

Teaching Engineering Courses in an Off-Campus Environment

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Abstract

This paper describes a new off-campus graduate program in environmental engineering that is offered through Southern Illinois University Carbondale. Courses are offered to working professionals on a weekly basis in Springfield, IL, located 200 miles from the university's main campus. The paper notes several key differences between teaching styles and effectiveness in this off-campus program when compared to that in a more traditional on-campus setting. These differences include that the instructors must be consciously aware of additional job-related constraints imposed on their students, that students tend to have a higher level of expectation with regard to content and delivery, and that additional time and effort must be invested by the instructor in order to create an effective learning experience for remote students.

I. Introduction

In November 1997, the Illinois Board of Higher Education (IBHE) authorized Southern Illinois University Carbondale (SIUC) to establish a graduate program in Springfield, Illinois leading to a Master of Science degree in Civil Engineering. The authorization came in response to an expressed interest by a number of engineers employed at state agencies including the Illinois Environmental Protection Agency (IEPA) and Illinois Department of Transportation (IDOT). The inaugural program has been designed with an emphasis in environmental engineering and is intended to serve working professionals in both the private and public sectors. Beginning in August 1998, program courses that focus on topics such as water treatment, groundwater hydrology and hazardous waste incineration have been taught by faculty from both the Department of Civil Engineering and Department Mechanical Engineering and Energy Processes. In accordance with the IBHE authorization, on-site instruction for the courses is provided at the headquarter offices of the IEPA, located approximately 200 miles from the SIUC main campus. Requirements for the degree program, however, are identical to on-campus policies and standards, including faculty qualifications, student admission and performance, and program evaluation and review. The arrangement ensures that quality instruction and a high level of student-teacher interaction can be maintained.

As instructors participating in the Springfield MSCE program, the authors have noted significant differences between the off-campus and more conventional on-campus teaching environments. For example, classes often require additional preparation, and course material and instructional style require modification to challenge and maintain interest of the nontraditional student. This

paper compares engineering education in this off-campus program to that in a traditional university classroom and discusses the mechanics of teaching an off-campus course.

II. Enrollment and Student Profiles

Since the inception of the Springfield off-campus graduate program during the fall 1998 semester, two courses have been offered every fifteen-week semester. During the term in which each course was taught, the same instructor also offered the class on campus. Table 1 lists the courses that have been offered as part of the program, along with their corresponding sponsoring department. Over six semesters, the average enrollment in these courses has been fifteen students. The majority of these students, approximately 85%, are full-time, staff professionals at the IEPA or other state agencies. The remaining students are full-time consultants working in various fields directly related to environmental engineering. Levels of work experience vary dramatically among the students between two and fifteen years, and range from entry-level engineering positions to managerial staff. For students enrolled in the program, an advanced professional degree is not only important for expanding and updating their knowledge base, but it increases opportunities for upward mobility and for obtaining pay raises.

TABLE 1. Springfield MSCE Courses

<i>Semester</i>	<i>Course Identification</i>	<i>Sponsoring Department</i>
Fall 1998	ME 416 - Air Pollution Control	Mechanical Engineering
Fall 1998	CE 419 - Water Supply and Treatment	Civil Engineering
Spring 1999	ME 419 - Hazardous Waste Incineration	Mechanical Engineering
Spring 1999	CE 471 – Modeling Groundwater Flow and Pollution	Civil Engineering
Fall 1999	ME 592 – Bioremediation Engineering	Mechanical Engineering
Fall 1999	CE 517 - Industrial Waste Treatment	Civil Engineering

Many of the off-campus students who participate in the program find it particularly constraining to combine a forty or more hour per week job with class preparation, assignments and studying for exams. To help accommodate the students' employment obligations, classes meet once per week for two and one-half hours during the evening. Although the time required to complete their degree may be more than that of the full-time student, the remote students generally appreciate the opportunity since they are not required to temporarily suspend their professional career. In addition, the majority students have found managing a full-time job along with two collegiate classes leaves little time for research activities. Consequently, many have decided to pursue a non-thesis option, which requires six additional semester hours of course credit beyond that of the thirty-hour thesis option.

Although students in the Springfield MSCE program are coping with significant time constraints, they have performed very well on average. Final grades given to remote students have generally been higher than those earned for the same courses offered at the main campus. For example, the

average grades for both CE 471 and CE 419, taught by different instructors, were approximately 7% higher in the off-campus course than for the same courses at SIUC. Previous research indicates that a consistently higher level of performance by remote students is arguably attributable to extraneous factors such as age and level of maturity, as well as professional experiences³. In addition, the authors feel that these nontraditional students simply take the process of learning more seriously. Students seem more motivated to learn new information since application of course concepts can frequently be incorporated directly into their daily work routine for realistic problems. For instance, after discussing the groundwater recovery method for evaluating aquifer properties, one student noted that he was able use information during the same week to guide his resident hydrogeologist through a pump test when they were unable to obtain a response in an observation well. Another student noted on an end of semester questionnaire that he particularly enjoyed solving these types of realistic problems that required creativity.

The majority of off-campus students have regular access to computers and the Internet. This is especially convenient since class assignments, notes and announcements can be regularly posted on a course website. Additionally, most have had little to no trouble completing assignments that require word processing or spreadsheet analysis. A significant amount of anxiety has been encountered, however, when assigning class projects that require computer modeling or programming skills. While the former are skills likely to be used as part of their work routines, modeling and programming represent skills that are not. On-campus graduate students enrolled in the same courses have generally had less trouble completing the same assignments.

III. Instructional Styles in the Off-Campus Program

Lowman² indicates that a key element of cognitive learning is for students to be fully engaged in the learning process and that attention must be consciously focused on the material being presented. He also states that maintaining the interest value of a lecture is the best way to create an active, rather than passive learning environment. After spending a full day at the office or being on-site for a project, the students enrolled in the Springfield MSCE program are expected to attend class and participate in classroom discussions. One student stated that, “after a long day at work, I found it difficult to stay focused in class.” Bland lectures with little classroom interaction will undoubtedly be ineffective in such a setting and can leave this student in a debate of whether to return for more. While presenting material in a spontaneous and interesting fashion is important in any course, it becomes even more critical in the off-campus program. The instructor must, therefore, recognize the need and develop ways to incorporate effective methods for maintaining student interest and attention.

A tactic used by at least one instructor for maintaining students’ focus has been to lecture in brief periods, between which the classroom is prompted to engage in a discussion of a particular concept. Frequent and spontaneous questioning posed by the instructor are also useful techniques in this regard. These strategies are simply designed to change the pace and manner in which concepts are presented and effectively pique the immediate interests of students.

The medium that is selected to assist in delivering course material is another item to consider in engaging the attention of students. A typical course might rely on several types of equipment for

visual aids ranging from handouts and blackboards/whiteboards to overhead transparencies and multimedia software. For the off-campus program, courses are taught in a conference room at the IEPA offices. Permanent equipment consists of one 3 ft x 5 ft whiteboard and an overhead projector. As a result, the majority of courses offered off-campus have relied heavily on the use of transparencies and department-owned multimedia display software for teaching. For example, the instructor for CE 419 and CE 517 prepares lecture notes within a Microsoft's PowerPoint presentation and distributes them to students via the Internet prior to the class. Although a significant amount of time must be invested in preparing these types of lectures, the electronic displays can appeal to the students' sensory stimuli through the use of sound, color and graphic images and tend to attract their immediate attention without sacrificing class material or content². In addition, many of the remote students have not been in a conventional university classroom setting in years, but have attended and given many professional presentations. As a result, they seem to have higher levels of expectation regarding method of delivering instruction and expect the use of visual aids beyond that of the traditional, yet reliable, whiteboard.

A final aspect to consider in stimulating student interest hinges upon the material presented in a course. Many of the off-campus students have spent years working in the environmental engineering field. In some cases, they have had previous exposure to and applied concepts that are now being covered in their graduate classes. The authors note two important implications regarding this fact. First, course content must be modified in some cases to further challenge these more experienced students. At the same time, however, the instructors have an obligation not to alter course material to an extent that it is far different from that of the same course being taught on-campus. Secondly, a thorough review of fundamentals is not only useful to the student, but rather required. Many are solely interested in and have little difficulty with application of concepts as a result of their simultaneous professional careers. In many cases, however, they have not had to recall fundamentals for some time. An example of such a review is a thorough discussion of fluid properties or conservation laws in a class designed to cover groundwater remediation techniques.

IV. Student-Teacher Interaction

Instructors involved with the Springfield graduate program are located approximately 200 miles from their remote students. Once a week, they commute to the off-campus classroom to teach a class and return to the main campus. To minimize the effects of this distance on students, there has been specific attention paid to the maintenance of interaction between the student and teacher when outside of the classroom.

Similar to their assigned on-campus courses, instructors typically provide a short period for 'office hours' either immediately before or following the off-campus sessions. In addition, the authors feel that use electronic mail has significantly contributed to their ability to respond promptly to questions and engage in discussions with students outside of the classroom. Finally, all of the instructors participating in the program have utilized course websites for activities ranging from the distribution of assignments and class notes, to posting announcements and homework solutions. As a result of these measures, the effects of being in a remote location are minimized, and students are more likely to feel a sense of belonging from the classroom standpoint.

V. Student Assessment

Feedback provided by participating students is particularly important at this early stage of the Springfield Program since it provides a basis upon which to improve off-campus courses. In addition, it allows for a comparison of instructional effectiveness between courses taught both on- and off-campus. While student assessments have generally been favorable, the evaluation results of off-campus students have been consistently lower than those of on-campus students enrolled in the same courses. Table 2 lists relative evaluation scores for two courses in response to an end of semester questionnaire concerning instructor performance. When faced with a similar trend in off-campus course evaluations, Lewis¹ speculated that the professional interests and experiences of remote students leads to the course being an insufficient challenge. As previously noted, the authors agree in that remote students have had higher expectations of both the level of course content and delivery of instruction. Since the same course is intended to be offered in both on- and off-campus settings, the key then is to balance the level of difficulty and challenge imposed on the student so that expectations of both remote and on-campus students are satisfied.

TABLE 2. Comparison of Student Course Evaluations

<i>Evaluation Question</i>	<i>[Off-Campus Score/On-Campus Score]%</i>	
	<i>CE 419</i>	<i>CE 471</i>
Prepared for class	81.0	104.6
Made clear assignments	90.0	97.6
Set clear standards for grading	97.5	104.8
Graded fairly	92.9	90.9
Knew if students understood him or her	83.4	95.2
Spoke understandably	90.0	89.1
Answered impromptu questions	83.3	91.3
Showed interest in the course	100.0	97.8
Gave examples for complex ideas	88.2	85.7
Accepted criticism and suggestions	86.8	95.2
Increased appreciation for the subject	100.0	95.7
Organized and presented the subject well	70.7	97.8
Specified course objectives	94.7	93.2
Achieved specific course objectives	92.1	88.6
Explained the subject clearly	79.0	84.8
Showed interest in students	73.2	93.2
Was enthusiastic about the subject	90.5	91.3
Available outside of class	78.1	90.5
Encouraged student participation	102.9	88.6
In general, taught the class effectively	89.7	93.2
AVERAGE	88.2	93.5

VI. Summary and Conclusions

This paper has provided an overview of an off-campus graduate program offered through Southern Illinois University Carbondale. Beginning in the fall of 1998, courses that focus on different aspects of environmental engineering have been offered in Springfield, Illinois, located 200 miles from the university's main campus. The program directly benefits many full-time employees of state agencies and local consulting firms by expanding their current knowledge base and increasing their opportunities for promotion. As participating instructors in the program, the authors have identified the following key points in comparing teaching styles and effectiveness in this off-campus program to that of a more traditional on-campus environment.

- The remote students are subjected to additional full-time job related constraints that increase time required to complete a graduate degree and reduces opportunities for graduate research;
- Participating off-campus students tend to be more motivated and take courses more seriously than their on-campus counterparts;
- While the majority of remote students are computer literate, many have difficulty with advanced computer usage, including programming and computational modeling skills;
- The design of lectures that interest and engage the student is even more critical in the off-campus program;
- Students have higher levels of expectation with regard to the delivery of instruction;
- Although a review of fundamentals is important, the general level of course content may need to be raised in order to challenge the student;
- Student-teacher interaction is reduced in an off-campus program, but can be maximized through effective use of the Internet and electronic mail;
- Instructors must plan to allocate additional time and effort for planning and preparing courses, as well as for commuting to the classroom location.

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