Assessment of Practitioner Interaction in the Classroom

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Abstract

The Accreditation Board for Engineering and Technology (ABET) has adopted a revised set of criteria for accrediting engineering programs. Nevertheless, as in the past, civil (construction) engineering departments will be required to demonstrate proficiency in specific subject areas which are included in the ABET program criteria.

This paper investigates, according to civil engineering and construction related students, the level at which their understanding of various subject areas required by ABET has been enhanced by attendance at and/or participation in class field trips in addition to lectures and seminars presented by practicing professional engineers. In particular, the findings suggest that both undergraduate and graduate students believe that three areas have been greatly enhanced with this activity. They include environmental engineering, project management/scheduling and estimating, and team work. In addition, undergraduates perceive that their understanding of health and safety issues, and ethical considerations has also been increased at a high percentage. In contrast, graduate students believe that their knowledge of hydraulics/hydrology/water resources and geotechnical engineering has been enhanced, but at a lower rate, by interaction with practitioners.

I. Introduction

The American Society of Civil Engineers (ASCE) believes that the practice of civil engineering is broad and diverse, including numerous disciplines. As a result, the breadth of the professional component of civil engineering education is necessarily broad. This precept is recognized by the ASCE Committee on Curriculum and Accreditation and has been adhered to in the development of the criteria for accreditation[8, 9,10]. In this regard, numerous students and practitioners believe that being aware of or involved with engineering work complements the theoretical and design concepts developed in class. To further investigate this perception, data was obtained from a survey instrument which was distributed to graduate and undergraduate students enrolled in courses taught by the Department of Civil Engineering at Lamar University. Respondents were requested to indicate whether (and at what specific level) various design activities and academic subjects have been enhanced by attendance at and/or participation in class field trips in addition to lectures and seminars presented by practicing professional engineers. The subjects chosen are those that have been included in the criteria that has been adopted by the Accreditation Board for Engineering and Technology (ABET) and must be satisfied for a program to be accredited[3].

II. Engineering Education and Practice

An educational learning community may be defined as an organization consisting of students, faculty, and industry[5]. This group, hopefully with common interests, should work as partners to improve the engineering educational experience. In fact, it has been mentioned that by looking forwards and "proactively redefining the future" engineers can help restore the profession to a leadership role in society[4]. Some professionals believe that the tendency to focus on the technical and not emphasize the cultural aspect of an engineering curriculum does not produce well-rounded graduates[1]. They also perceive that, today, engineers are needed who are proactively aware of the cultural values of their profession in order to relate to society with significant impact. Taking this concept into consideration, engineering may be considered to be basically concerned with enhancing the quality of life[7].

Engineers, in particular, have at times exhibited difficulty working with people[2]. This deficiency may reduce the optimal level at which an employee may contribute to an organization. However, some authorities believe that working with people is a learned skill[11]. In fact, ongoing dialogue among professionals is needed for the country to realize the potential that engineering has made and can make to enhance living standards[6]. In any case, gaining this knowledge can assist students to use their engineering degrees to their highest potential.

III. Undergraduate Students

As a segment of a continuing review of factors related to the curriculum, a survey instrument shown in Figure 1 was distributed to students enrolled in required senior and typical graduate courses offered by the Civil Engineering Department of Lamar University. In particular, questionnaires with usable data were returned by 41 students enrolled in undergraduate and 74 students enrolled in graduate courses. The overall response rate was 81%. The tabulated results of the study form the database for the investigation. Specifically, the survey form listed various ABET civil engineering program requirements and requested respondents to indicate at which level – high, average, low, or unsure/none – each is enhanced by attendance at and/or participation in class field trips in addition to lectures and seminars presented by practicing professional engineers. The subject areas chosen are among those listed in the recently adopted set of criteria for accrediting engineering programs, *Engineering Criteria 2000*[1].

Specifically, the findings suggest that undergraduate students have increased their understanding of many of the subject areas at a high level. For example, Table 1 illustrates that students who have attended programs involving engineering practitioners believe that six areas are enhanced at or above 60% in the high level category. As shown, they include:

- Structural Engineering
- Environmental Engineering
- Project Management/Scheduling and Estimating
- Team Work

- Ethical Considerations
- Health and Safety Issues

FIGURE 1. ENGINEERING EDUCATION AND PRACTITIONER INTERACTION

The American Society of Civil Engineers (ASCE) believes that the practice of civil engineering is broad and diverse, including numerous disciplines. As a result, the breadth of the professional component of civil engineering education is necessarily broad. This precept is recognized by the ASCE Committee on Curriculum and Accreditation and has been adhered to in the development of the criteria for accreditation. Furthermore, numerous students and professionals believe that practical engineering experience complements the theoretical concepts developed in class. Taking this concept into consideration, kindly indicate on the list below whether (and at what specific level) various design activities and academic subjects have been enhanced by attendance at, and/or participation in, class field trips in addition to lectures, seminars, and various presentations given by practicing professional engineers during your course of study. Please feel free to list a particular class if you wish to do so.

Academic Areas or Design Considerations	Enhanced Understanding of Theoretical and Design Class Work				Comments
	High (H)	Avg (A)	Low (L)	Unsure/None (U)	
Academic Subjects					
Materials Engineering	___	___	___	___	_____
Structural Engineering	___	___	___	___	_____
Geotechnical Engineering	___	___	___	___	_____
Environmental Engineering	___	___	___	___	_____
Hydraulics/Hydrology/Water Resources	___	___	___	___	_____
Project Management/Scheduling and Estimating	___	___	___	___	_____
Design Considerations					
Team Work	___	___	___	___	_____
Engineering Codes and Standards	___	___	___	___	_____
Sustainability	___	___	___	___	_____
Aesthetics	___	___	___	___	_____
Economic factors	___	___	___	___	_____
Manufacturability (Constructability)	___	___	___	___	_____
Ethical Considerations	___	___	___	___	_____
Health and Safety Issues	___	___	___	___	_____
Social Ramifications	___	___	___	___	_____
Political Factors	___	___	___	___	_____
Legal Issues	___	___	___	___	_____
Other (?) _____	___	___	___	___	_____
Other (?) _____	___	___	___	___	_____

TABLE 1. PERCEPTIONS OF UNDERGRADUATE STUDENTS CONCERNING PRACTITIONER INTERACTION

Academic Areas or Design Considerations	Enhanced Understanding of Theoretical and Design Class Work, As a Percentage of Respondents: High	Avg	Low	Unsure/None	*Composite Score
Academic Subjects					
Materials Engineering	51.4	31.4	5.7	11.4	3.2
Structural Engineering	59.5	79.7	8.1	2.7	3.5
Geotechnical Engineering	41.6	36.1	8.3	13.9	3.1
Environmental Engineering	68.3	17.1	7.3	7.3	3.5
Hydraulics/Hydrology/Water Resources	50.0	30.0	12.5	7.5	3.2
Project Management/Scheduling and Estimating	62.2	24.3	8.1	5.4	3.4
Design Considerations					
Team Work	67.5	25.0	7.5	0.0	3.6
Engineering Codes and Standards	52.6	34.2	7.9	5.3	3.3
Sustainability	36.1	44.4	11.1	8.3	3.1
Aesthetics	40.5	40.5	13.5	5.4	3.2
Economic factors	54.1	32.4	10.8	2.7	3.4
Manufacturability (Constructability)	56.8	27.0	16.2	0.0	3.4
Ethical Considerations	64.9	21.6	8.1	5.4	3.5
Health and Safety Issues	64.1	28.2	5.1	2.6	3.5
Social Ramifications	43.2	43.2	5.4	8.1	3.2
Political Factors	30.6	44.4	13.9	11.1	2.9
Legal Issues	44.4	27.8	13.9	13.9	3.0

*Composite Score based upon 4.0 = High; 3.0 = Average; 2.0 = Low; 1.0 = Unsure/None

In addition, the following three subjects are perceived to be assisted at a slightly lower rate in the high level category:

- Engineering Codes and Standards
- Economic Factors
- Constructability

The nine areas listed above are perceived by undergraduate students to be enhanced at a relatively high level. They include the traditional subjects of environmental and structural engineering as well as ethical considerations and constructability. These areas are strongly needed in project work. Teamwork, project management/scheduling and estimating, and health and safety issues are also considered very important. Students appear to recognize that consideration of these academic subjects and practical issues may be required for a civil engineering or construction project to be a successful operation.

Sustainability and political factors were given low ratings. These areas were probably not considered vital for the completion of the projects on which the practitioners interacting with students were working. It is perhaps significant that teamwork and project management/scheduling and estimating received relatively high scores. This reinforces *Engineering Criteria 2000,* which stresses the concepts of teamwork and professional considerations as attributes that should be developed in engineering students.

IV. Graduate Students

The perceptions of graduate students who have attended and/or participated in class field trips in addition to lectures and seminars presented by practicing professional engineers are shown in Table 2. Here, respondents indicate that their understanding of seven areas have been enhanced above 50% in the high level category by interaction with practitioners. They include:

- Geotechnical Engineering
- Environmental Engineering
- Hydraulic/Hydrology/Water Resources
- Project Management/Scheduling and Estimating
- Team Work
- Ethical Considerations
- Health and Safety Issues

Graduate students perceive that the aforementioned seven subject areas are enhanced at a relatively high level. Five of these, (environmental engineering, project management/scheduling and estimating, team work, ethical considerations, and health and safety issues), are also rated at a high level by undergraduate students. As shown, graduate students also rate hydraulics/hydrology/water resources, and geotechnical engineering with a relatively high score. Apparently their experience indicates that these subjects are highly utilized by practicing professionals in the design and construction of civil engineering projects. It may be noteworthy that both undergraduate and graduate students rate project management/scheduling and estimating, and teamwork with high scores. These are important professional areas, which should be included in the engineering curriculum.

TABLE 2. PERCEPTIONS OF GRADUATE STUDENTS CONCERNING PRACTITIONER INTERACTION

Academic Areas or Design Considerations	Enhanced Understanding of Theoretical and Design Class Work, As a Percentage of Respondents: High	Avg	Low	Unsure/None	*Composite Score
Academic Subjects					
Materials Engineering	48.5	30.3	3.0	18.2	3.1
Structural Engineering	44.4	47.2	5.6	2.8	3.3
Geotechnical Engineering	52.8	30.6	5.6	11.1	3.2
Environmental Engineering	61.4	20.5	6.8	11.4	3.3
Hydraulics/Hydrology/Water Resources	52.4	38.1	7.1	2.4	3.4
Project Management/Scheduling and Estimating	73.3	21.7	3.3	1.7	3.7
Design Considerations					
Team Work	61.8	33.8	2.9	1.5	3.6
Engineering Codes and Standards	45.2	43.5	4.8	6.5	3.3
Sustainability	40.0	46.7	5.0	8.3	3.2
Aesthetics	37.3	50.8	3.4	8.5	3.2
Economic factors	47.5	45.8	1.7	5.1	3.4
Manufacturability (Constructability)	41.1	44.6	5.4	8.9	3.2
Ethical Considerations	54.4	36.8	5.3	3.5	3.4
Health and Safety Issues	55.4	36.9	1.5	6.2	3.4
Social Ramifications	41.8	40.0	7.3	10.9	3.1
Political Factors	28.8	46.2	13.5	11.5	2.9
Legal Issues	49.1	31.6	7.0	12.3	3.2

*Composite Score based upon 4.0 = High; 3.0 = Average; 2.0 = Low; 1.0 = Low/Unsure

V. Summary and Conclusions

This paper reviews a number of recent recommendations involving engineering education. In addition, it presents the results of an investigation of the perceptions of a group of engineering students concerning the level at which various ABET accreditation requirements have been enhanced by attendance at and/or participation in class field trips in addition to lectures and seminars presented by practicing professional engineers. Data for the study was obtained from a survey instrument, which was completed by students enrolled in various civil engineering degree programs at Lamar University. The findings of the investigation could be utilized, for comparative purposes, by other institutions and departments that may wish to study their curriculum and how it relates to the interaction with engineering practitioners.

In particular, the data suggest that both undergraduate and graduate students believe that their understanding of three areas has been greatly enhanced. They include: environmental engineering, project management/scheduling and estimating, and team work. In addition, undergraduates and graduates also perceive that their understanding of health and safety issues, and ethical consideration has increased, but at a lower percentage for graduate students. In contrast, graduate students believe that their knowledge of hydraulics/hydrology/water resources and geotechnical engineering has been enhanced. The data also shows that the understanding of the following has been enhanced for both undergraduate and graduate students at a below average level: political factors. This is unfortunate since practical input to this area is vital for civil engineering students.

The subject areas in this investigation are required by ABET as criteria that must be satisfied for a program to be accredited. Specifically, they are included in Engineering *Criteria 2000* which was adopted by ABET and will be required by all programs for accreditation purposes beginning in the year 2001 – 2002. It appears, therefore, that the knowledge and experience gained by students interacting with practicing professionals complements the criteria required for accreditation. In addition, the activities should enhance the skills required by engineering students for a successful career involving the design and management of engineering and construction projects.

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