Assessment of Engineering Attributes for ABET Accreditation

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Abstract

The Accreditation Board for Engineering and Technology (ABET) has revised the accreditation criteria that is designed to assure that graduates of accredited programs are prepared to enter the practice of engineering. The general criteria also 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 (Construction) 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. This suggests that not all ABET educational attributes are considered by Civil (Construction) students and practitioners to have the same level of significance and perhaps should not be stressed to the same degree in an engineering program. 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.

I. 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. Engineering educators have also been involved with these efforts. 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.

This paper presents the results of an investigation 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.
were asked to indicate the level at which their civil engineering coursework was related to the 11 attributes.

II. Engineering Criteria 2000

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, Engineering Criteria 2000. The accreditation process recommended in Engineering Criteria 2000, continues, as in the past, to be voluntary. However, it also now 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, Engineering Criteria 2000 requires that engineering programs must demonstrate that their graduates possess the following:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global/societal context
- A recognition of the need for, and an ability to, engage in lifelong learning
- A knowledge of contemporary issues
- 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.

III. Perception of Practitioners and Graduating Seniors of Educational Attributes

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 *Engineering Criteria 2000* and are listed in the previous section.

In particular, Table 1 lists the recommendations of practitioners who have graduated from civil engineering programs. As shown, the composite scores indicate that two attributes should be covered at the highest level (3.9), including:

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

These results indicate that practitioners generally support the traditional technical aspects of engineering. In addition, the two areas, tabulated in the following, are also rated with a high score (3.7):

- An ability to communicate effectively
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

The aforementioned attributes, according to practitioners, should be presented at a high level. Nevertheless, as shown in Table 1, three attributes—an ability to design a system, component, or process to meet desired needs; the broad education necessary to understand the impact of engineering solutions in a global/societal context; and a knowledge of contemporary issues—are rated in the average range (3.0). This suggests that practicing civil engineers do not believe that all *Engineering Criteria 2000* attributes should be in the high level category.

The findings also indicate that, according to graduating seniors the majority of educational attributes are presently incorporated into the curriculum at a high level. For example, Table 1 shows the undergraduate students believe that four areas are treated at the highest level (3.9):

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to identify, formulate, and solve engineering problems
- A recognition of the need for and an ability to engage in life-long learning
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

These attributes generally support the traditional technical aspects of engineering. In fact, the first two attributes are identical to those recommended by practicing engineers. In addition to the aforementioned, the two areas listed in the following received strong support at the high category level (3.7):

- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to communicate effectively
Here, the ability to communicate effectively received the identical composite score by practicing engineers (3.7). Graduating seniors recommend that the six areas listed be covered at high level. Nevertheless, as shown in Table 1, two attributes—the broad education necessary to understand the impact of engineering solutions in a global and societal context; and a knowledge of contemporary issues—are rated with a composite score of 3.1. Practitioners gave these attributes a similar score of 3.0.

According to graduating seniors, all educational attributes should not be covered at a high level. However, undergraduates may not have developed the background necessary to recognize the importance of a broad education. In addition, a knowledge of contemporary issues may be considered by undergraduate students to be a personal responsibility. This may explain why this attribute was rated at a lower level.

<table>
<thead>
<tr>
<th>Educational Attribute</th>
<th>Graduating Seniors</th>
<th>Practitioners</th>
</tr>
</thead>
<tbody>
<tr>
<td>An ability to apply knowledge of mathematics, science, and engineering</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>An ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>An ability to design a system, component, or process to meet desired needs</td>
<td>3.6</td>
<td>3.0</td>
</tr>
<tr>
<td>An ability to function on multidisciplinary teams</td>
<td>3.6</td>
<td>3.1</td>
</tr>
<tr>
<td>An ability to identify, formulate and solve engineering problems</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>An understanding of professional and ethical responsibility</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>An ability to communicate effectively</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>The broad education necessary to understand the impact of engineering solutions in a global/societal context</td>
<td>3.1</td>
<td>3.0</td>
</tr>
<tr>
<td>A recognition of the need for and an ability to engage in lifelong learning</td>
<td>3.9</td>
<td>3.4</td>
</tr>
<tr>
<td>A knowledge of contemporary issues</td>
<td>3.1</td>
<td>3.0</td>
</tr>
<tr>
<td>An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>3.9</td>
<td>3.7</td>
</tr>
</tbody>
</table>

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

Engineering program assessment for an academic institution is periodically conducted by an ABET team during a scheduled accreditation visit. *Engineering Criteria 2000* is designed to assure that graduates of accredited programs are prepared to enter the practice of engineering. Specifically, 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 *ABET Engineering Criteria 2000* report and asked 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 an 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 an engineering curriculum.

Overall, the findings indicate that practicing engineers generally tend to rate the ABET educational attributes at a slightly lower level compared with undergraduate students. This may reflect a natural human resistance to change. However, the data and comments also suggest that practitioners do not believe that the attributes, in general, reflect all the skills and knowledge required for most engineering positions. Nevertheless, the information indicates 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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Bibliography


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