ABET EDUCATIONAL ATTRIBUTES: ASSESSING THE NEEDS OF INDUSTRY

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Abstract *— The Accreditation Board for Engineering and Technology (ABET) specifies that engineering programs must demonstrate that their graduates possess 11 educational attributes. This investigation suggests that practitioners consider two of the 11 attributes to be particularly important. In addition, graduating seniors in Civil Engineering believe their coursework has given them a strong background in the identical two areas. These include: (1) an ability to apply knowledge of mathematics, science, and engineering; and (2) an ability to identify, formulate, and solve engineering problems. In contrast, two attributes received lower ratings from both groups. They include: (1) the broad education necessary to understand the impact of engineering solutions in a global/societal context; and (2) a knowledge of contemporary issues. For comparative purposes, the findings of the investigation could be utilized by other institutions and departments that may wish to study their curriculum and satisfy ABET criteria.*

Index Terms — Accreditation, Criteria, Engineering, Industry, Practitioners, Students.

INTRODUCTION

Over the years there have been recommendations from employers and various technical/professional societies to revise the engineering curriculum to ensure that students are prepared for the increasing complexity and international aspects of engineering work [1], [4], [9]. Engineering educators have also been involved with these efforts [5], [6], [7]. Nevertheless, there appears to be a general belief that the engineering profession must change so that in the future it will be highly recognized and respected at national and international levels [2], [3], [8].

This paper presents the results of the perceptions of two groups: engineering undergraduates and practitioners. The data for the study was obtained, part, from a survey instrument that was distributed to graduating seniors at Lamar University. In addition, a similar questionnaire was completed by practicing engineers who attended an alumni meeting sponsored by the civil engineering department. Practitioners were requested to indicate the optimal level at which the various attributes should be incorporated into the curriculum. Graduating seniors were asked to indicate the level at which their civil engineering coursework was related to the 11 attributes.

ENGINEERING CRITERIA

ABET is the agency responsible for accreditation of engineering degree programs in the United States. In order to update the accreditation process, the ABET Board of Directors has adopted a new set of criteria which is required of all programs and has the following objectives:

- To assure that graduates of accredited programs are prepared to enter the practice of engineering
- To stimulate and improve engineering education
- To encourage innovative approaches to education

To enhance these objectives, the criteria requires that engineering programs must demonstrate that their graduates possess the following:

(a) An ability to apply knowledge of mathematics, science, and engineering
(b) An ability to design and conduct experiments, as well as to analyze and interpret data
(c) An ability to design a system, component, or process to meet desired needs
(d) An ability to function on multidisciplinary teams
(e) An ability to identify, formulate, and solve engineering problems
(f) An understanding of professional and ethical responsibility
(g) An ability to communicate effectively
(h) The broad education necessary to understand the impact of engineering solutions in a global/societal context
(i) A recognition of the need for, and an ability to, engage in lifelong learning
(j) A knowledge of contemporary issues
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

In addition to these, a system of ongoing evaluation must be in place to measure how well the aforementioned objectives are being achieved.

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COMPARISON OF PERCEPTIONS BETWEEN GRADUATING SENIORS AND PRACTITIONERS

As a segment of the continuing review and evaluation of the curriculum, a survey instrument was distributed to alumni practitioners and graduating seniors of the Civil Engineering Department of Lamar University. The tabulated results of which form the database for the investigation. The questionnaire listed 11 educational attributes and requested that respondents indicate at which level—strongly agree/high, agree/average, disagree/low, or neither agree or disagree/unsure—each attribute should be incorporated into the curriculum. The educational attributes chosen were those that engineering programs must require of their students before they are allowed to graduate. They were included in the program outcomes and assessment section of The Criteria and are listed in the previous section (a-k).

Tables I-IV compare the perceptions of graduating seniors and those of practitioners. As shown in Tables I and II two attributes are in the high category for both groups (3.9). This indicates strong belief that these items must be incorporated into the curriculum, including:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to identify, formulate and solve engineering problems

A comparison of low scores was also accomplished. As shown in Table III, undergraduates and practitioners rate two attributes at 3.1 and below, including:

- The broad education necessary to understand the impact of engineering solutions in a global/societal context
- A knowledge of contemporary issues

Reviewing the data, it appears that the two groups strongly endorse, as previously mentioned, the technical aspect of engineering such as the ability to apply knowledge of mathematics, science, and engineering and the ability to identify, formulate and solve problems. This may be considered to be the traditional role of civil engineers. A knowledge of contemporary issues and the broad education necessary to understand the impact of engineering solutions in a global/societal context are not perceived, overall, as critical by students and practitioners. These beliefs may change in the future, however, as the profession becomes more international in nature.

PRACTITIONER RECOMMENDATIONS

Table IV compares the composite scores for graduating students with those of practicing engineers. However, it is restricted to attributes with differences equal to or greater than .5. As illustrated, practitioners do not believe that an ability to design a system, component, or process to meet desired needs; an ability to function on multidisciplinary teams; and the recognition of the need for an ability to engage in lifelong learning are as important compared with the perceptions of undergraduate students. This may reflect the actual job experience of practitioners who responded to the questionnaire.

A number of practitioners have written comments involving specific attributes, including [6]:

- "Lifelong learning in the form of documented continuing education classes or experiences will most likely be required by the various state registration boards in the next 10-15 years."
- "The ability to design a system, component, or process to meet desired needs should be developed in a work environment, and not in a classroom."
- "An understanding of professional and ethical responsibility is difficult to accomplish in an academic setting."
- "Knowledge and use of modern methods does not necessarily guarantee a quality product."

It is noteworthy that some practitioners believe that industry is in a better position than an educational institution to teach certain concepts in engineering.

TABLE I
COMPARISON OF ABET ATTRIBUTES WITH COMPOSITE SCORES = 3.9

LEVEL OF EDUCATIONAL ATTRIBUTES, AS A PERCENTAGE OF RESPONDENTS		
Educational Attribute (1)	Graduating Seniors (2)	Practitioners (3)
An ability to apply knowledge of mathematics, science, and engineering	3.9	3.9
An ability to identify, formulate and solve engineering problems	3.9	3.9

Composite score based upon 4.0=strongly agree/high; 3.0=agree/average; 2.0=neither agree nor disagree/unsure; 1=disagree/low

TABLE II
COMPARISON OF ABET ATTRIBUTES WITH RELATIVELY HIGH COMPOSITE SCORES

LEVEL OF EDUCATIONAL ATTRIBUTES, AS A PERCENTAGE OF RESPONDENTS		
Educational Attribute (1)	Graduating Seniors (2)	Practitioners (3)
An ability to design and conduct experiments, as well as to analyze and interpret data	3.7	3.5
An understanding of professional and ethical responsibility	3.6	3.6
An ability to communicate effectively	3.7	3.7
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	3.9	3.7

Composite score based upon 4.0=strongly agree/high; 3.0=agree/average; 2.0=neither agree nor disagree/unsure; 1=disagree/low

TABLE III
COMPARISON OF ABET ATTRIBUTES WITH COMPOSITE SCORES ≤ 3.1

LEVEL OF EDUCATIONAL ATTRIBUTES, AS A PERCENTAGE OF RESPONDENTS		
Educational Attribute (1)	Graduating Seniors (2)	Practitioners (3)
The broad education necessary to understand the impact of engineering solutions in a global/societal context	3.1	3.0
A knowledge of contemporary issues	3.1	3.0

Composite score based upon 4.0=strongly agree/high; 3.0=agree/average; 2.0=neither agree nor disagree/unsure; 1=disagree/low

TABLE IV
COMPARISON OF ABET ATTRIBUTES WITH DIFFERENCES IN COMPOSITE SCORES

LEVEL OF EDUCATIONAL ATTRIBUTES, AS A PERCENTAGE OF RESPONDENTS		
Educational Attribute (1)	Graduating Seniors (2)	Practitioners (3)
An ability to design a system, component, or process to meet desired needs	3.6	3.0
An ability to function on multidisciplinary teams	3.6	3.1
A recognition of the need for and an ability to engage in lifelong learning	3.9	3.4

Composite score based upon 4.0=strongly agree/high; 3.0=agree/average; 2.0=neither agree nor disagree/unsure; 1=disagree/low

SUMMARY AND CONCLUSIONS

Engineering program assessment for an academic institution is periodically conducted by an ABET team during a scheduled accreditation visit. Specifically, the criteria utilized is designed to assure that graduates of accredited programs are prepared to enter the practice of engineering. In particular, it is recommended that engineering programs must demonstrate that their graduates have satisfied 11 educational attributes.

As part of a continuing review and evaluation of its curriculum, the Civil Engineering Department at Lamar University distributed a survey instrument to two groups: graduating seniors and practitioners. The questionnaire listed the 11 educational attributes contained in the criteria and requested respondents to indicate the level at which they are or should be included in the engineering curriculum. The findings indicate that the respondents believe that two of the 11 attributes should be incorporated into the curriculum at a high level. They include: an ability to apply knowledge of mathematics, science, and engineering; and ability to identify, formulate, and solve engineering problems. These results suggest strong support for the traditional technical aspect of engineering. In contrast, two attributes received lower ratings. They include: the broad education necessary to understand the impact of engineering solutions in a global and societal context; and a knowledge of contemporary issues. This suggests that not all ABET educational attributes are considered by graduating seniors and practitioners to have the same level of significance, and should, perhaps, not be stressed to the same degree in engineering curriculum.

Overall, the findings indicate that practicing engineers rate the ABET educational attributes in the high/average level. However, comments suggest that practitioners do not believe that the attributes, in general, reflect all the skills and knowledge required for most engineering positions. Nevertheless, the data indicate that the graduating seniors believe their coursework has given them a strong background in the 11 educational attributes required by ABET.

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