to have hands-on experience with the software and other computing materials discussed in the morning sessions. There are also recreational and enrichment educational activities available in the afternoon, such as hiking or visits to interesting sites in the area of the Summer School. Some of these events are particularly targeted for the family members of the attendees.

The evening sessions provide suitable means to introduce the latest research materials into the classroom or the laboratory. The evening workshop sessions are used to introduce the participants to the topical areas of current research emphasis and provide suggestions as to incorporation of this material into traditional courses. Some of these workshops are presented in two sequential evening workshops. The intent is to provide an overview of important research areas to individuals who are not doing research in these areas but who would like to understand the engineering and scientific principles that are involved. Materials for lectures and representative examples are provided along with possible homework problems for future use.

The final activity for the day is a social gathering with selected poster presentations from 9:45 PM until 11:00 PM in a lounge or central facility close to the main housing for the participants. The posters are mostly provided by the new faculty participants and highlight lecture or laboratory materials or problems that have come from their research or industrial experiences. Topics focus on emerging technologies where chemical engineering principles or creative thinking and problem solving can be applied. Prizes are awarded each night after judging by a panel of senior faculty mentors.

Attendance

Participation at the Summer School must be limited due to space and monetary constraints, but the Chair of each Department of Chemical Engineering can nominate a departmental representative, paid for by the conference, and additional representatives are accepted as space permits with the costs being paid by the home department. In the most recent Summer School, attendance increased to 160 participants plus 50 speakers and workshop coordinators. However, with the increases in new faculty, the demand for participation is expected to increase significantly.

Summer School Timing and Locations

The Summer School is typically held every five years. However, serious consideration is being given to changing the timing to four-year intervals at the suggestion of recent attendees. The actual Summer School is scheduled from Sunday through Thursday noon in late July or early August. New faculty should attend a full-day teaching methods workshop on Saturday, while all participants attend workshops beginning Sunday morning. This scheduling has allows attendees to incorporate a Saturday night in their air travel arrangements, and thus incurring a significant cost savings.

Locations have varied from resorts in Colorado and Utah to major campus locations such as Universities in California, Montana and Colorado. Experience has shown that a campus location tends to be considerably less expensive and can provide for the needed multiple lecture rooms, computing facilities, and laboratories for demonstration purposes. Residence hall accommodations on campus provide economical housing options. Good air travel connections (with multiple carriers) and a central location in the US help to minimize the travel costs.

The Program

The flagship workshop is always the "Teaching Effectiveness for New Faculty Workshop" which is given by established experts in this field and usually involves some chemical engineering faculty members. This workshop is held the day before the school workshops so that the attendees can devote their undivided attention to it. In fact, attendance is required of the new faculty receiving support to attend the Summer School.

There are typically nine session periods with each period offering four (or five) parallel workshop sessions. Sessions are held in the morning and evening, with the afternoons allowing for informal activities. Some of those afternoon activities (particularly those involving computers) involve optional laboratory demonstrations in which participants can get a hands-on involvement with material presented in the morning/evening sessions. Others will involve execution of advanced software packages such as those for computational fluid dynamics.

The program in 2002 is summarized below:

Plenary Lectures

Thoughts on the Evolution of Chemical Engineering Education - One MIT Perspective. Robert A. Brown
Industrial Panel on *Industrial Needs from CHEG Graduates*
NSF Programs of Interest to ChE Faculty. Thomas W. Chapman
The Role of Representations in Problem Solving in Chemistry. George M. Bodner

Flagship Workshop: Effective Teaching for Engineering Professors – A One-Day Workshop by Richard M. Felder, Rebecca Brent, and Phillip Wankat

Poster Presentations by Attendees - Poster presentations were presented from the attendees in the following areas, and the best posters were selected in the following areas:

- Learning Styles, General Approaches & Outreach
- Strategies for Lecture Courses
- Computer-Based Strategies
- Strategies for Laboratory Courses

Workshops

1: Career Development
2: Computational Fluid Dynamics (CFD)
3: Integrating Instructional Technology in the Classroom

4: Enhancing and Advancing Student Learning
5: Process Control Simulation using Control Station and Process Control Modules (MATLAB)
6: Molecular Modeling
7: Bioengineering
8: Green Chemical Engineering
9: Cellular Engineering
10: Teaching Fluid Flow and Heat Transfer through Visualization
11: Incorporating Communication Skills
12: Integration of Design Software into the ChE Curriculum
13: Syllabi for Core Courses
14: Ethics for Engineers - the Engineer's Toolchest Course and Engineered Biomaterials
15: Designing Challenge-Based Learning Modules
16: Mathematical Software Packages
17: Novel Laboratory Experiments
18: Integrating Computing across the Curriculum via Spreadsheets
19: Process Safety
20: Teaching Troubleshooting

Workshop Leaders

The selection of workshop leaders is made by the Summer School co-chairs with the advice of the Chemical Engineering Division leadership and colleagues in chemical engineering and other disciplines. These leaders are very well established and respected in their disciplines with a particular dedication to educational activities. The workshop leaders organize the particular workshop and determine the presenters and the workshop contents. These leaders are also expected to attend as much of the Summer School as possible and serve as mentors to attendees.

Distribution of Summer School Materials

Major improvements in the collection, use, and dissemination of materials were implemented for the first time in the 2002 Summer School. Plenary and workshops presenters were asked to submit their materials approximately seven weeks prior to the Summer School to allow for the preparation of CD-ROM's for distribution to the participants for use during the Summer School. This effort resulted in the preparation of a set of two Pre Summer School CD-ROM's containing presentation, handouts, resources materials, references, computer programs, etc. of benefit to all participants. All participants were expected to bring and utilize notebook computers with CD-ROM drives during the Summer School. This allows a large amount of materials to be conveniently available to participants during their various sessions and allow materials from all sessions to be widely available to all participants. This allowed for efficiency during the workshops/plenary presentations and very significantly reduced the reproduction and distribution of a very large volume of printed materials that was necessary in the past.

Immediately after the Summer School, a major effort was made to collect all of the presentations and materials that were actually used or referenced during all of the workshops, plenary

presentations, and poster sessions for a set of two Post Summer School CD-ROM's. This complete compilation of all materials was solicited during the three weeks following the Summer School. A web site was created to allow rapid review of all submitted materials by all of the plenary and workshop presenters. This web site was first restricted to plenary and workshop presenters for a review of their materials to assure that contributions were properly available for distribution to the participants and to the Chemical Engineering academic community in general. This web site was created with the dual purpose of providing the materials for the Post Summer School CD's and for a general web site from which these materials would subsequently be widely available the to Chemical Engineering faculty.

The Post Summer School CD-ROM's were sent to each Summer School participant and workshop presenter. CD sets were also distributed by mail to the department heads/chairpersons of each accredited Chemical Engineering program in the US, and additional copies were made available at duplication and handling costs.

An extensive web site containing all of the Summer School was created in which the web access is controlled with an appropriate User Name and Password. The access information was distributed along with the CD-ROM mailings and via e-mail requests to the Summer School CO-chairs. The web site is http://www.che.utexas.edu/cache/asee, and the access information can be obtained from Michael.Cutlip@Uconn.Edu. The current Summer School web site contains 701.5 Mb's of materials in 1400 separate files including 300 graphic files and 3900 hyperlinks to other web materials. Future plans include maintaining and upgrading these materials and promoting access by academics throughout the US and around the world.

Budget for 2002 Summer School

1 All Day Teaching Workshop
5 Plenary Sessions
36 Regular Sessions

Attendees:

Summer School Leaders (Presenters, Mentors, Plenary Speakers, Coordinators)	60
.....Participants	140
..... Total attendees:	200

Total Costs

1) Presenters
   a) Single rooms and board in Residence Hall
      Room and Board $80pp/night (2002 prices)
      6 nights x 80/night = $480pp
      60 presenters x $480 = ...$28,800
   b) Airfare Estimate $700pp in 2002
      60 presenters x $700 = ...$42,000

c) Total costs for presenters $70,800

2) Participants
   a) Double Rooms in Residence Hall
      Room and Board $60pp/night (2002 prices)
      6 nights x 60/night = $360pp
      140 participants x $360 =.....$50,400
   b) Airfare Estimate $700pp in 2002
      140 participants x $700 =..... $98,000
   c) Total costs for participants.....$148,400

3) Lodging, Meals, and Airfare costs $70,800 + $148,400 = ...$219,200

4) Miscellaneous ~ 5% (mailings, refreshments, etc.) $10,800

5) Estimated conference cost.....$230,000

Amount Requested from NSF

1) Costs for presenters.....$70,800
2) Costs for 70 participants with priority given to women and under represented minorities..... $74,200
   $145,000

Amount Requested from Industry and Other Sources

1) Costs for 70 participants with priority given to women and under represented minorities.....$74,200
2) Contingency $10,800
   $85,000

Total ($145,000 + $85,000) = 230,000

Sponsors of the 2002 Summer School

National Science Foundation
The University of Michigan
The University of Colorado
Environmental Protection Agency
BASF Corporation
The Dow Chemical Corporation
ExxonMobil Foundation
Merck Company Foundation
Pharmacia & Upjohn Company
Shell Foundation
3M Engineering Systems Technology Center

CACHE Corporation
Sony Corporation

Summary

The highlights of the most recent ASEE Summer School for Chemical Engineering Faculty are indicated below.

- Essential to Timely Progress in Chemical Engineering Education
- Unique to the Discipline of Chemical Engineering and Involves Typically 200+ Educators
- Offered every Five Years
- Thirteen Offerings Dating back to 1931
- Emphasis on New Faculty Hired within the Last Five Years
- Targeted to Provide Innovative and Effective Teaching Methods
- Provides Educational Classroom Materials on Latest Technologies and Research
- Involves Active Participation by Exceptional Mid-career and Senior Faculty as Mentors
- Invites all Chemical Engineering Departments in US to Send Participants
- Encourages and Particularly Supports Attendance by Women and Minority Faculty
- Garners Support and Participation by Major Corporation, Educational Corporations, and Federal Agencies
- Results and Materials are Widely Disseminated by CD-ROM's and an Internet Web Site

Conclusions

The Summer School represents an exception event for the development of new faculty and for the dissemination of materials and the latest educational methodologies in the subject areas related to Chemical Engineering. The authors of this paper and the many participants in our Summer Schools strongly encourage other disciplines and divisions within the ASEE to consider initiating a similar activity for new faculty and for the betterment of Engineering Education and for the creation and enhancement collegial relationships among faculty at all levels with the discipline and related fields.

Acknowledgments

The Chemical Engineering Division of ASEE would like to thank all the individuals, universities, government agencies particularly NSF, and the industrial and foundations for their support of our previous Chemical Engineering Summer Schools.

Please contact the authors of this paper or the officers of the Chemical Engineering Division of ASEE for more information. (http://www.asee-ched.org/)

Biographical Information

Michael B. Cutlip is professor of chemical engineering at the University of Connecticut in Storrs, CT where he has been on the faculty for 35 years. He is co-author of POLYMATH, a numerical analysis package, which is widely used in chemical engineering students. He has been particularly active with the AICHE and the ASEE Chemical Engineering Division having served as Division Programming Chair for the Seattle Annual Meeting in 1998 and was the Division Chair in 2000. He was also a co-chair of the ASEE Chemical Engineering Division Summer School in 2002 at the University of Colorado.

H. Scott Fogler is the Vennema Professor of Chemical Engineering at the University of Michigan. He is the author of *Elements of Chemical Reaction Engineering*, which is widely used in chemical engineering departments throughout the world. In 1995 he was the recipient of the Warren K. Lewis award from the American Institute of Chemical Engineers for contributions to chemical engineering education. He is a former director and is a fellow of the AICHE. He is a former chair of the ASEE Chemical Engineering Division and a co-chair of the ASEE Chemical Engineering Division Summer School in 2002 at the University of Colorado.

C. Stewart Slater is Professor and Chair of Chemical Engineering at Rowan University where he has headed the efforts to establish a new department with innovative approaches to engineering education. His research and teaching interest are in separation and purification technology, laboratory development, and investigations for novel processes for interdisciplinary fields such as biotechnology and environmental engineering. Dr. Slater has been active withy ASEE, having served as Program Chair and he is currently Chair of the Chemical Engineering Division. He has held every office in the DELOS Division.