

# A Missouri Exploratory Study of Industry Perception on the American Council for Construction Education's Bachelor Degree Student Learning Outcomes

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In 2014, the American Council for Construction Education (ACCE), the leading accreditation body for construction degree programs, formally approved new student learning outcome (SLO) based standards. As degree programs across the country begin to adopt these new guidelines into their courses, there are still questions as to how these SLOs match industry needs. This study is a first attempt to gauge industry perceptions of ACCE's Bachelor Degree SLOs and identify where similarities and differences exist. Also, the study explores the industry expectations of the recent graduates' development. Findings show a trend of overall agreement with the original ACCE ranking with some major exceptions such as developing safety plans (SLO 8) and analyzing the construction documents for planning and management (SLO7).

**Key Words:** Accreditation, Student Learning Outcomes, ACCE

## Background

Over the past three decades both policy makers and the general public have been demanding the evidence of student learning in higher education. While the traditional method of assessing student learning has been through the grading method, the current trend is to establish a culture of evidence-based measurement. As such, the development and use of outcomes based assessment in the academic environment is rapidly growing (Shavelson, Schnider and Shulman, 2007). Student learning investigations have aimed at finding an association between student-preferred learning approaches, the educational setting and the desired learning outcomes (Trigwell & Prosser, 1991). In an academic environment, there are different but identifiable learning approaches used by students to assimilate information. These different learning styles affects the quality of learning outcomes (Gow & Kember, 1993; Roger Saljo, 1979). Consequently, most institutions and accreditation bodies have been shifting towards the student learning outcomes (SLOs) method of assessment.

### *Definition and History of SLOs*

Learning outcomes can be defined as “statements that specify what learners will know or be able to do as a result of a learning activity, where the outcomes are usually expressed as knowledge, skills, or attitudes” (Phillips, 1994). A student learning outcome can also be defined as a clear statement that details what a student has learned after the completion of a course or a program (Boyd & Vitzelio, n.d.; Chaplot and Stute, 2008).

The history of student learning outcomes dates back to the early 20<sup>th</sup> century. The College Learning Assessment (CLA), a U.S. based standardized testing initiative, evolved through four eras: (1) the origin of standardized tests of learning: 1900–1933; (2) the assessment of learning for general and graduate education: 1933–47; (3) the rise of test providers: 1948–78; and (4) the era of external accountability: 1979–present (Shavelson, Schnider and Shulman, 2007). In the 1960s, when both government and private organizations were aggressively searching for assessment methods to evaluate student learning, the federal government took an early first step by establishing a national student assessment system. Created in 1964, the Exploratory Committee on Assessing the Progress of Education (ECAPE) included collecting statistical data nationwide (Vinoviskis, 1998).

At the end of 1970's, university faculty members voiced their dissatisfaction about these assessment methods. They believed that student learning could not be identified based on simple multiple choice questions and argued for more comprehensive answers based on open-ended tasks which required more critical thinking. This concept of learning assessment came under the name of the Collegiate Learning Assessment (CLA). The CLA emphasized critical thinking, analytic reasoning, problem solving and written communication (Shavelson, Schneider and Shulman, 2007).

More recently, the National Institute for Learning Outcomes Assessment (NILOA) was established in 2008 in order to “discover and disseminate ways that academic programs and institutions can productively use assessment data internally to inform and strengthen undergraduate education, and externally to communicate with policy makers, families and other stakeholders” (NILOA, 2015). NILOA's first report in 2009 came with the following findings: (1) higher education or post-secondary level education accreditation is the major driver for learning outcomes assessment; (2) there is a need that accreditation institutions must give attention to strengthening the standard for assessing learning outcomes; (3) universities must be responsible for showing the proof of a good learning outcome assessment and (4) the data collected from learning assessment should be utilized in improving teaching and learning (Kuh & Ikenberry, 2009).

### *Benefits of SLOs*

When the SLO system is executed in an organized and orderly fashion, its benefits are realized by the students, the faculty and the institution as a whole. SLOs can help students by making them understand what every course in their degree expects out of them in order make goals clearer and decision making more focused. SLOs are also a transparent and consistent way of scoring students (Clinton community college, 2015). According to Carnegie Mellon, “learning objectives can help to foster creativity” among students (Carnegie Mellon, n.d).

Faculty can also benefit from SLOs as they help create a clear understanding of what every course must accomplish. It also provide faculty with the evidence to justify the needed resources for the course. SLOs allow faculty to refine their courses based on the gathered data and not just anecdotal evidence. As for the academic institution benefits, a set of SLOs is a way to demonstrate that its institutional goals are being implemented and that academic programs and services offered by the College are continually being updated. It also helps the institution in academic planning by providing relevant data which can also be helpful in getting aid from state and local government (Clinton community college, 2015).

With a quality set of SLOs, the faculty can work together to make academic milestones for students and augment the standard to reach those milestones across the curriculum. SLOs make the courses more creative and dynamic. It also makes it easy for the appropriate person to know the student standing in the course according to a set cognition level and helps the students to meet the professional and intellectual levels desired by the industry. Finally, SLOs can help institutions to get an evidence of educational results and where they stand in the educational environment (David Shupe, 2007). Well defined learning outcomes can furnish stability and direction in the course, it can also “help to guard against over-reliance on a particular staff member or idiosyncratic interpretation of syllabuses” (Centre for the Enhancement of Learning & Teaching, 2015)

### *SLOs in educational branches*

After NILOA's 2009 report, various accreditation institutions have started applying student learning outcomes as a standard for assessment. Some of the streams where it is applied are engineering, humanities, life sciences and others. One example is Forensic Science Education Programs Accreditation Commission's (FEPAC) use of learning outcomes as part of the standard for their programs. The tools FEPAC uses to quantify student learning outcomes are the “retention rate and the job placement rate of students” enrolled in a FEPAC-accredited programs. For every five years the accreditation institution conduct review of the standard, to make sure the standard helps in evaluating the quality of forensic science programs (FEPAC, 2015).

At the university and departmental level, several examples exist. The Department of Biological Science at Fayetteville State University has included learning outcome as the part of curriculum for biology and forensic science programs (Accredited by FEPAC) at the undergraduate level (Fayetteville State University, 2015). Allegheny College is using student learning outcomes as the standard for students to successfully complete its

environmental sciences program. The University of Wyoming History department has identified key areas to assess student learning based on student learning outcome. (University of Wyoming, 2015; Allegheny College, 2015).

In construction education, ACCE is the leading organization for the accreditation of construction education programs. In 2014, ACCE formally approved an outcomes-based assessment model for accrediting construction education programs. According to an ACCE taskforce, “the outcome-based accreditation requires a set of outcomes that represent behaviors, skills, and knowledge practitioners need to possess in order to function in their profession” (Burt et. Al., 2013). According to ACCE, Bachelor degree programs must now collect data on graduate ability to:

1. Create written communications appropriate to the construction discipline.
2. Create oral presentations appropriate to the construction discipline.
3. Create a construction project safety plan.
4. Create construction project cost estimates.
5. Create construction project schedules.
6. Analyze professional decisions based on ethical principles.
7. Analyze construction documents for planning and management of construction processes.
8. Analyze methods, materials, and equipment used to construct projects.
9. Apply construction management skills as a member of a multi-disciplinary team.
10. Apply electronic-based technology to manage the construction process.
11. Apply basic surveying techniques for construction layout and control.
12. Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.
13. Understand construction risk management.
14. Understand construction accounting and cost control.
15. Understand construction quality assurance and control.
16. Understand construction project control processes.
17. Understand the legal implications of contract, common, and regulatory law to manage a construction project.
18. Understand the basic principles of sustainable construction.
19. Understand the basic principles of structural behavior.
20. Understand the basic principles of mechanical, electrical and piping systems (ACCE DOC 103-OB).

## **Research Objectives and Methodology**

The goal of this research is to provide a snapshot of industry’s perception of the new SLOs developed by ACCE. The study aims to develop an understanding of the industry’s opinion and identify agreement and differences between the construction industry’s expectations and the SLOs. Specifically, the study’s main objectives can be stated as:

- 1- Identify the industry’s perception and ranking of ACCE’s bachelor degree program SLOs.
- 2- Identify the expectations of the industry regarding the recent graduates’ cognition level of the ACCE SLOs.
- 3- Identify the expectations of the industry regarding the experienced industry professionals’ cognition level of the ACCE SLOs.

This study uses quantitative research methods through the use of a survey questionnaire. The methodology process entailed selecting the sample, developing the survey instrument, distributing the survey questionnaire and then collecting and analyzing the data. As an exploratory study aimed as being a first step towards a more comprehensive study of ACCE SLOs, it was determined that a target sample of contractors in Missouri would be an appropriate representation for the study. About 35 construction professionals representing multiple companies across the state of Missouri were contacted via email, and the survey questionnaire was sent to each.

The authors designed the survey around the main objectives of the study with the help of construction professionals and academic experts. The survey questionnaire used four types of questions: (1) close ended questions such as ranking or ordered choices, (2) open-ended questions to draw general feedback from the respondents, (3) Yes/No

nominal questions and (4) six point Likert-scale questions. The main survey questionnaire were divided into three parts: (1) the construction industry's ranking of the relative importance of the skills stemming from the SLOs; (2) the construction industry's ranking of the cognition level needed for the SLOs regarding the recent CM graduates and the industry professionals (5 years + experience) and (3) different demographics of the respondents.

The finalized survey was made using a familiar user-friendly web-designed survey tool (Survey Monkey) to simplify the distribution and data collection electronically via internet email invitations. The survey was opened for the respondents for a little over a month with two reminders sent on the second and the third weeks. 33 out of the 35 (94.3%) responded to the survey, with 26 (74.3%) of them completing all the questions and only 7 chose not to complete the cognition level questions.

### *Data Analysis*

As previously indicated, the survey questionnaire was divided into 3 main sections. The first section analyzes the industry's perception on the relative importance of the SLOs. The second section identifies the cognition levels needed for every SLO – once for the recent CM graduates and a second for industry professionals (more than 5 year of experience). The final section was aimed towards understanding the respondents' demographics and profiles.

After running descriptive analysis for all the data collected, box and whiskers plots were used as a graphical representation of the data distribution for the three main queries collected in the survey questionnaire. As per each plot, the box represents the middle 50% of the SLO ranking or cognition level (median) and the whiskers indicates the range of the scores for each SLO. The Box and Whiskers was plotted for the first question to indicate the ranking for each SLO, where the industry ranked all the SLO according to their relative importance. The Box and Whiskers were also plotted for the fourth and fifth questions on the survey where the respondents were asked to choose (on a Likert scale) the cognition level they think appropriate for each SLO, for both, the recent graduate and the 5 year seasoned professional.

This was followed by ranking all of the SLOs in the 3 different questions according to their average score (mean) which is a weighted average based on the respondents rating of the relative importance for question one and the cognition level for questions four and five. All the data were analyzed using SPSS 21.0.

### **Results**

Based on the demographic questions in the survey questionnaire, the vast majority (more than 90%) of the respondents were general contractors. Although most of the respondents (85%) were involved in commercial projects, they were also involved heavily in several other types with 50% in educational projects, 46% healthcare projects, 42% industrial projects and 31% heavy civil projects. The respondents also reported a 44% public work share compared to a 56% private work share. As per the industry experience, 35% of the respondents have more than fifteen years of experience, 15% have eleven to fifteen years of experience, 23% have six to ten years of experience, another 23% have three to five years of experience and a very small portion of 4% have only one to two years of experience in the construction industry. It is also worthy to mention that about 58% of the respondents were familiar with the ACCE accreditation in general with 38% of them being involved with the ACCE accreditation process or ACCE campus visits.

As the respondents were asked to arrange the twenty SLOs based on the relative importance of the skills that each SLO entails, the results indicated that the industry's opinion varied greatly when it came to the relative importance of each of the SLO skills as showed in Figure 1. Figure 1 also shows that SLO 7 (Analyze construction documents for planning and management of construction processes) is consistently rated as the most important of the 20 SLOs. SLO 9 (Apply construction management skills as a member of a multi-disciplinary team) and SLO 1 (Create written communications appropriate to the construction discipline) came also as of the highest important SLOs, second only to SLO7. On the contrary, SLO 18 (Understand the basic principles of sustainable construction) was ranked the least important outcome along with SLO19 (Understand the basic principles of structural behavior) and SLO 11 (Apply basic surveying techniques for construction layout and control). One of the most noticeable relative important results

in the meantime, is the SLO 3(Create a construction project safety plan). SLO 3 relative importance have a median of 12, although it is recognized as one of the highest cognition levels by ACCE

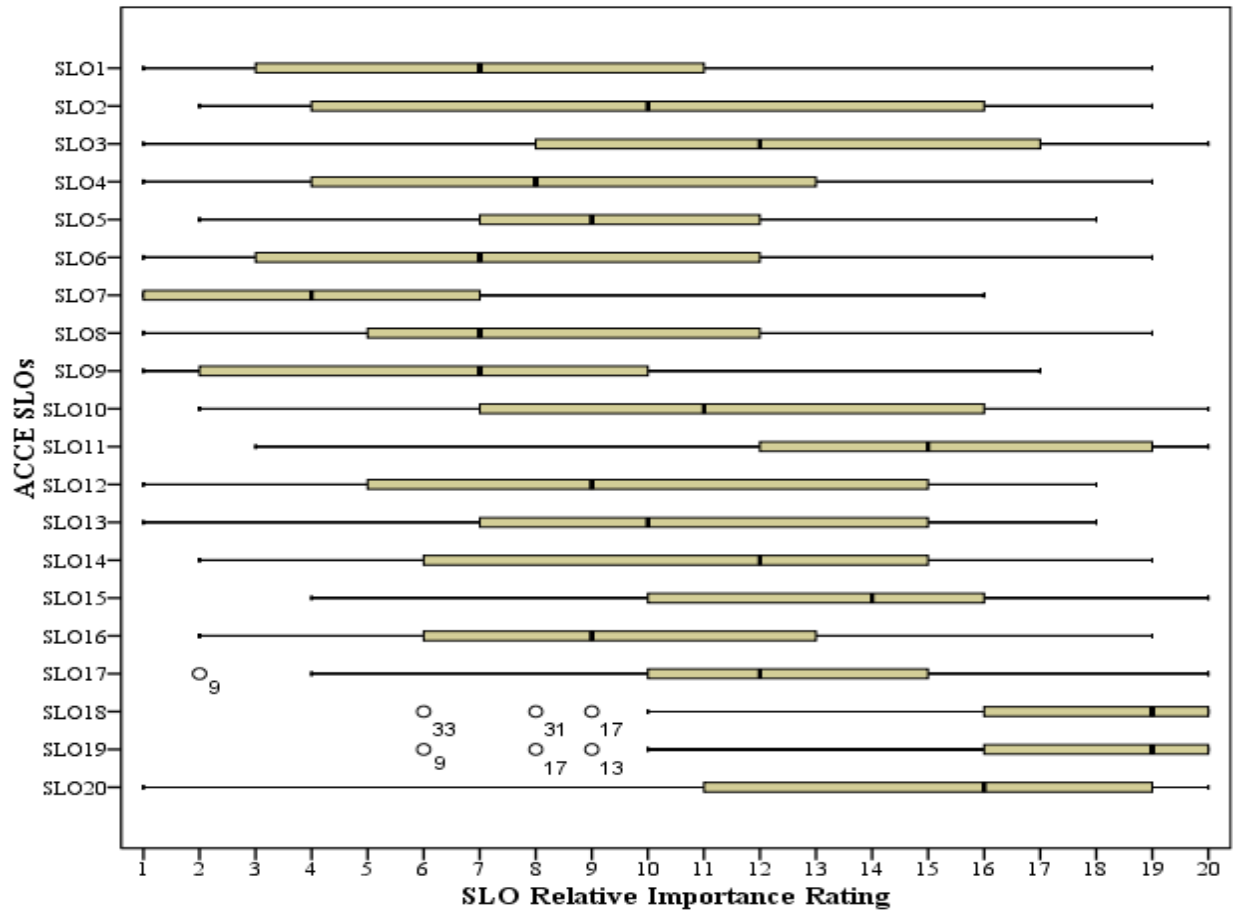


Figure 1. Box and Whisker Plot for the Relative Importance of the Skills entailed per each SLO

As per the survey design, after ranking the relative importance of each SLO, the taxonomy and cognition levels concept were introduced and defined to the respondents in the survey. After the introduction of the cognition levels, the respondents were asked to rank the SLOs on Likert scale that matched the cognition level, with 1 being the highest (create) and 6 being the lowest (understand), with the cognition level being taken out of the SLO verbiage, so it will not affect their selection. A Box and Whisker plot was also developed for both the ranking for a recent graduate and the ranking for a seasoned professional, to also provide a guidance for the industry’s expectations within 5 years from graduation as shown in figure 2. Figure 2 indicated a major change of perception within the industry when it comes to demand a certain cognition level instead of rank the relative importance. For example, SLO7 which ranked the highest, based on the relative importance, did not necessarily translates into the highest cognition level of 1 based on the majority of the respondents’ opinion. Instead the majority of the respondents opted for the second level of cognition (Evaluate) for SLO7. It is also very intriguing to see the expectations of the industry regarding the development of the recent graduates in a 5 year span. The industry development expectation is very consistent in almost every SLO, by one or two cognition levels.

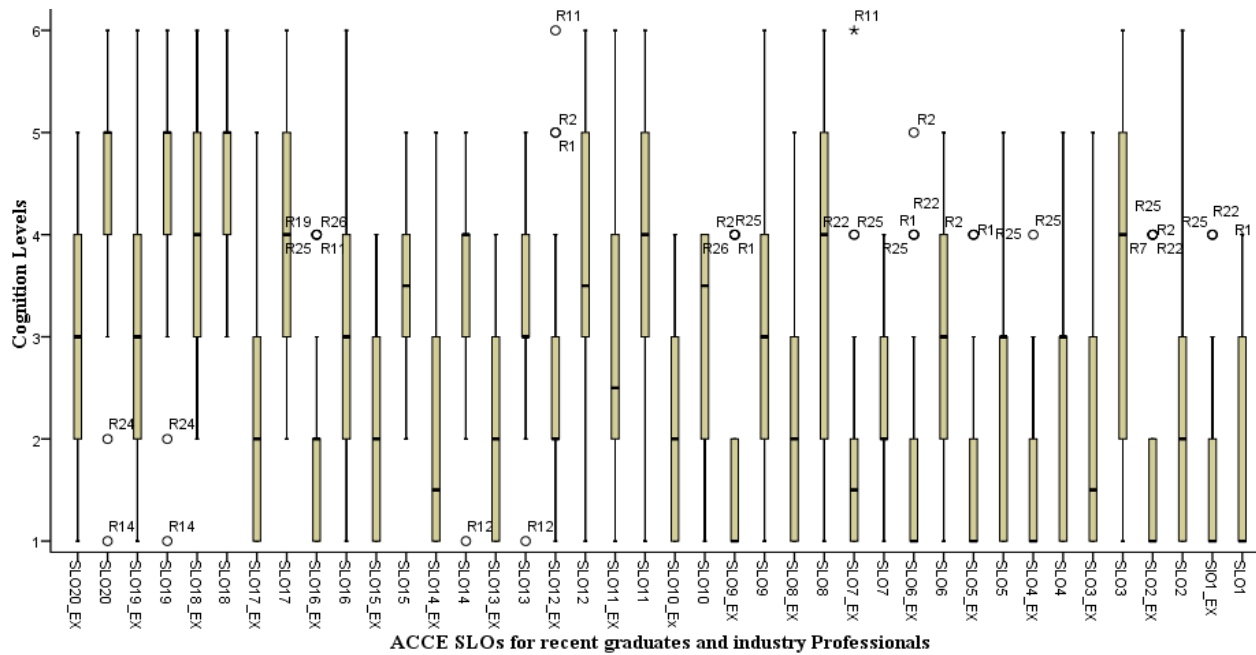


Figure 2. Box and Whisker Plot of Recommended Cognition Levels for Graduates and Experienced Professionals

Table 1. SLOs ranking according to their normalized mean scores for relative importance and cognition levels

SLO Ranking	Relative Importance	Cognition Level I	Cognition Level - II
1	SLO 7	SLO 1	SLO 4
2	SLO 9	SLO 2	SLO 1
3	SLO 1	SLO 7	SLO 5
4	SLO 6	SLO 5	SLO 2
5	SLO 8	SLO 4	SLO 9
6	SLO 4	SLO 9	SLO 6
7	SLO 5	SLO 10	SLO 7
8	SLO 12	SLO 6	SLO 16
9	SLO 16	SLO 13	SLO 14, SLO 8 (tie)
10	SLO 2	SLO 16	SLO 14, SLO 8 (tie)
11	SLO 13	SLO 3	SLO 3, SLO13 (tie)
12	SLO 14	SLO 14, SLO 15 (tie)	SLO 3, SLO13 (tie)
13	SLO 10	SLO 14, SLO 15 (tie)	SLO 10
14	SLO 3	SLO 8	SLO 15
15	SLO 17	SLO 11	SLO 17
16	SLO 15	SLO 12	SLO 12
17	SLO 20	SLO 17	SLO 11
18	SLO 19	SLO 19	SLO 20
19	SLO 11	SLO 20	SLO 19
20	SLO 18	SLO 18	SLO 18

The final data analysis were to rearrange the order of the different SLOs based on the mean score, which is a weighted average compared to each SLO score as shown in Table 1. The first column represent the SLOs ranking according to the 3 successive columns. The second column is the SLOs ranking based on the relative importance (weighted on 1-20 scale) while the third and fourth columns are based on the cognition levels for the recent graduates and after five years of experience respectively (weighted on 1-6 scale). According to Table 1, certain SLOs ranking changed drastically from the relative importance ranking perception to the cognition perception. The highest variation recognized are attributed to SLO 8 (Analyze methods, materials, and equipment used to construct projects) which jumped from the 5th in relative importance to 13th in cognition level for recent graduate to 9th in

cognition level for professionals. Similarly, SLOs 12 (Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process) and SLO 2 among the highest varied ranking among all the SLOs.

## Conclusion

The main goal of this exploratory study was to gauge industry's perception of the new ACCE SLOs regarding their importance and development. From the responses of the relative importance perception depicted in the data results in Figure 1, the data shows a trend of overall agreement with the original ACCE ranking with some major exceptions such as developing safety plans (SLO 8) and analyzing the construction documents for planning and management (SLO7). The data also reflected a major change in perception which is reflected in the changes in ranking after the cognition levels have been introduced. This may indicate that the industry might assume some skills as of a relative importance but with a different cognition level than the ACCE assigned levels as in the case SLO 7 or SLO 8. The data also reflected the expectations of the development of the graduate in a 5 year span and set a high expectation, considering that most of the SLOs expected to develop by 1 and 2 cognition levels across the board. The industry expects the graduates to acquire the highest levels of cognition in the SLOs (1 to 10) after 5 years in the industry. Although the results were quite satisfying for an exploratory study, this study has several limitations which is being addressed in the current study. This study was limited to the general contractors in the state of Missouri.

## Future Research

Future research by the authors will be working toward extending this research beyond these limits through different efforts. First, this research will be expanded to address a larger and more diverse sample to represent the industry as a whole including general and specialty contractors in addition to other parties related to the AEC industry as a whole. Second, it will be expanded to address most of the states and finally, it can also include the educators in AEC higher education so the research can address any gaps between the accredited SLOs, the industry's perception and the educators' efforts.

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