

Learning Outcomes

Perceptions About the Influence of ABET Accreditation on OSH Education

By Darryl C. Hill

Higher education institutional culture has shifted from an emphasis on assessing teaching methodology to assessing student learning (Allen, 2006) as a way of measuring educational quality.

This change of paradigm will also make it more difficult to assess quality because it will be necessary to assess not only the quality of teaching, but also the quality of learning, which means assessing the performance of graduates in the world of work. Is this feasible? (Hirsch & Weber, 1999, p. 9)

Accrediting agencies emphasize student learning outcomes and assess student learning during the accreditation process (Burke, 2005). Colleges and universities seek regional accreditation, and several programs pursue program-level accreditation. This is an additional process designed to demonstrate that quality learning is taking place. Institutions invest considerable time and financial resources during the accreditation process, which includes preparing for the assessment, the site visit and any follow-up actions based on the findings. Student learning is an important component in the assessment process.

Assessing learning outcomes is an integral component to ensure that quality learning is occurring. Institutions increasingly understand the need to convince stakeholders of the value of their credentials and how coursework will demonstrate the knowledge, skills and behaviors students are expected to acquire as a re-

sult of their education (Banta, 2001). In an analysis of student assessment, Otter (1995) says that competence statements define “what learners are intended to achieve” (p. 45) rather than the courses or programs of learning that are used to develop them.


Learning outcomes help to ensure competencies as students matriculate to graduation. Defining *competence* as the integration of skills, abilities and knowledge when focused on a particular task (Jones & Voorhees, 2000), it is understood that competence after graduation in the occupational safety and health (OSH) profession is usually assessed with job performance.

The true assessment of student competence must come from not only the student’s performance in the undergraduate academic setting that checks an individual’s competence; but it must also come from the program graduates extended experiences after leaving the un-

IN BRIEF

- **ABET accreditation provides assurance that a college or university program meets the quality standards established by the profession for which it prepares its students.**
- **Assessing program learning outcomes is an integral component to ensure that quality learning is occurring.**
- **Occupational safety and health programs should consider ABET accreditation.**

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dergraduate program. (Palomba & Banta, 2001, p. 156)

Competence after graduation is important because graduates must demonstrate to their employer the skills, knowledge and behaviors necessary for success in the workplace.

Learning Outcome Perceptions

This study was designed to assess differences in perceptions of learning outcomes between graduates of OSH degree programs accredited by ABET and graduates of non-ABET-accredited OSH degree programs.

The following research question served as the framework for this study: When comparing graduates from ABET-accredited OSH programs and graduates from non-ABET-accredited programs:

- 1) Is there a difference in perceptions of learning outcomes?
- 2) Is there a difference in feedback about the programs?
- 3) Is there a difference in advice to other students?
- 4) Is there a difference with regard to professional development as determined by the questionnaire survey?
- 5) Is there a difference in the perceptions of curriculum theory used in their programs of study?

Significance of the Study

Universities and programs invest a considerable amount of time and money to achieve ABET accreditation. The SH&E profession has advocated that ABET accreditation adds value for graduates. At the time of this study, only 13 undergraduate and graduate OSH programs were ABET accredited. This research may help educators in non-ABET-accredited programs decide to actively pursue ABET accreditation.

In addition, OSH program faculty may consider the learning outcome perceptions revealed when designing program curriculum. The research may serve as a means of evaluating existing learning outcomes and improving the quality

of curriculum development before the accreditation review. Furthermore, ASSE may evaluate the results to assess learning outcomes within the accreditation continuous improvement process.

Finally, to help SH&E professionals in today's changing and dynamic workplace, accreditation criteria and standards must be examined (Institute of Medicine, 2000) to facilitate student learning. The Institute of Medicine study suggests that accrediting bodies and professional organizations evaluate accreditation criteria and focus on student learning needs to further advance the SH&E

profession. This study supports that recommendation by assessing student learning outcomes and its application in the SH&E profession.

Research Design

Five research questions were examined using an ex post facto (nonexperimental) survey questionnaire. The questionnaire was analyzed primarily in the quantitative paradigm while comparative analysis was used to address the two qualitative research questions. The sample included 169 graduates from ABET-accredited programs and 154 graduates from non-ABET-accredited programs.

The questionnaire contained 35 quantitative questions to gather demographic and learning outcomes data, as well as perceptions of graduates relative to their learning experiences in their degree programs. A Likert-type rating scale was used to indicate the degree to which respondents believed survey statements to be true or untrue. The survey also was designed to collect qualitative data; two open-ended questions allowed participants (graduates) to address issues related to the value and key components of their student learning experiences that may not have been reflected in the quantitative questions. This combined quantitative and qualitative approach provided an analysis of perceptions of the value of and satisfaction related to their OSH-related learning experiences.

Descriptive statistics were used to analyze the general univariate pattern of the data. Descriptive statistics including percentages, ranges, means, frequencies and standard deviations were calculated to analyze the demographic, curriculum theory and learning outcome questions. Analysis of variance (ANOVA) was used to examine differences between the independent variables and mean satisfaction and mean value scores. Open-ended questions with associated narrative responses were analyzed using comparative analysis.

Definitions

• **Assessment.** The processes that identify, collect and prepare data to evaluate meeting program outcomes and program objectives.

• **Evaluation.** The processes for data interpretation and evidence collected through assessment practices. The process determines effectiveness of achieving program objectives and outcomes, and ensuring the program's continuous improvement.

• **Institutional accreditation.** Evaluates overall institutional quality. Regional accreditation of colleges and universities is one form of institutional accreditation.

• **Performance criteria.** Establish minimum criteria for evaluation and indicate specific actions students should perform as a result of their program learning experience.

• **Program educational objectives.** Broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

• **Program outcomes** (also program student learning outcomes). Narrow statements that describe what students are expected to know and be able to perform by the time of graduation. These relate to skills, knowledge and behaviors that students acquire in their matriculation through the program.

• **Specialized (program) accreditation.** Such accreditation evaluates specific programs of study. Disciplines such as nursing, law, medicine and engineering programs often are evaluated through specialized accreditation.

Instrument Used

The 37-item online questionnaire was divided into six parts. Part 1 was an introduction. Part 2 gathered demographic data and information on each respondent's college degree. Part 3 focused on professional development and related topics such as professional society membership, certifications and technical articles published.

Part 4 included four questions that addressed the four curriculum theories outlined in the literature review. Part 5 served as the foundation for the study and included 14 questions pertaining to the ABET learning outcomes for OSH programs. Part 6 consisted of two open-ended questions that allowed respondents to reflect on their college experience and offer recommendations to current students.

Parts 4 and 5 used a four-point Likert-type scale to force participants to select a response from listed alternatives. The range of the scale was 1 ("completely untrue") to 4 ("completely true").

By design, close-ended questions do not allow respondents to communicate

opinions and engage in personal reflection. To address this limitation, the two open-ended questions were included.

Table 1 outlines the relationship between ABET learning outcomes and the survey questions; the learning outcomes are based on the 2008-09 Criteria for Accrediting Applied Science Programs (ABET, 2009).

Data Collection

Data were collected online using Survey Monkey. A link was sent to OSH program directors, along with an introductory letter, consent form and Institutional Review Board approval. The link was then sent to program graduates using databases provided by the participating institutions. To prevent multiple survey submissions, the IP address was identified. The response rate was 40.2%—804 surveys distributed and 323 surveys collected.

The response rate excludes the undeliverable surveys. One disadvantage noted during the study was the high number of undeliverable e-mail addresses received from participating schools, which decreased the response rate for surveys collected.

Table 1

Relationship Between ABET Learning Outcomes to Survey Questions

Survey question	ABET outcome
Professional development courses in past 10 years (7)	Engage in lifelong learning
ASSE member (8)	Engage in lifelong learning
Professional safety certifications (9)	Understand functional aspects of safety; design and evaluate safety programs
Design and conduct experiments (16)	Conduct experiments and analyze/interpret data
Published peer-reviewed articles (10)	Communicate effectively
Curriculum theory questions (11-14)	Understand the impact of solutions in a global and societal context
Math and science skills (17)	Knowledge of math, science and applied science
Ethical and professional responsibility (19)	Professional and ethical responsibility
Scientific and technical tools (20)	Use techniques, skills and tools for professional practice
Standards, regulations and codes (21)	Identify and apply standards and regulations
Accident investigations and analyses (22)	Conduct accident investigations
Multidisciplinary teams (15)	Function on multidisciplinary teams
Applied science problems (18)	Identify and solve applied science problems
Communication skills (23)	Communicate effectively
Lifelong learning (24)	Engage in lifelong learning
Business and risk-management concepts (25)	Application of business and risk management concepts
Design and evaluate safety, health and/or environmental programs (26)	Design safety programs
Adult learning theory (27)	Apply adult learning theory to safety training methodology
Intern, cooperative or supervised experience (28)	Apply principles of safety in a nonacademic setting



To view the online survey instrument used in this study, visit www.asse.org/psextra.

Data Analysis

A *t*-test was conducted for independent samples. ABET OSH-rated (mean score) program learning outcomes were tested to determine whether they were higher than those of non-ABET-accredited school graduates for all 14 student learning questions (SLQs). Only seven of the 14 SLQs are significant ($p < .05$). Thus, the likelihood of accepting the null hypothesis (no differences between graduates) for the other seven student learning questions is marginally significant to significant. Next, an ANOVA on ABET/noncovarying experience was conducted to determine whether the difference is an ABET-related difference or an experience difference.

Results

The hypothesis driving this study was based on the premise that the skills, knowledge and behaviors acquired by graduates of ABET-accredited OSH programs contribute to higher outcome perceptions than for graduates of non-ABET-accredited programs. The respondents' perceptions of student learning outcomes were used to measure the degree of learning.

Findings From the Research Questions

Perceptions of Learning Outcomes

Fourteen questions were derived from ABET learning outcomes and were used to answer research question 1, "Is there a difference in perceptions of learning outcomes?" The questions measured what graduates were expected to know and be able to do by the time of graduation. Table 2 shows the mean rating for each SLQ comparing graduates by type of program attended. The last column shows whether these differences were statistically significant.

The means for each question were higher for

graduates of ABET-accredited programs than for graduates of non-ABET-accredited programs. Seven of the 14 items showed a significant difference ($p < .05$). This finding is a significant observation since graduates of ABET-accredited programs had a mean of 5.52 years' experience, while graduates from non-ABET-accredited programs had a mean of 11.06 years' experience.

The question, "My safety degree program allowed me to apply principles of safety and health in a nonacademic setting through an intern, cooperative or supervised experience," was both the highest perceived student learning outcome for ABET graduates and had the greatest difference (0.42) when compared to non-ABET program graduates. This finding suggests that an internship or similar supervised experience may be an important component of ABET accreditation. At the other end of the continuum, the question that focused on applying adult learning theory to safety training methodology had the lowest mean for ABET-accredited (3.28) and non-ABET-accredited (3.02) program graduates.

After analyzing the *t*-test comparisons of student learning outcomes, an ANOVA analysis was conducted to evaluate differences after considering years of experience (Table 3). The covaried analysis was conducted on all 14 learning outcomes. Twelve of the 14 SLQs showed no significant difference between the study groups after controlling for years experience. The questions, "Effectively taught math and science skills" ($p = .001$), and "Effectively taught me how to solve applied science problems" ($p = .018$) were significantly different after controlling for years of experience. Graduates from ABET-accredited programs reported learning more than graduates of non-ABET-accredited programs in the areas of math and science and solving applied science problems.

In general, responses from ABET program graduates were higher for each of the 14 learning outcome questions compared to their non-ABET program counterparts. Half of these items showed a significant difference, but only two maintained their significance after controlling for years of experience. These results clearly suggest an advantage for ABET accreditation, but do not provide clear evidence relative to years of experience.

This finding was consistent with the literature on accreditation and student learning. Accreditation criteria have had a positive effect on student experiences and student learning (ABET, 2006). The Engineering Change study supports this study's findings that the accreditation student learning criteria and the continuous improvement process enhanced student learning.

Another interesting finding was that applying safety principles through a su-

Table 2

ABET vs. Non-ABET by Student Learning Outcomes

Survey question	Student learning outcomes	ABET mean rating	Non-ABET mean rating	t-test
22	Function on multidisciplinary teams	3.71	3.66	0.939
23	Design and conduct experiments	3.39	3.36	0.391
24	Taught math and science skills	3.57	3.24	3.73***
25	Solve applied science problems	3.57	3.34	3.06**
26	Understanding of ethics	3.79	3.64	2.37*
27	Use of techniques for practice	3.56	3.54	0.173
28	Apply standards and regulations	3.82	3.68	1.98*
29	Conduct accident investigation	3.51	3.41	1.14
30	Effective writing skills	3.66	3.46	2.62**
31	Engage in lifelong learning	3.68	3.60	1.27
32	Apply business concepts	3.45	3.35	1.21
33	Design and evaluate safety programs	3.56	3.51	0.664
34	Apply adult learning to training	3.28	3.02	2.70**
35	Apply principles through internship	3.88	3.46	4.76***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

pervised, cooperative or internship experience, with a *t*-test value of 4.76, was a significant relationship ($p < .001$). ABET program graduates had a higher mean (3.88) compared to non-ABET program graduates (3.46).

This finding supports a study that demonstrated the value of the experiential learning component of the ABET accreditation process (McGlothlin, 2002). The assessment of graduate perceptions of such experiences may provide valuable information needed to continue to foster a rewarding learning experience.

Suggested Changes in Safety Degree Programs

The second research question investigated whether the groups differed in their views about what they would change about their safety degree program learning experience. The survey included questions that asked about experiences before, during and after their learning experience. These open-ended questions were asked to allow respondents to reflect on their college experience and share recommendations with current students.

Responses to the *before* question were categorized in five general themes (Table 4). The majority (52%) of graduates reported they would do nothing different, or wished they had identified safety as a career opportunity sooner. This finding demonstrates that the surveyed graduates were satisfied with their career choice. The results also reflect the need to incorporate business principles into OSH curriculum. Seventeen percent of ABET program graduates identified the importance of business courses, compared to only 2% of non-ABET program graduates.

Graduates also were asked what they would do differently *during* their learning experience if given the opportunity to do it over based on their job performance. These responses were categorized in five general themes (Table 5, p. 58). The surveyed graduates expressed a desire to take on more internships during their education process. A greater percentage (39%) of non-ABET program graduates expressed this desire compared to their ABET program counterparts (19%). This difference may reflect the fact that ABET-accredited programs require an internship, cooperative or supervised experience.

A similar finding was that non-ABET program graduates wanted more hands-on experience/plant tours. For both groups, more internships received the highest response; the second highest response for ABET program graduates was more hands-on experience (11%); for non-ABET program graduates, it was more involvement in safety student organizations/networking (23%).

Graduates were also asked what they would do differently *after* their learning experience if given the op-

Table 3

ANOVA Analysis of ABET Program by Student Learning Outcomes

Learning outcomes	F
Function on multidisciplinary teams	0.204
Design and conduct experiments	0.183
Taught math and science skills	10.887**
Solve applied science problems	5.642*
Understanding of ethics	2.685
Use of techniques for practice	0.011
Apply standards and regulations	3.041
Conduct accident investigation	0.374
Effective writing skills	3.458
Engage in lifelong learning	0.034
Apply business concepts	0.646
Design and evaluate safety programs	0.005
Apply adult learning to training	2.203
Apply principles through internship	4.806

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

portunity to do it over based on their job performance. These responses were categorized in five general themes (Table 6, p. 58).

Both groups identified completing professional development courses, although non-ABET graduates had a stronger response (37%) than did ABET graduates (19%). Similarly, the second most common response for both groups was to do nothing differently; again, non-ABET graduates had a stronger representation (29%) than did ABET graduates (18%).

Respondents also expressed a desire to start their safety career or research the field as a career opportunity sooner. The primary difference in this area was that ABET graduates had a larger variety of responses, so they had smaller percentages in the most common response areas.

Table 4

Frequency of General Themes

Frequency of general themes in response to the question, "What would you do differently about your safety degree program learning experience (before) if given the opportunity to do it over based upon your job performance?"

Participant responses	ABET n = 94	Non-ABET n = 86	Total n = 180
Nothing different	29%	27%	28%
Start in safety career sooner/research the safety field sooner as a career opportunity	26%	21%	24%
Take more business courses	17%	2%	10%
Take more science and math courses	7%	10%	9%
Take more engineering courses	6%	7%	7%

Responses to these survey questions reflect high satisfaction among OSH graduates. Members of both study groups responded that they either desired to learn about the safety profession sooner or would do nothing differently if given the opportunity. They also indicated that internships are an important component of the student learning experience. Respondents also identified the need to understand business principles and to seek professional development such as professional safety certifications, safety organization memberships and networking.

Advice to OSH Students

The third research question asked whether the two graduate groups differed in student advising. Specifically, respondents were asked what advice relating to the learning experience they would give to current OSH students. Answers were qualitatively analyzed, identifying six general themes (Table 7, p. 59).

An internship experience was the most frequent response for both research groups. Non-ABET graduates perceived the importance to engage in lifelong learning as the second-highest theme for advice to current students, while ABET graduates' second most common theme was to acquire business and management skills. Response rates to these themes did not differ much between the two groups.

The finding about gaining an internship or practical work experience was consistent with findings about research questions 1 and 2. Although most of the general themes' response rates did not differ greatly, 12% of ABET program graduates advised current students to acquire business and management skills, while only 4% of non-ABET program graduates made this recommendation. Accreditation criteria state that graduates must demonstrate the application of business and risk management concepts. This may explain the higher responses from ABET program graduates.

Professional Development

The fourth research question asked about differences related to professional development. To examine this question, responses to four survey items were analyzed. The four professional development topics included professional certifications, professional membership, professional development course attendance and published articles (Table 8).

The major accredited occupational safety and health certifications are CSP, CIH, certified hazardous materials manager (CHMM) and P.E. Fifty-two percent of ABET program graduates ($n = 169$) achieved at least the CSP, compared to 34% of non-ABET graduates ($n = 154$). In general, ABET program graduates obtained more safety certifications than non-ABET program graduates.

Table 9 (p. 60) shows the differences between the two groups with respect to ASSE membership. Seventy-two percent of ABET program graduates were ASSE members compared to 51% of non-ABET program graduates. This difference was statistically significant.

Professional development courses included conferences or seminars for which participants received continuation of certification credits from certification accrediting bodies. Courses had to last at least 2 days. Based on the responses, ABET program graduates attended professional development courses more frequently than their non-ABET counterparts (Table 10, p. 60).

Participants were asked how many articles they had published in safety- and health-related journals. ABET program graduates had articles published more frequently than their non-ABET program counterparts (Table 11, p. 60).

Table 12 (p. 60) shows a summary of differences regarding certifications, professional development courses and published articles. In each area, ABET graduates had higher responses. In these three areas, number of published articles was the only item that did not achieve statistical significance.

The fourth research question shows the importance of professional development. Professional development sup-

Table 5

Frequency of General Themes

Frequency of general themes in response to the question, "What would you do differently about your safety degree program learning experience (during) if given the opportunity to do it over based upon your job performance?"

Participant responses	ABET $n = 115$	Non-ABET $n = 105$	Total $n = 220$
Take an/more internships	19%	39%	29%
More involvement in safety student organization(s)/networking	7%	23%	14%
More hands-on (lab) experience/plant tours	11%	13%	12%
Take more business courses	6%	13%	9%
Take more environmental courses	8%	10%	9%

Table 6

Frequency of General Themes

Frequency of general themes in response to the question, "What would you do differently about your safety degree program learning experience (after) if given the opportunity to do it over based upon your job performance?"

Participant responses	ABET $n = 95$	Non-ABET $n = 90$	Total $n = 185$
Complete professional development courses	19%	37%	27%
Nothing different	18%	29%	23%
Networking/ASSE involvement	13%	19%	16%
Acquire safety certification (CSP) sooner	7%	22%	14%

ports the ABET accreditation criteria that graduates recognize the need for and have the ability to engage in lifelong learning, which is achieved by completing professional development courses, joining professional organizations and publishing articles. The qualitative responses also showed relationship to the *Greater Expectations* report that addresses the need for students to become learners who can adapt to multiple environments, apply knowledge from multiple sources and engage in lifelong learning (AACU, 2002).

Limitations

One limitation of this study is the relatively small sample of OSH programs. This makes it difficult to generalize the results to schools beyond the study's boundaries. The limited participation of schools may have influenced the data and the results. The schools that participated had a high number of undeliverable surveys due to inaccurate e-mail addresses. Disadvantages of an electronic survey include reduced flexibility, potential for unanswered questions, lower response rates versus interviews, lack of control of responses and inability to use complex questions (Fraenkel & Wallen, 1996).

A second limitation was the graduate databases for the participating schools. The 13 schools had different database retention times. Thus, a program with a database that covers more years may have graduates whose perceptions of learning outcomes are attributable to curriculum changes over time.

Additional limitations include construct validity and reliability of the measures. The SH&E profession is not as well-defined as professions such as engineering or medicine. Also, number of positions, type of industry and organizational alignment contribute to responses, but not all of these confounding factors were evaluated. Finally, there is a potential for misrepresentations regarding answers to questions.

Conclusion & Recommendations

The highest perceived student learning outcome for ABET program graduates is that the safety degree program allowed the individual to apply safety and health principles in a nonacademic setting through an internship, cooperative or supervised experience (3.88). Non-ABET program graduates also perceived such an experience as important (3.46).

This finding supports previous research that the internship, cooperative or supervised experience aids student learning and provides an advantage to employers, stakeholders and institutions of higher education (McGlothlin, 2002). An experience-based learning component is

Table 7

Graduates' Advice to Occupational Safety & Health Students

Participants' advice	ABET n = 138	Non-ABET n = 126	Total n = 264
Gain internship/practical work experience	48%	41%	45%
Engage in lifelong learning	9%	13%	11%
Acquire proficiency in communication skills	10%	10%	10%
Recognize importance in networking	11%	8%	9%
Acquire business and management skills	12%	4%	8%
More environmental and science courses	5%	4%	4%

Table 8

ABET vs. Non-ABET Graduates: Certifications

Professional certification	ABET n = 169	Non-ABET n = 154
Certified safety professional	52%	34%
Certified industrial hygienist	2%	1%
Certified hazardous materials manager	5%	2%
Professional engineer	1%	0%

required by ABET accreditation criteria and is required in most other higher education OSH programs. The data in this study imply that the respondents would seek an internship or several internships if given the opportunity during their college career. Respondents also advised current students to seek an internship during their learning experience. This finding calls for OSH programs to integrate an internship, cooperative or supervised opportunity into their curriculum.

The study's findings indicate that OSH degree programs must show students the need to engage in lifelong learning. Respondents expressed a desire to be more involved in professional safety organizations and networking during their learning experience as well. This observation may be attributable to ABET-accredited programs that use the student learning outcome to show students the importance of lifelong learning. Based on this finding, OSH degree programs should encourage students to understand the importance of professional development (e.g., joining professional organizations, seeking accredited certifications, attending courses/seminars, writing articles for professional publications).

Also, current ABET accreditation criteria for OSH programs must be examined, and efforts must be made to ensure that faculty demonstrate competence as evidenced by participation in professional societies, having applicable certifications issued by nationally accredited credentialing bodies and/or extensive experience in the

Table 9**ABET vs. Non-ABET Graduates: ASSE Membership**

ASSE member	ABET	Non-ABET	Chi-square value
Yes	72.2%	50.5%	24.5***
No	27.8%	49.5%	--

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

OSH discipline. It is suggested that the criteria be more specific and state that the majority of core faculty hold the CSP designation and/or are a licensed P.E.

These findings also call attention to the need for OSH programs to integrate business principles into the curriculum. The profession has deemed it important that graduates have competencies in business terminology and objectives (Behm, Veltri & Kleinsorge, 2004; Hill, 2002). The success of SH&E professionals in making a business case lies in the availability of educational opportunities in engineering economy and economic analysis. As noted, many respondents highlighted the importance of understanding business principles and of taking more business courses. The findings suggest that an opportu-

nity exists for OSH programs to partner with business schools and that faculty develop more business courses for OSH students within their own departments.

In addition, BCSP waives the fundamental examination for practitioners who graduate from an ABET-accredited OSH program. This may contribute to the higher number of ABET program graduates who pursued and achieved professional safety certification. BCSP examined ABET curriculum requirements and determined that graduates

from ABET-accredited programs (bachelor's and master's level) meet a standard of "substantial equivalence" of being prepared to engage in professional safety practice. Thus, OSH degree programs should consider ABET accreditation as BCSP encourages programs to meet high standards of academic rigor through a quality, comprehensive, peer-reviewed program process.

Finally, this study revealed that OSH degree programs should consider ABET accreditation. Non-ABET-accredited programs offer a quality learning experience. However, these programs can demonstrate additional value to their stakeholders by achieving ABET accreditation.

This study supports several studies that demonstrated the importance of student learning outcomes and the accreditation process (Baker, 2001; Ferrara, 2007; Ray, 1990; Silverstein, 2005). ABET indicated that the implementation of the EC2000 accreditation criteria has had a positive effect on engineering programs, student experiences and student learning. The quantitative and qualitative findings indicate that graduates of ABET-accredited programs learn more when compared to graduates of non-ABET-accredited programs. University and college administrators and faculty should examine the results of this study and initiate ABET accreditation processes for their programs.

The need to complete an internship, become involved in safety organizations, network and understand business principles were identified

Table 10**ABET vs. Non-ABET Graduates: Professional Development**

No. of professional development courses	ABET $n = 169$	Non-ABET $n = 154$
0	11%	16%
1 to 4	38%	60%
5 to 9	33%	19%
> 10	18%	4%

Table 11**ABET vs. Non-ABET Graduates: Published Articles**

Published articles	ABET $n = 169$	Non-ABET $n = 154$
0	89%	97%
1 to 4	8%	1%
5 to 9	3%	1%
> 10	0%	0%

Table 12**ABET vs. Non-ABET Graduates: Mean Counts, All**

Differences in mean counts of certification, professional development courses, and articles between ABET and non-ABET graduates.

Measure	ABET	Non-ABET	t-test
Certifications	0.94	0.63	2.71**
Courses	1.65	1.22	1.96*
Articles	0.68	0.14	0.987

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

in the open-ended responses. Furthermore, an appreciation of lifelong learning was identified in the qualitative analysis.

The findings support the literature and reflect the shift in higher education institutional culture emphasis from teaching methodology to student learning (Allen, 2006). Assessing learning outcomes is an integral component to ensuring that quality learning is occurring. Learning outcomes help ensure that students will build competencies as they matriculate to graduation. This study demonstrates that ABET accreditation was perceived by ABET program graduates as important and that they learned more as compared to graduates from non-ABET programs.

Future Studies

A future study might extend this research by increasing the number of schools participating and enlarging the group of respondents. This would add validity and increase the ability to generalize findings. The survey instrument should be administered to a sample population within a specified time after graduation. The time requirement would ensure more uniformity in years of experience.

A second area for a future study would be employers' perceptions of graduate student learning outcomes. Researchers could compare employers' perceptions to graduates' perceptions. Furthermore, the study might distinguish employers by industry type, size and organizational structure to allow for more in-depth comparative analysis.

A third area for further study would be analysis of perceptions of educational objectives and a comparative study between ABET program graduates and their non-ABET program counterparts. Learning outcomes include what graduates should know upon graduation. Educational objectives are what graduates should be able to do 5 years after graduation.

A fourth possible study involves qualitative research using one or more programs to develop a greater, in-depth assessment of learning outcomes based on graduate perceptions. A qualitative analysis that includes interviews and focus groups would result in greater depth of inquiry than the mixed quantitative/qualitative results reported in this study.

Finally, a fifth study might evaluate the variances within the ABET and non-ABET groups. Each program is unique as are its graduates. This within analysis would help the profession to more fully understand the issues. **PS**

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