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How do undergraduate engineering programs contribute to student learning?

How do undergraduate engineering programs contribute to student learning? Benchworks Undergraduate Engineering Exit Assessment Research Note

Research Description and Summary

The Undergraduate Exit Assessments measure program effectiveness from the student's perspective. The results illuminate which learning outcomes and key dimensions of the program are the strongest and which areas need to be improved. The knowledge gained from these assessments drive and sustain continuous improvement program and support accreditation efforts. In 2013-14, the Skyfactor Undergraduate Engineering Assessment was completed by 11,956 respondents.

Overall, the majority of respondents reported their engineering program had enhanced key skills and abilities including interpreting data, designing a system to meet desired needs, functioning on multidisciplinary teams, and using modern engineering tools. The quality of student/faculty interaction was related to all student learning outcomes. Those students who indicate higher levels of quality of student/faculty interaction are more likely to report the program enhanced their abilities and skills. Likewise, student satisfaction with the level of camaraderie with fellow students is also highly related to student learning.

1. Undergraduate engineering programs enhance students' ability to apply knowledge and identify problems.

- Eight out of ten respondents indicated that their program enhanced their ability to solve engineering problems.
- Three-fourths of respondents reported that their program enhanced their ability to use the techniques and skills necessary for engineering practice.
- Seven out of ten respondents indicated that their program enhanced their ability to formulate engineering problems or understand contemporary issues.
- Six out of ten respondents reported that their program enhanced their ability to identify engineering problems.
- Six out of ten respondents indicated that their engineering program enhanced their ability to formulate engineering problems.
- About one-half of respondents reported that their program enhanced their ability to apply knowledge of engineering.
- Four out of ten respondents indicated that their program enhanced their ability to apply knowledge of science.

TABLE 1	N	Small Extent (1-2)	Moderate Extent (3-5)	Large Extent (6-7)
Apply Knowledge and Identify Problems - Degree that engineering education enhanced ability to:				
Solve engineering problems	10,059	0%	23%	77%
Use the techniques and skills necessary for engineering practice	10,291	1%	24%	75%
Formulate engineering problems	10,283	1%	29%	70%
Understand contemporary issues	10,244	1%	32%	68%
Indentify engineering problems	10,333	2%	38%	61%
Apply knowledge of engineering	2,948	5%	49%	46%
Apply knowledge of science	2,965	5%	53%	41%

2. Undergraduate engineering programs contribute to student learning related to system design and problem solving as well as effective management and leadership skills.

- Eight out of ten respondents indicated that their engineering program enhanced their ability to use modern engineering tools, communicate effectively, or recognize the need to engage in lifelong learning.
- More than three-fourths of respondents reported that their program enhanced their ability to function on multidisciplinary teams or understand professional responsibility.
- Seven out of ten respondents indicated that their engineering program enhanced their ability to interpret data or design a system, component, or process to meet desired needs.
- Approximately two-thirds of respondents reported that their engineering program enhanced their ability to understand ethical responsibilities.
- Only about one-third of respondents indicated that their engineering program enhanced their ability to conduct experiments or design experiments.

TABLE 2	N	Small Extent (1-2)	Moderate Extent (3-5)	Large Extent (6-7)
System Design & Problem Solving - Degree that engineering education enhanced ability to:				
Function on multidisciplinary teams	10,432	1%	23%	76%
Design a system, component, or process to meet desired needs	10,559	1%	28%	72%
Interpret data	10,581	1%	28%	71%
Conduct experiments	2,911	17%	49%	35%
Design experiments	2,945	13%	53%	34%

TABLE 2 (cont.)	N	Small Extent (1-2)	Moderate Extent (3-5)	Large Extent (6-7)
Effective Management and Leadership Skills - Degree that engineering education enhanced ability to:				
Use modern engineering tools	10,314	1%	17%	83%
Communicate effectively	10,288	1%	20%	80%
Recognize the need to engage in lifelong learning	10,322	1%	22%	78%
Understand professional responsibility	10,004	0%	23%	76%
Understand ethical responsibilities	10,349	1%	34%	65%

3. The quality of student/faculty interactions in undergraduate engineering programs is highly related to student learning.

- Respondents who rated student/faculty interactions as poor were significantly less likely than those who rated it as moderate to report that their engineering program enhanced any of the abilities listed. Additionally, respondents who rated student/faculty interactions as moderate were significantly less likely than those who rated it as excellent/exceptional to report that their engineering program enhanced any of the abilities listed.
- Nine out of ten respondents who indicated that the quality of student/faculty interactions was excellent or exceptional also indicated that their engineering program enhanced their ability to solve engineering problems, understand professional responsibility, communicate effectively, recognize the need to engage in lifelong learning, or use modern engineering tools. Less than two-thirds of respondents who rated the quality of student/faculty interactions as very poor or poor indicated their program enhanced their abilities.
- Of respondents who rated student/faculty interactions as poor, less than half indicated that their engineering program had enhanced their ability to identify engineering problems or understand ethical issues compared to more than three-fourths of those who rated student /faculty interactions as excellent/exceptional.

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- Approximately eight out of ten respondents who indicated that the quality of student/faculty interactions was excellent or exceptional also indicated that their engineering program enhanced their ability to use the techniques and skills necessary for engineering practice, formulate engineering problems, understand contemporary issues, design a system, component, or process to meet desired needs, interpret data, or understand ethical responsibilities. Only about half of respondents who rated the quality of student/faculty interactions as very poor or poor indicated their program enhanced their abilities.
- More than six of ten respondents who rated the quality of student/faculty interaction as excellent or exceptional also indicated that their engineering program enhanced their ability to apply knowledge of engineering, apply knowledge of science, or design experiments. In contrast, less than two of ten respondents who rated the quality of student/faculty interaction as poor also indicated their program had enhanced their abilities.

Quality of: Student/faculty interaction			
TABLE 3	**Very Poor/Poor**	**Fair/Good/Very Good**	**Excellent/Exceptional**
Percentages responding to "Large Extent" (6-7) **Apply Knowledge and Identify Problems -** Degree that engineering education enhanced ability to:			
Solve engineering problems*	60%	71%	90%
Use the techniques and skills necessary for engineering practice*	55%	69%	88%
Formulate engineering problems*	51%	64%	83%
Understand contemporary issues*	50%	61%	82%
Identify engineering problems*	43%	53%	76%
Apply knowledge of engineering*	18%	37%	68%
Apply knowledge of science*	16%	33%	62%

Quality of: Student/faculty interaction			
TABLE 3 (cont.)	**Very Poor/Poor**	**Fair/Good/Very Good**	**Excellent/Exceptional**
Percentages responding to "Large Extent" (6-7) **System Design and Problem Solving -** Degree that engineering education enhanced ability to:			
Function on multidisciplinary teams*	52%	71%	89%
Design a system, component, or process to meet desired needs*	53%	66%	84%
Interpret data*	53%	66%	82%
Conduct experiments*	12%	26%	56%
Design experiments*	5%	24%	60%
Effective Management and Leadership Skills - Degree that engineering education enhanced ability to:			
Use modern engineering tools*	65%	80%	91%
Recognize the need to engage in lifelong learning*	60%	73%	89%
Understand professional responsibility*	60%	71%	89%
Communicate effectively*	63%	75%	88%
Understand ethical responsibilities*	48%	58%	78%

Significantly different at the p<.001 level.

4. Camaraderie among students is linked with student learning.

- Approximately 90% of respondents who were satisfied with the level of camaraderie with classmates reported their program enhanced their ability to use modern engineering tools, compared to 64% of those who were dissatisfied with the level of camaraderie with classmates.
- Less than one-half of respondents who were dissatisfied with the level of camaraderie with fellow classmates reported that the engineering program enhanced their ability to identify engineering problems, apply knowledge of engineering or science, conduct experiments, or design experiments.

Satisfaction with level of camaraderie with fellow classmates			
TABLE 4	**Dissatisfied**	**Neutral**	**Satisfied**
Percentages responding to "Large Extent" (6-7) **Apply Knowledge and Identify Problems -** Degree that engineering education enhanced ability to:			
Solve engineering problems*	62%	67%	84%
Use the techniques and skills necessary for engineering practice*	55%	65%	82%
Formulate engineering problems*	54%	59%	78%
Understand contemporary issues*	50%	57%	76%
Identify engineering problems*	47%	50%	68%
Apply knowledge of engineering*	17%	29%	59%
Apply knowledge of science*	14%	25%	53%

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| Satisfaction with level of camaraderie with fellow classmates			
TABLE 4 (cont.)	**Dissatisfied**	**Neutral**	**Satisfied**
Percentages responding to "Large Extent" (6-7) **System Design & Problem Solving -** Degree that engineering education enhanced ability to:			
Function on multidisciplinary teams*	55%	66%	83%
Design a system, component, or process to meet desired needs*	54%	61%	79%
Interpret data*	53%	61%	77%
Conduct experiments*	4%	19%	47%
Design experiments*	8%	19%	45%
Effective Management and Leadership Skills - Degree that engineering education enhanced ability to:			
Use modern engineering tools*	64%	73%	90%
Communicate effectively*	54%	67%	87%
Recognize the need to engage in lifelong learning*	58%	67%	86%
Understand professional responsibility*	62%	66%	84%
Understand ethical responsibilities*	53%	55%	71%

Conclusion

Most respondents indicated that their engineering program enhanced their abilities and skills. Both student/faculty interaction and satisfaction with the level of camaraderie between students play important roles in the student experience and student learning.

About Skyfactor

Skyfactor Benchworks includes over 60 easy-to-use student affairs and academic program assessments, all rooted in accreditation and professional standards, and designed to support a culture of continuous program improvement. Assessment reports include longitudinal data, the ability to benchmark against peer institutions, and interactive dashboards that enable rapid identification of critical issues.

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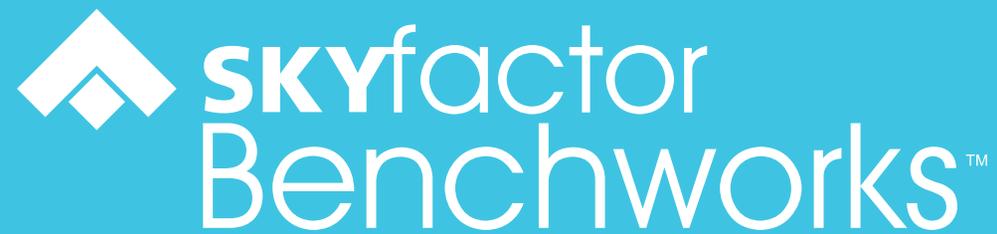
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