

Undergraduate Engineering Skill Preparedness

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Abstract

This paper presents the findings of a survey done at Stevens Institute of Technology where the expectations of the employers were compared to the preparedness of its graduating engineering undergraduate students. Deficiencies in ethics, listening, written and oral communications and responsibility and management were found. Employers expectations in technical proficiency were exceeded. These results are similar to studies done at Arizona State University and other NJ colleges. Surveys such as this should be used as a tool in understanding curriculum deficiencies, required changes and new initiatives which better satisfy the needs of the employers.

I. Introduction

A core issue for engineering undergraduate education is determining how well the institution prepares its students for the needs of its employers. Such information is essential to guide curriculum changes and new course initiatives.

There have been a number of articles and wide discussion on the requirements that engineers need. However, there have been few actual surveys published which compare¹⁻⁴ the needs of the employers against those of graduating undergraduates. The two most recent surveys have been done at Arizona State University (ASU)¹ and in New Jersey³. The ASU study compared the importance of ten generic attributes in new engineering graduates by surveying 14 companies. The NJ study, sponsored in part by the State Higher Education Executive Officers (SHEEO), evaluated 14 attributes, but more broadly addressed bachelors degrees from all disciplines in NJ colleges by surveying 404 NJ companies.

This paper reports on a survey, which is similar to the SHEEO study, but addresses the needs of employers who have hired engineers graduating from Stevens Institute of Technology.



II. Methodology

The set of 13 desirable attributes which were surveyed are given in Table 1. Each of the companies surveyed were asked to evaluate the importance of the skill to their company on a 4 point scale. (Choosing a 4 if the skill is extremely important and a 1 if it is not important.) The companies were then asked to repeat the evaluation but evaluate how well the graduates were prepared by choosing a 4 if the students were highly prepared and 1 if they were unprepared.

1. **Reading** (Locating, understanding and interpreting written information.)
2. **Written Communication** (Communicating ideas and information through documents.)
3. **Oral Communication** (Communicating ideas and information through verbal presentations.)
4. **Technical Proficiency** (Ability to understand and utilize learned technical skills.)
5. **Listening** (Attending to and interpreting verbal messages from others.)
6. **Creative Thinking** (Generating new ideas.)
7. **Decision Making** (Prioritizing goals, selecting alternatives and considering risks.)
8. **Problem Solving** (Recognizing problems and devising and implementing plans to solve them.)
9. **Knowing How-to-Learn** (Acquire and applies new knowledge and skills.)
10. **Responsibility and Self-Management** (Exerts high levels of effort, strives to achieve goals, monitors progress and exhibits self control.)
11. **Sociability** (Works and interacts well with others.)
12. **Integrity and Honesty** (Chooses ethical courses of action.)
13. **Diversity** (Able to function in a multi-cultural and diverse work environment.)

Table 1. The 13 desirable attributes utilized in this study.

The survey was mailed in two parts to maintain confidentiality of the employer. The first part contained the employer's name and contact and was mailed back separately from the second part, which was the survey itself

III. Results

The survey was mailed to the Institute's top 20 employers receiving a return from 8 (40%). Over the last 3 years these 8 employers hired a mean of 460, 364 and 525 graduating undergraduates engineers from colleges throughout the United States in the years 1993, 1994 and 1995, respectively. The majority (7 of the 8 companies) were large companies with greater than 250 employees.

Survey results are shown in figures 1 through 4 with comparisons to the SHEEO and ASU studies. Figures 1 and 2 show the results that are important to the employer. Over 50% of the employers surveyed rated integrity and honesty, knowing how to learn, listening, written communication, responsibility and self management and problem solving as "extremely important." Figure 2 presents similar results but where the survey ratings are plotted as a function of the mean.

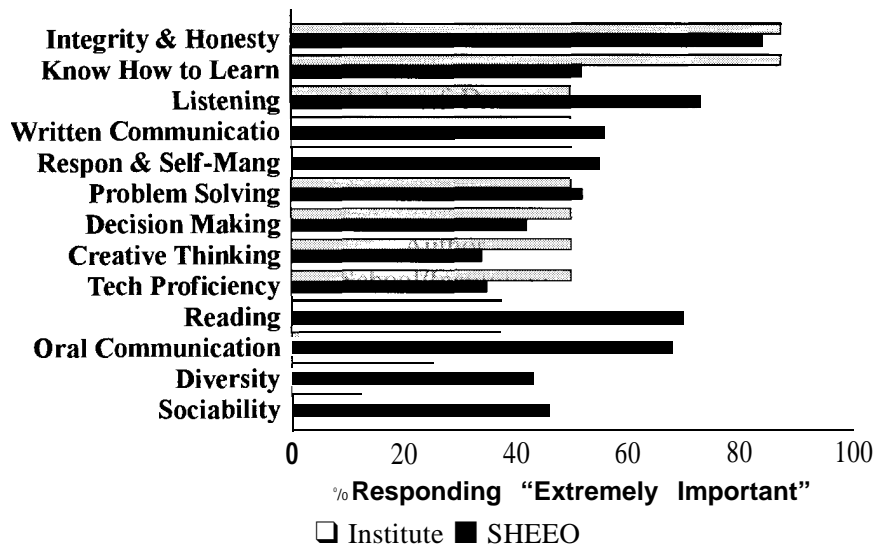


Figure 1. Attributes rated as important by the employers.

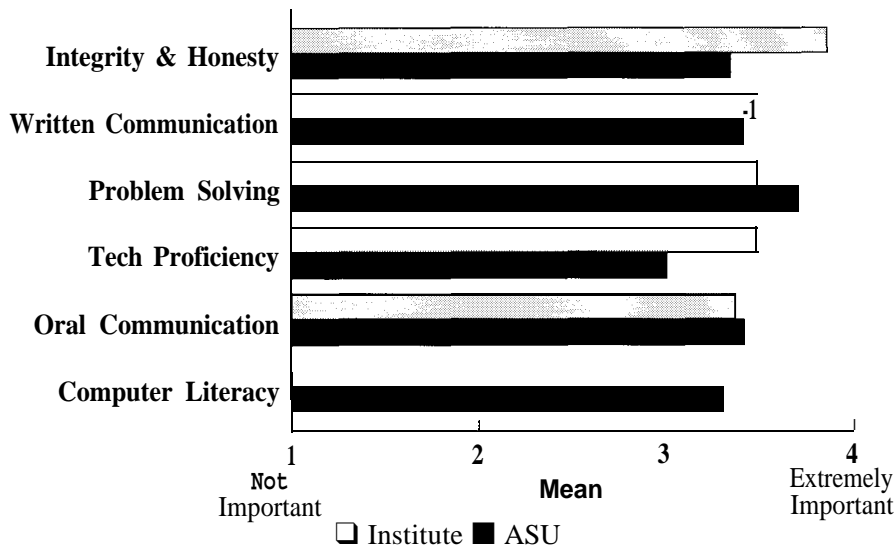


Figure 2. Mean value of employers rating. Only attributes which are in both the Institute and ASU studies are shown.

Preparedness level as compared to the attributes needed by the employers are shown in figures 3 and 4. The gap analysis compares the skill level needed by the employer with their assessment of how prepared the students are. Approximately 50% of the employers indicated that the graduating students at the Institute and in the NJ schools were not highly prepared in integrity and honesty, listening, written and oral communication, responsibility and self management and decision making. Technical proficiency was the only area that the Institute students had superior skills. A similar Comparison is done on a mean basis in figure 4. The Institute technical proficiency is shown to exceed the expectation of the employers. Computer literacy of the ASU students, which was not included in the Institute survey, was superior to the expectations of the employers.

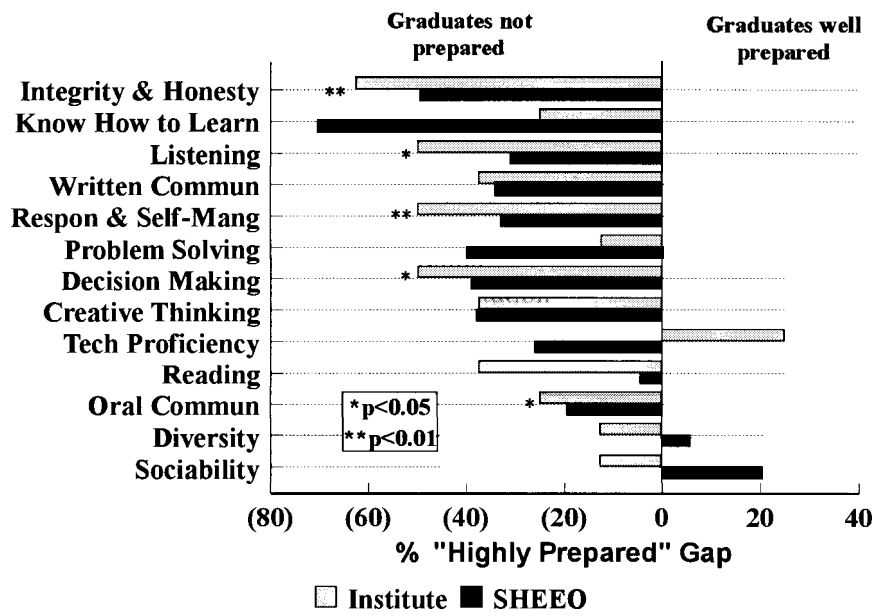


Figure 3. Attribute gap analysis between the students preparedness and the employers need. (Statistical significance is shown between the Institute's preparedness and its employers needs.)

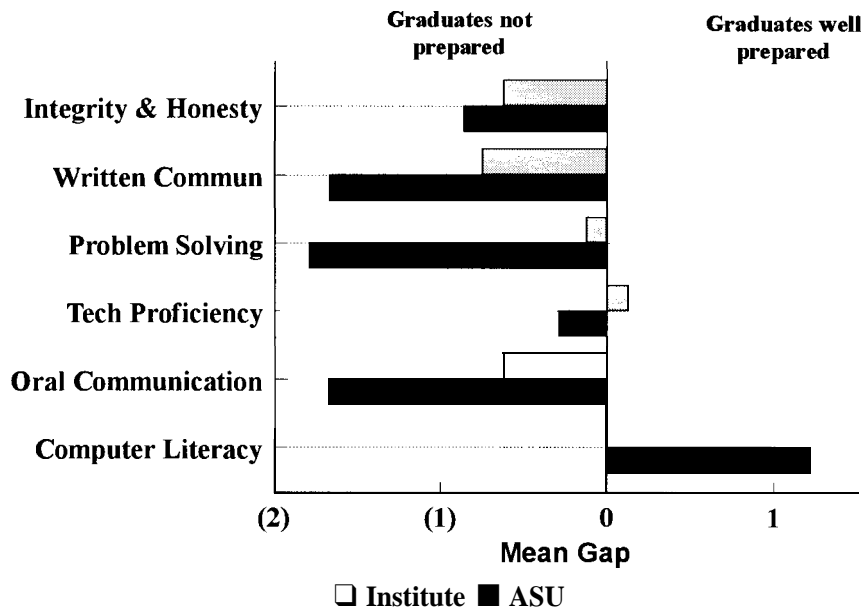


Figure 4. Mean value of gap analysis between student preparedness and the employers need. Only attributes which are in both the Institute and ASU studies are shown.

IV. Discussion

This survey, as well as the SHEEO and ASU studies, have weaknesses. The SHEEO study, while surveying a large number of companies, does not separate engineering students from other majors. The requisite skill and attribute set should, in part, be dependent on the bachelors degree major. This and the ASU study, while specific to engineering students, surveyed to small a group of companies.

Nevertheless the results, I suspect, would be similar to many engineering schools showing significant weaknesses in the “softer” skills. Learning, teaming, oral communication, ethics, and problem solving are skills required to participate in multidisciplinary, international team based 3rd generation R&D companies. However, we fall short in preparing students.

Surveys similar to this should become part of a TQM approach to curriculum change and development. We can better implement product improvements (i.e. curriculum changes) when we understand the gap between the product (i.e. graduating undergraduates) and the customer needs (i.e. needs of the employer).

V. Bibliography

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VI. Biographical Information

PETER A. KOEN recently joined Stevens Institute of Technology as a full time Associate Professor in the Management and Engineering Management Department. Dr. Keen’s background includes over 19 years of experience in companies such as Becton Dickinson and AT&T Bell Laboratories. Dr. Keen is supporting the Institute by doing this survey in order to better align curriculum initiatives with the needs of the employers.

