Using Course Materials to Change Teaching Methodology

John T. Demel, Robert J. Gustafson, John A. Merrill,
Richard J. Freuler - First-Year Engineering Program /
Kathy A. Harper - Faculty and Teaching Associate Development

The Ohio State University

Abstract

As part of the restructuring in Ohio State's College of Engineering, a new unit called the First-Year Engineering Program (FEP) was created between 1994 and 1998. The Program provides engineering instruction for new first-year students (~1000 students) and transfer students (~130 students). The Program is led by the Associate Dean and has two faculty members, a staff of six, and purchases the teaching services of Engineering faculty from their home departments on a release time basis. In order to prepare the faculty members and other members of the teaching team to teach in the FEP, the leadership and staff provide training and education. This paper covers some of the unique features of this Program, particularly those that deal with teaching personnel preparation and the use of collaborative learning. It documents the changing culture in the Program and the College.

Introduction and Background

Description of the Previous and Current First-Year Organizations – From the 1874 until 1994, the education of the first-year engineering students at Ohio State was handled by the Department of Engineering Graphics (EG). This department of tenured and tenure-track faculty devoted their teaching activities to the first-year students. These EG faculty members had expertise in engineering graphics, CAD, and computer programming. Almost all had industrial experience and thus provided the students with information about engineering in the real world. With the re-organization of the College of Engineering in 1994, the EG Department was merged with the Department of Civil Engineering and a new organization was created for teaching the first-year students. This organization is called the First-Year Engineering Program (FEP) and reports to the Associate Dean for Academic Affairs and Student Services.

FEP has permanent staff including two full time faculty members but hires most of the faculty (on a release time basis) from the degree-granting programs to do the teaching. The members of the staff include a Director who provides management of the graduate and undergraduate students and leads the assessment activities, a Faculty Coordinator who helps recruit and work with the faculty and provides mentoring and technical expertise, an Honors Coordinator who coordinates with the Engineering, Math, and Physics faculty and provides mentoring and technical expertise for the FEH faculty, an information specialist who works with course materials and WebCT, an administrative assistant who handles personnel and purchasing, and two instructional laboratory supervisors.

Many of the faculty members who volunteer do not necessarily have expertise in graphics, CAD, MATLAB, hands-on laboratories, or design. They must be educated in these areas and provided with the teaching materials.

The Current Program

Description of Course Content Covered – There are two course sequences for the First-Year engineering students. The first option is a two quarter sequence, known as Fundamentals of Engineering or (FE). Students designated Honors can opt for a different three quarter sequence known as Fundamentals of Engineering for Honors (or FEH). Students are required to select one of these sequences. The following topics are in both sequences – engineering graphics and CADD, MATLAB, hands-on labs, and a ten-week design/build project.[1] Teamwork is required for the hands-on laboratory exercises and laboratory reports and for the design project.[2] Students receive instruction on project planning, management, and documentation. At the end of the design project, the teams must submit a formal written report and do an oral presentation with visual aids. For the Honors students, the third course deals with programming and real-time data acquisition and analysis. The physics and mathematics are coordinated with the FEH engineering sequence. The FEH students are involved in collaborative learning in engineering, in physics, and, to a limited extent in mathematics. The description of the teaching methodology for the physics follows.

The physics portion of the Fundamentals of Engineering for Honors sequence incorporates several non-traditional teaching methods. The overall instructional approach is based on the scientific process and required students to observe phenomena, construct possible explanations, test those possibilities, revise them if necessary, and apply this knowledge to new situations. The approximately 75 students in each of three lecture sections are organized into sections of about 28 students for recitation and lab and work in four-person collaborative groups assigned via a stratified random process.[3] These groups work together in all aspects of the course, including an occasional group homework assignment or project and a group problem on each midterm. Activities in recitations and labs are structured to help students strengthen their conceptual understanding, analytical skills and experimental skills. Students learn to use different representations of physics ideas such as pictorial representations, motion diagrams, graphs, vector diagrams, free-body diagrams, and energy bar-charts before they solve numerical problems.[4, 5] Problem solving sessions include problems that are ill-defined, based on real life situations, require estimations, or require students to reason qualitatively.[6,7] Laboratories frequently include portions where student teams must design experiments to test competing theories explaining a phenomenon.

The Engineering Teaching Environment and the Engineering Teaching Team - The classrooms for the First-Year courses are equipped with a networked computer for every student in the classroom and a computer, high intensity projector, and a document camera for the instructor.[8] The tables have seating for four students facing each other so that they can work in pairs or fours. There is a software package – NetOp School – which allows the instructor to take control of the student machines so that the instructor can put the PowerPoint slides on the desktop as well as on

the screen in front of class. For each section there is a teaching team, with a faculty member as the leader of the teaching team. The members of the teaching teams include both graduate and undergraduate teaching associates. Assessment is a regular part of these FEP courses. The faculty attitudes about their teaching experience in the FEP are collected. Students have the opportunity to provide feedback on a weekly basis through electronic journals and on a quarterly basis for the teaching and for the course organization and implementation. Their attitudes about the courses and toward engineering are surveyed as well.[9]

Materials Provided for Faculty – When the faculty members agree to teach with the FEP, they receive a notebook with the course syllabus, a paper copy of all of the lecture notes, a paper copy of the problems the students will solve along with the answer keys, and a CD or Zip disk with an electronic copy of all of the lecture materials. They also receive textbooks and a copy of any CAD or analysis software that is used in the course. The faculty members and graduate students work together to develop the midterm and final exams.

Workshop for the Teaching Teams – The faculty along with the graduate and undergraduate teaching associates or peer mentors constitute the teaching team. The teams attend a workshop prior to the beginning of the quarter. The workshops vary from one and one-half to three days depending on the material to be covered and the expertise of the teaching team members. This workshop includes material on how students learn, learning styles, cognitive growth in the college years, assessment, standard practices, the use of the technology in the classroom along with WebCT, alternative methodologies, and the course contents. They also are instructed how to use the collaborative exercises which are included in teaching materials.

Instructional Practices - While the faculty can change the instructional materials to suit their styles and methodologies (primarily presentation style), most use the materials as provided (see Faculty Survey below). The classrooms and labs have been set up for collaborative learning. Collaborative learning materials are now incorporated in the PowerPoint slides. Thus far, the think – share – compare types of questions are part of the lecture. Teams of two or four students are created for doing the laboratory exercises, writing the laboratory reports and working on design projects. For some of the courses there is a question of the day relating to some part of engineering and technology history included and the students are encouraged to compare and share answers for these questions. Assessment processes survey the faculty and the students and their attitudes about these courses and the course materials that are used. The results of the assessment show how these active learning strategies are being used and how they are being perceived.

The intent is to continue to develop materials and directions for the students (and faculty) so that the classroom environment becomes more collaborative for the students and more focused on the learning of materials rather than the presentation of materials. The appropriate assessment instruments and processes have been incorporated to document the effect of changes course materials and practices.

Weekly Meetings for the Teaching Team – In the FE program, the faculty, GTAs and peer mentors meet once a week to go over the materials for the coming week. One of the teaching

teams leads the discussion of the classroom work and the next laboratory exercise. The teaching teams then work through the laboratory exercise so that they are prepared for the next hands-on lab. In the FEH program, the Engineering, Math and Physics faculty members meet once a week to go over the next set of topics in all three courses and work to coordinate the presentation and reinforcement of course materials. Time is also allotted for discussion of the journal responses for the previous week. Exams are coordinated so that the FEH students have only one midterm or final exam on any given day.

Materials Provided for Students - Most of the course material is provided to the students in the format of PowerPoint presentations. These are presented during class (as well as in labs) by the instructors and are also available online for the students to access on their own. In the past, these presentations had been made available to students only in printed format and were included in the course packet purchased by students at the book store. In summer quarter 2002 students were provided with all of the course material online, including the PowerPoint presentations. Students have responded positively to this change and find it convenient to access the materials from any computer at anytime and it cuts down on the amount of printed material they are required to carry to and from class. (Students can also burn their own CD from the online files, or print and organize their own course notebook. Lab procedures are still published and available for purchase.) With regard to the presentations themselves, students comment positively on their clear organization and the visual aid they provide in their learning. In addition, according to the students, they review these presentations frequently in order to review animated and detailed slides used in lectures, to prepare for class, and to review material after class in preparation for the midterm and final examinations.

Profile of the Faculty

The faculty members who have been teaching these introductory classes include six professors, eight associate professors, and one assistant professor. All nine of the engineering departments have provided professors for the program. The professors who have taught all have their tenure home in a degree-granting department and are teaching courses in their discipline and doing research in addition to teaching the first-year students. The faculty members are hired by paying their home departments for a percentage of their time – approximately ten percent per credit hour that they teach. The pay includes both their salary and the associated benefits.

The Faculty Survey

Survey Form – An on-line survey was created that included the following questions:

1. In which sequence have you taught? FE or FEH
2. Which courses have you taught? 181, 183, H191, H192, H193 Do you use the PowerPoint slides without modification? Yes, Most times, Half, Seldom, No
3. If you answered 'No' please elaborate on what types of modifications you may make to a presentation? (text box provided for answer)

4. Do you have your FE/FEH classes complete all suggested team/collaborative activities? Yes, Most times, Half the time, Seldom, No
5. How do you think team activities have impacted the course? (text box provided for answer)
6. Has the use of prepared materials in the FYEP influenced you to change the methods you use to teach your departmental courses?
7. Please elaborate on how the prepared materials have influenced you to change or not change your teaching methods. (text box provided for answer)

Survey Results – 12 of 15 people responded

1. In which sequence have you taught? Twelve responses: FE 6, FEH 3, Both 3
2. Which courses have you taught? Twelve responses: Eight had taught two or more courses
3. What type of modifications? Three used the slides without modification. Four usually used them without modification and two sometimes used them without modification. One person had added a question of the day (this is now incorporated in the FEH slides).
4. Do you have your FE/FEH classes complete all the suggested team Activities? Eleven faculty members had used all of the activities and the other person used most of the activities.
5. How do you think team activities have impacted the course? Three people provided a written answer and all were positive about the team activities.
6. Has the use of prepared materials in the FEP influenced you to change methods in your departmental courses? Three said 'Not at all', four said 'limited', three said 'moderate', and one said 'To a great extent.' One respondent had helped create the original Power Point slides and uses Power Point slides in all of her courses.
7. Please elaborate on how you have changed your teaching methods. One person has added homework problems that use the FEP materials. Four commented that they are now using Power Point slides in their departmental courses. One professor commented on adding teamwork to his departmental courses.

Student Attitudes on Team Interaction

Student attitudes regarding teamwork are extremely positive. Every quarter students identify teamwork as one of their most favorable experiences in the course. There are several reasons for the student enthusiasm regarding their teamwork experiences. Most frequently mentioned by students is the fact that they are able to learn so much from one another. Students tell us that each person brings different knowledge and experiences to the team learning experience. This diversity strengthens the teams overall knowledge base and the students are able to teach one another as peers. (Students also report assisting one another in other non-engineering course work. They refer to one another as their "support system.") In addition to aiding in the learning process, teamwork improves the overall classroom environment and makes learning more enjoyable for students. Students tell us that working together makes projects seem less intimidating and can also serve as a stress reliever when jokes are shared. Finally, students tell us that teamwork helps to build a sense of community among the members and brings them together to accomplish a common goal. Solid friendships with team members have grown and many enjoy the time they

spend together both in and out of class. One student summarized the majority of comments from the students in the following comment. "Being with our small group was a nice comfort zone for us as beginning students. We worked on almost everything together and I know I could easily talk to them if I had a problem. Being in a team also is a good thing because it makes the class seem smaller."

Summary

The results of the teaching materials survey showed that most of the faculty members are using the teaching materials as they are provided. They are making use of teams and the collaborative and active learning methods that are included in these materials. The students appreciate the teamwork exercises and the active learning environment. Certainly the culture during the first year for these students and faculty has changed from one focusing on individual work to one focusing on collaboration and active learning. This helps to create an atmosphere where the students feel that they are a part of the College. In addition, some the faculty members who have participated in teaching the FEP courses are now employing these new methods in their departmental courses. Thus the changes in the First-Year Engineering Program are helping change the teaching and learning culture in the College. It is the intent of the FEP to continue to introduce new methodologies for the faculty to employ with the first-year students and to incorporate learning how to learn for the students.

As Colleges are developing or revising their first-year programs, they should plan not only the course(s) content but how it will be presented in the classrooms and laboratories. In addition, it is worth cultivating the faculty in physics, mathematics, and chemistry who teach courses parallel to the engineering courses. With this larger group of faculty working together, they can reinforce in one course what was originally presented in a course in a difference area, and they can make collaborative learning the norm rather than the exception.

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AUTHOR BIOGRAPHIES

JOHN T. DEMEL
John T. Demel is Professor of Engineering Graphics in the Department of Civil & Environmental Engineering. Dr. Demel is the Faculty Coordinator and teaches for the First-Year Engineering Program (FEP). He helped create and develop the FEP program. Dr. Demel earned his B.S.M.E. at the University of Nebraska-Lincoln (1965) and his Ph.D. (1973) degree in Metallurgy from Iowa State University. He is a registered professional engineer in Texas.

ROBERT J. GUSTAFSON
Robert J. Gustafson is Associate Dean for Academic Affairs and Student Services in the College of Engineering and Professor of Food, Agricultural and Biological Engineering at The Ohio State University. Dr. Gustafson earned his B.S. and M.S. degrees in Agricultural Engineering from Illinois and Ph.D. in Agricultural Engineering at Michigan State University in 1974. He served on the faculty at Minnesota from 1975 to 1987.

JOHN A. MERRILL
John Merrill is the Director for the First-Year Engineering Program at The Ohio State University (OSU). His current responsibilities include operations, faculty recruiting, curriculum development, and program assessment. Dr. Merrill received his Ph.D. in Instructional Design and Technology from OSU in 1985, and has an extensive background in public education, corporate training, and contract research.

RICHARD J. FREULER
Richard J. Freuler is the Coordinator for and teaches in the Ohio State Fundamentals of Engineering for Honors sequence. He is also Associate Director for the Aeronautical and Astronautical Research Laboratory. Dr. Freuler earned the B.S. and M.S. degrees in Aeronautical and Astronautical Engineering (AAE) in 1974, a B.S. in Computer and Information Science in 1974, and a Ph.D. in AAE in 1991. All of these degrees are all from Ohio State.

KATHLEEN A. HARPER
Kathleen A. Harper is an Instructional Consultant with Faculty and TA Development at The Ohio State University. Dr. Harper earned her BS in Electrical Engineering at Case Western Reserve University and her Ph.D. in Physics at The Ohio State University. Her PhD research was in the area of Physics Education. Following her Ph.D., she worked at a post doctoral fellow in the Physics Education Research Group at Ohio State with Alan Van Heuvelen.