

Construction Faculty's Perception of the American Council for Construction Education's Bachelor Degree Student Learning Outcomes

Mohammed S. Hashem M. Mehany, Ph.D., PMP
Colorado State University
Fort Collins, Colorado

Richard J. Gebken II, Ph.D.
Missouri State University
Springfield, Missouri

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 an attempt to gauge construction faculty perceptions of ACCE's Bachelor Degree SLOs and identify where similarities and differences exist. Also, the study explores faculty expectations of the recent graduates' development. The data indicate that there is general agreement with the original ACCE cognition levels and relative importance with some exceptions including SLO2 (create oral presentations appropriate to the construction discipline), SLO3 (Create a construction project safety plan), SLO7 (analyzing the construction documents for planning and management), SLO16 (understand construction project control processes), and SLO17 (Understand legal implications) and SLO20 (understand the basic principles of MEP).

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, Schneider 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 Säljö, 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 20th 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, Schneider 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 (Vinovskis, 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 provides 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; Alleghany 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 construction faculty's perception of the new SLOs developed by ACCE. The study aims to develop an understanding of the construction faculty's opinion and identify agreement and differences between their expectations and the SLOs. Specifically, the study's main objectives can be stated as:

1- Identify construction faculty's perceived importance of the ACCE's bachelor degree program SLOs.
2- Identify the expectations of construction faculty regarding the recent graduates' cognition level of the ACCE SLOs.
3- Identify the expectations of construction faculty 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. The target sample was Associated Schools of Construction (ASC) faculty and surveys were sent via email to 851 contacts.

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) closed-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 questionnaires were divided into three parts: (1) the construction faculty's ranking of the perceived relative importance of the skills stemming from the SLOs; (2) the construction faculty's assessment 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 survey tool (Survey Monkey) to simplify the distribution and data collection electronically via internet email invitations. The survey was opened for the respondents for four weeks with one reminder sent on the third week. Of the 851 invitations, 60 (7.1%) responded to the survey, with 49 (5.8%) of them completing all the questions.

Data Analysis

As previously indicated, the survey questionnaire was divided into 3 main sections. The first section analyzes the construction faculty'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 (five years post-graduation). The final section was aimed towards understanding the respondents' demographics and profiles.

After running descriptive analysis for all the data collected, box and whisker 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 plot of the first question shows how construction faculty ranked each SLO according to their relative importance. The plots of the fourth and fifth questions on the survey indicate 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 three 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 24.0.

Results

Based on the demographic questions in the survey questionnaire, the vast majority (more than 81%) of the respondents were tenure-track construction faculty. Most of the respondents (55%) emerged from construction engineering/management departments of 10 or more faculty members. As per the industry experience, 59% of the respondents have more than ten years of experience, 26% have five to ten years of experience, 8% have three to five years of experience, and a very small portion of 6% have only two years or less experience in the construction industry. It is also worthy to mention that an overwhelming majority of the respondents (97%)were familiar with the ACCE accreditation in general with 83% of them being involved with the ACCE accreditation process or ACCE campus visits.

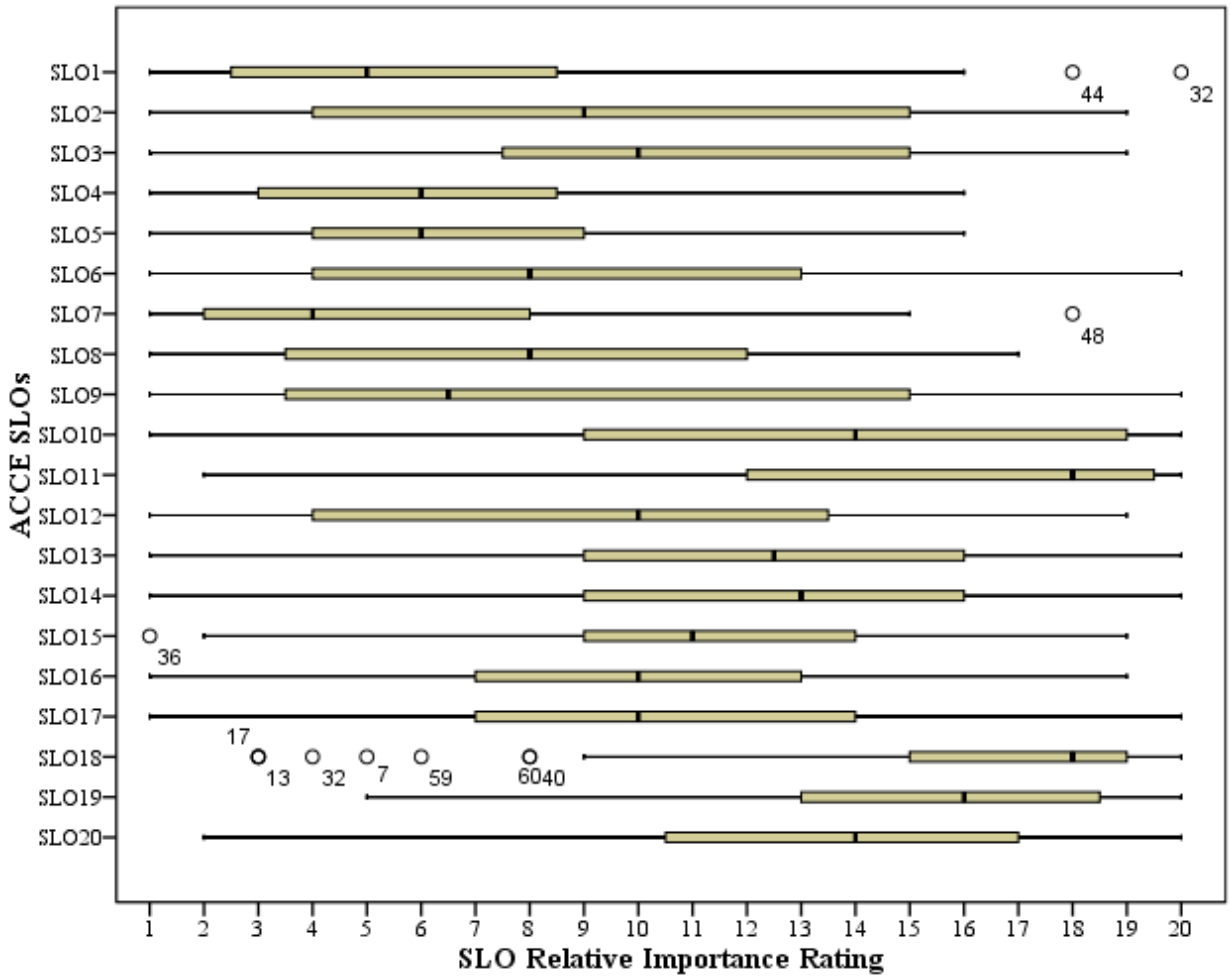

Figure 1. Box and whisker plot for the relative importance of the skills entailed per each SLO

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 educators' 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 1 (Create written communications appropriate to the construction discipline) SLO 4 (Create construction

project estimates) and SLO 5 (Create construction project schedules) 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 SLO 11 (Apply basic surveying techniques for construction layout and control) and SLO19 (Understand the basic principles of structural behavior). 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 10, although it is recognized as one of the highest cognition levels by ACCE.

As per the survey design, after ranking the relative importance of each SLO, the Bloom's taxonomy and cognition level concepts were introduced and defined. After the introduction, respondents were asked to rate the SLOs with the cognition level being taken out of the SLO verbiage, on a Likert scale that matched the cognition level, with 1 being the highest (create) and 6 being the lowest (understand). A box and whisker plot was also developed for both recent graduates and seasoned professionals (five years post-graduation). Figure 2 indicates a major change of perception within the construction educators when it comes to assigning a cognition level instead of ranking the relative importance. For example, SLO7, which ranked the highest based on the relative importance, did not necessarily translate 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 consensus of the educators on choosing the highest cognition levels with respect to SLO1 (Create written communications appropriate to the construction discipline) and SLO5 (Create construction project schedules) for both the recent graduates and the experienced professionals (after 5 years into the industry). It is also noticeable to see the expectations of the construction faculty regarding the development of the recent graduates in a 5-year span where the development expectation is expected to develop by about one to two cognition levels across the board.

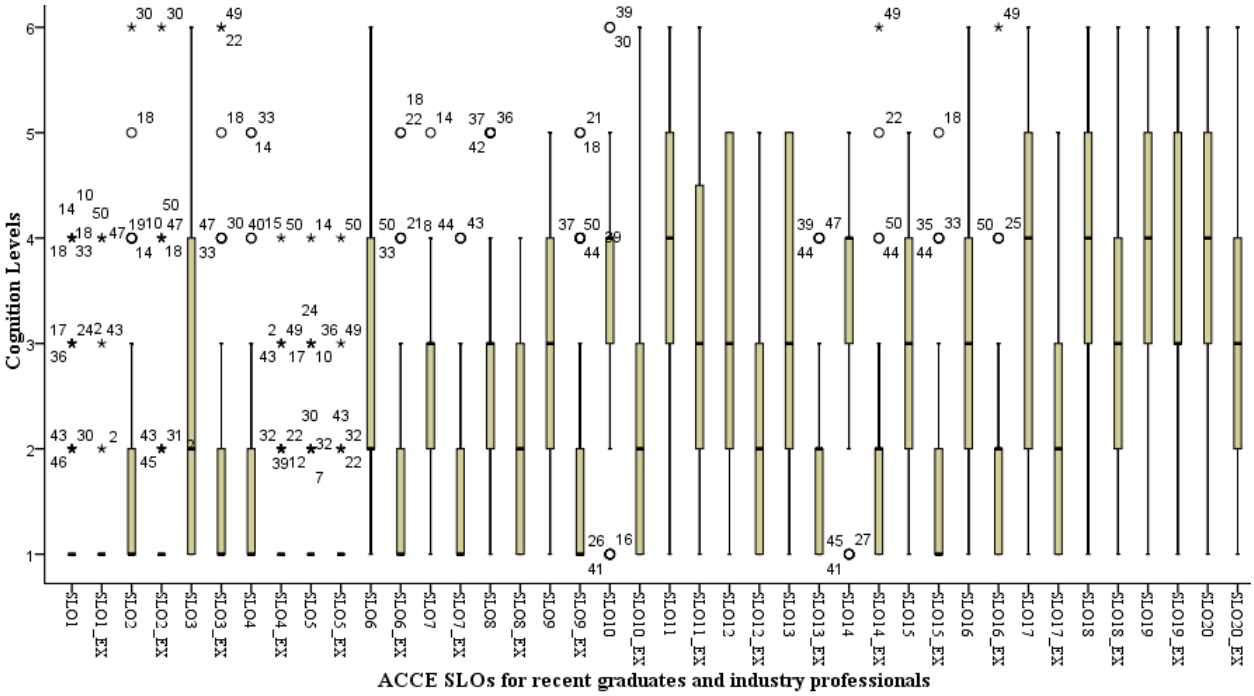

Figure 2. Box and whisker plot of recommended cognition levels for graduates and experienced professionals

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	SLO7	SLO5	SLO5
2	SLO1	SLO1	SLO1
3	SLO4	SLO4	SLO4
4	SLO5	SLO2	SLO2
5	SLO8	SLO3	SLO3
6	SLO9	SLO7	SLO7
7	SLO6	SLO6	SLO16
8	SLO12	SLO8	SLO15
9	SLO2	SLO9	SLO6,SLO9 (tie)
10	SLO16	SLO16	SLO12
11	SLO17	SLO15	SLO13
12	SLO3	SLO13	SLO14
13	SLO15	SLO12	SLO8
14	SLO13	SLO14	SLO17
15	SLO14	SLO10	SLO10
16	SLO10	SLO17	SLO18
17	SLO20	SLO11	SLO20
18	SLO19	SLO18, SLO20 (tie)	SLO11
19	SLO18	SLO19	SLO19
20	SLO11		

The final data analysis rearranged 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 represents 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, there have been no significant variation in the SLOs from the relative importance ranking perception to the cognition perception with only some exceptions such as SLO 8 (Analyze methods, materials, and equipment used to construct projects) which jumped from the 5th in relative importance to 8th in cognition level for recent graduate to 13th in cognition level for professionals. Similarly, SLO 7 (Analyze construction documents for planning and management of construction processes), SLO12 (Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process) and SLO 17 (Understand the legal implications of contract, common, and regulatory law to manage a construction project) among the relatively highest varied ranking among all the SLOs. Another interesting observation is the consistency of the SLOs ranking based on the cognition levels in the recent graduate and the professionals e.g. SLO1, SLO7, SLO4, SLO5, SLO9, SLO2, SLO3, SLO10, SLO19.

Conclusion and Future Research

The main goal of this preliminary study was to gauge construction faculty'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 a fairly overall agreement with the original ACCE ranking with some major exceptions such as SLO2 (create oral presentations appropriate to the construction discipline), SLO3 (Create a construction project safety plan), SLO7 (analyzing the construction documents for planning and management), SLO16 (understand construction project control processes), SLO17 (Understand legal implications)

and SLO20 (understand the basic principles of MEP). 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 some construction educators 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, SLO 8, SLO12 or SLO17. The data also reflected the expectations of the development of the graduate in a 5-year span to develop by about 1 to 2 cognition levels across the board. However, the construction educators expect some SLOs to be consistent in those 5 years of experience (SLO1, SLO7, SLO4, SLO5, SLO9, SLO2, SLO3, SLO10, SLO19) with respect of their ranking. Although the results were quite satisfying for a preliminary study, this study had a limited sample size. Future research by the authors will be working toward extending this research beyond this limit through different efforts. This research can be expanded to address a larger sample to more fully represent the construction educators. The authors also plan to address the construction industry and the construction student's perspectives to address any gaps between the accredited SLOs, the industry's perception and the educators' efforts while studying the alignment between the three bodies along with the correlation between the different analyzed factors.

References

ACCE. (2015). DOCUMENT 103 - STANDARDS AND CRITERIA FOR ACCREDITATION OF POSTSECONDARY CONSTRUCTION EDUCATION DEGREE PROGRAMS. Retrieved from http://www.acce-hq.org/images/uploads/Doc_103_OBS_final_0429151.pdf

Allegheny College. (2015). Environmental science department - Student Learning Outcomes. Retrieved from http://sites.allegheny.edu/envsci/department-facts/student-learning-outcomes/

Boyd, M., & Vitzelio, T. A Guidebook to Student Learning Outcomes And Administrative Unit Outcomes Retrieved from http://www.chaffey.edu/slo/resources/slo_handbook.pdf

Burt, R., Batie, D., Burns, T., Fletcher, D., Harris, G., & Schmidt, J. (2013). Commentary on the ACCE Student Learning Outcomes - SLO Task Force Report.

Carnegie Mellon. The Educational Value of Course-level Learning Objectives/Outcomes - Eberly Center of Teaching Excellence. Retrieved from https://www.cmu.edu/teaching/resources/Teaching/CourseDesign/Objectives/CourseLearningObjectivesVa lue.pdf

Centre for the Enhancement of Learning & Teaching. (2015). Advantages and disadvantages of the Learning Outcomes approach. Retrieved from http://www2.rgu.ac.uk/celt/pgcerttlt/specifying/speci10.htm

Chaplot, P., & Stute, C. (2008). A Guidebook to Student Learning Outcomes and Administrative Unit Objectives. *Walnut, CA: Mt. San Antonio College*.

Clinton Community College (2015). Who Benefits from Outcomes Assessment. *Student Learning Outcomes.* Retrieved from https://www.clinton.edu/StudentLearningOutcomes/WhoBenefitsfromOutcomesAssessment.cxml

Shupe, D. (2007). Significantly better: the benefits for an academic institution focused on student learning outcomes. On the Horizon, 15(2), 48-57. doi:doi:10.1108/10748120710757299

Fayetteville University. (2015). Department of Biological Sciences Learning Outcomes. Retrieved from http://catalog.uncfsu.edu/undergraduate/college-of-arts-and-sciences/bsci/learning-outcomes.htm

FEPAC. (2015). FORENSIC SCIENCE EDUCATION PROGRAMS ACCREDITATION COMMISSION POLICIES & PROCEDURES. Retrieved from http://fepac-edu.org/sites/default/files/FEPAC_Standards_11092012.pdf

Gow, L. and Kember, D. (1993), Conceptions of teaching and their relationship to student learning. British Journal of Educational Psychology, 63: 20–23. doi: 10.1111/j.2044-8279.1993.tb01039.x

Kuh, G., & Ikenberry, S. (2009). More Than You Think, Less Than We Need: Learning Outcomes Assessment in American Higher Education. Retrieved from: http://www.learningoutcomeassessment.org/documents/niloafullreportfinal2.pdf

New York State Archives (2015). Federal-State Education Policy Chronology 1944-2002 Retrieved from http://nysa32.nysed.gov/edpolicy/altformats/ed_research_chronology.pdf

NILOA. (2015). National Institute for Learning Outcomes Assessment - Mission and Vision. Retrieved from http://www.learningoutcomesassessment.org/AboutUs.html

Phillips, L. (1994). *The Continuing Education Guide: the CEU and Other Professional Development Criteria*. Dubuque, Iowa: Kendall/Hunt Publishing Company.

Säljö, R. (1979). Learning in the learner's Perspective-I. Some commonsense conceptions (Report No. 76). Gothenburg, Sweden: University of Gothenburg, Department of Education.

Shavelson, R. J., Schneider, G., & Shulman, L. S. (2007). A Brief History of Student Learning Assessment. Retrieved from http://cae.org/images/uploads/pdf/19_A_Brief_History_of_Student_Learning_How_we_Got_Where_We_Are_and_a_Proposal_for_Where_to_Go_Next.PDF

Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. Higher Education, 22(3), 251-266. doi:10.1007/BF00132290

University of Wyoming (2015). Department of History - Student Learning Outcomes. Retrieved from http://www.uwyo.edu/history/learning-outcomes/

Vinovskis, M. A. (1998). Overseeing the Nation's REPORT CARD Retrieved from https://www.nagb.org/content/nagb/assets/documents/publications/95222.pdf