Outcomes Assessment in an ACCE Construction Management Program

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Outcomes Assessment Development in an ACCE Construction Management Program

This paper presents the various perspectives on and levels of outcomes assessment developed by a construction management program implementing the new American Council for Construction Education (ACCE) Student Learning Outcomes accreditation requirements. The various elements of assessment are described with the methods of course assessment used in consideration of course learning outcomes and ultimately student learning outcomes. The process of developing the program through various iterations of faculty findings and subsequent refinements are illustrated with further implementation of data collection using Institutional Planning, Assessment and Research (IPAR) documentation to enhance the faculty collection process. These assessment efforts determined how the program continually contributed to student growth and development. The development process elaborated in this paper provides other construction management education programs, faculty, and researchers with a systematic structure for use in assessing program outcomes.

Introduction

With the recent transformation by the American Council for Construction Education (ACCE) moving from a prescriptive method of assessment to one using outcome-based assessment, a significant change has taken place by accredited programs. Even though the evolution into outcome based assessment, using 20 Student Learning Outcomes (SLO), has been in the planning and implementation stages since 2010, programs have been required to relook at their previous methods of assessment and determine the new format of assessment to use in their reaccreditation process. The author has been actively involved in the ACCE evolution to the new standards since 2010, and as such has been systematically involved in recreating the new assessment measures in the East Carolina University (ECU) construction management program. The following discussion explains the process of change by ACCE and how the ECU construction program developed their assessment program.

Historic Background

Since 1974 the American Council for Construction Education (ACCE) has been a leading advocate of quality construction education that promotes, supports, and accredits quality construction education programs. Its primary goal is promotion and continued improvement of postsecondary construction education. ACCE accredits construction education programs in colleges and universities that request its evaluation and meets its rigorous standards and criteria [1]. This accreditation enables employers to identify quality employees that have demonstrated their ability to meet industry standards through their education.

The governing body of the ACCE is the Board of Trustees which is composed of a representative of each construction association member, educators, a minimum of one and a maximum of five persons representative of the public-at-large, a minimum of one and a maximum of five persons representing the industry-at-large, and the Executive Vice President, ex-officio. This combination of industry and education membership encourage the continual development of a

professional needs education for future contractors. As employers recognize the significance of this accreditation body, the program's accreditation enables employers to identify quality employees that have demonstrated their ability to meet industry standards through their education [2].

The ACCE standards, before the change to Student Learning Outcomes (SLO) were developed in the 1990's and were periodically revised and updated. A three-level structure (*curriculum categories, core subject matter & fundamental topical content*) for setting the standards for the curriculum content came into force in 2002 following almost 10 years of committee work [11]. That curriculum standards were prescriptive that required a minimum number of credit hours to be taught in specific core subject matter and all fundamental topical content to be covered. Within each curriculum category, there was a specific core subject matter that has to be included in the curriculum. In most cases, a minimum number of credit or quarter hours were prescribed. Within each core subject matter area, the standards listed the topical content that had to be included in the curriculum. No quantitative measure was applied to topical content. There were about 70 items of topical content in those ACCE standards [3].

Beginning in fall 2010 the ACCE Student Learning Outcome (SLO) Committee started the process of moving the accreditation procedure from a Process Oriented Accreditation to an Outcomes-Based Accreditation [4]. Based on the analysis the Task Force recommended 10 step procedures for a Proposed ACCE Mapping of estimating learning outcomes to courses, assessment, and continuous improvement. They were: The ten steps were:

1. Define Learning Outcome
2. Map Learning Outcomes to Individual Courses
3. Map Learning Outcomes to Individual Courses and Direct Assessment
4. Set Targets for Students to Achieve for Direct Assessment
5. Record Students' Performance
6. Make Recommendations for Continuous Improvement
7. Map Learning Outcomes to Indirect Assessment
8. Set Targets for Direct Assessment
9. Record Indirect Evaluations
10. Make Recommendations for Continuous Improvement

In 2012, the SLO Task Force Committee and ACCE Executive Director, Mike Holland, conducted several workshops with AGC memberships around the country Industry involvement workshops took place in Atlanta, Dallas, Phoenix, and Milwaukee. Participants were provided with information to assist in developing student learning outcomes that would describe the knowledge, skills and abilities expected of students upon graduation. These results would be used for program assessment to demonstrate that graduates from the program have achieved the stated outcomes [11].

The information gathered from this exercise helped the Task Force not only formulate learning outcomes but also revise the Topical Content making up the ACCE body of knowledge. To define knowledge the Task Force used the standard definition used in Blooms Taxonomy:

Knowledge, as defined here, involves the recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting [5].

The Industry involvement workshops participants were given two tasks for development of the SLOs [11]. They were:

Task 1-Defining the knowledge students are expected to know by the time of graduation

Instructions to Groups for Task 1:
  i.   Each member spends 15 minutes writing down on their notepads as many items of knowledge or topical content as they can.
      - Use the examples from estimating below to help.
          o *"Quantity Takeoff"*,
          o *"Types of Estimates and Uses"* and
          o *"Job Direct and Indirect Costs"*.
      - Remember to identify knowledge or topical content outside of construction such as business and management knowledge.
  ii. Each group will have a recorder. For the next 15 minutes go around the group asking each member to identify the topical content or knowledge they rank as being the most important. Do not debate the merits of each item of topical content at this time. The aim here is for the recorder to develop a list of topics quickly. Record the list on your sticky notes so that other groups will be able to review.
  iii. Now review the groups list for 15 minutes and try to build a consensus on what the group believes are the most important items of topical content:
      - Consolidate similar items of topical content
      - Rank the groups top 15 items & add the ranking number to the sticky note
      - Review one last time for anything the group feels has been omitted
  iv. Now go around each group for the next hour, asking each group to nominate their highest ranked item of topical content. One of the facilitators will record the results.
      - Group 1 identifies its highest ranked item of topical content and the facilitator takes their sticky note and places it on the wall.
      - If another group has the same or similar item a facilitator will take their sticky note(s) at the same time.
      - Group 2 then identifies its highest ranked item of topical content, the facilitator takes their sticky note and the process is repeated until all items each group has chosen are recorded.
      - Review the display of topical content for any omissions
      - The final list of topical content will be displayed for use during the afternoon sessions.

Task 2- Defining the skills and abilities students are expected to have by the time of graduation

The information gathered from the exercise above will help us identify what our students need to know and understand by the time they graduate. The next step is to identify what skills and abilities you would expect students to have by the time they graduate; or to put it more simply,

answer the question, *"What would you expect them to do with the knowledge identified in Task 1?"* Blooms Taxonomy identifies the six intellectual skills and abilities as being remembering, understanding, applying, analyzing, evaluating and creating.

Instructions to Groups for Task 2:

i. Using the information gathered from Task 1. Each member spends 20 minutes writing down on your notepads as many skills and abilities a student should have at the time of graduation.

- Use your own experience and judgment to identify specific abilities and skills
- Use examples from "Bloom's action verbs" to help define the skills and abilities (see handouts)
- For example, if you use the topical content "Quantity Takeoff" as an example. You would expect students to be able to recall (remembering) how certain construction quantities are measured. You might however believe that a higher expectation for quantity takeoff is required based on your own experience or judgment. You might for example believe that a graduating student should be able to :
  - Classify quantities into CSI divisions (Understanding)
  - Calculate individual material quantities (Applying)
  - Analyze a set of material quantities (Analyzing)
  - Evaluate different quantity takeoff methods (Evaluating)
  - Create a bill of quantities (Creating)

ii. Each group will have a recorder. For the next 20 minutes go around the group asking each member to identify the most important skills and abilities a student should have upon graduation. Do not debate the merits of each item of the skills and abilities at this time. The aim here is for the recorder to develop a list of skills and abilities quickly. Record the list on the sticky notes so that other groups will be able to review.

iii. Now review your list for 20 minutes and try to build a consensus on what the group believes are the most important skills and abilities:

- Consolidate similar skills and abilities
- Rank your top 15 skills and abilities & add the ranking number to the sticky note
- Review one last time for anything the group feels may have been omitted

iv. We will now go around each group for the next hour, asking each group to nominate their highest ranked skills and abilities. One of the facilitators will record the results.

- Group 1 identifies its highest ranked skill or ability and the facilitator takes their sticky note.
- If your group has the same or similar skill or ability the facilitator takes their sticky note at the same time.
- Group 2 then identifies its highest ranked skill or ability, the facilitator takes their sticky note and the process is repeated until all skills and abilities of an individual group are recorded.
- Review the display of skills and abilities for any omissions
- The final list of skills and abilities will be displayed.

The outcomes of the Industry involvement workshops led to the development by the SLO Task Force of a proposal of 20 SLOs. At the 2013 ACCE Mid-Year Meeting, the SLO Task Force asked for Standards Committee approval of its proposed 20 SLO [6]. Those items were previously discussed and presented at the SLO Task Force meeting before the Standards Committee. At the meeting an additional request for the SLO "Apply appropriate knowledge of mathematics, science, and business fundamentals" be added. The ACCE Standards Committee passed the approval of the 21 SLOs. Before the 2014 Mid-Year meeting the committee reviewed and revised the standards to the new standard of 20 SLOs.

At the 2014 ACCE Mid-Year Meeting, a background overview of the Student Learning Outcome process and the development of the Outcome Based Standards (BS) Task Force (OBS) and the Training, Accreditation, Standards, Guidance (TASG) Task Force [7]. The project timeline for the revised 103 Standards implementation was:

Approval by Standards Committee	2/2014
Board Approval	7/2014
Document 102 & A-3	2/2015
Training	7/2015
Pilot Testing with new OBS Standards 103	Fall 2015
Programs can use either Old Standard or New Standard for Accreditation	Spring 2016
All Programs will use New OBS Standards for Accreditation	Fall 2016

Ultimately the new Outcome Based Standards 103 ((http://www.acce-hq.org/accreditation_process/accreditation-procedures/) were approved with all programs required to use the new standards in fall 2016 [8]. They are:

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 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

As one of the programs scheduled for reaccreditation in fall 2016, the ECU Department of Construction Management (CMGT) began its process of OBS assessment in spring 2013. The following discussion explains the process of developing their program assessment process following the new standards.

Program Assessment Development

During the spring 2013 and fall 2014 the ECU CMGT Department developed the Faculty and Core Course Coordinator Responsibilities document that included the initial faculty assignment of course and SLO responsibility for reviewing the assessment data relative to their courses annually, and prepare a summary as detailed in the Evaluating/Reporting Section for assessment

The assessment methods for the construction management program employs a variety of assessment methods to measure the students' achievements of outcomes and graduates' achievements of objectives. The assessment methods described are a mixture of *direct measures*, which are defines as quantified observations and ratings of student performance, and *indirect measures*, which are qualitative evaluations of student achievement, such as survey data. The assessment of the SLO Program outcomes is performed primarily with direct measures, including evaluations of specific samples of student work, targeted examination questions, and evaluations of capstone projects. These direct measures are supplemented by indirect measures, such as student surveys at the end of each class and at graduation. For assessment of Program Objectives, indirect measures are more prominent, as graduates and their employers are the best sources of information concerning post-graduation success. Qualitative measures, such as promotion/salary increases, professional development activities, and memberships in professional organizations can be used to measure achievement of objectives. Evaluation and reporting are important activities in "closing the loop". The use of assessment data is to improve individual courses and the CMGT program [9]. It was determined that at the end of each semester in which a course is regularly taught, the course instructors would prepare a report for the Assessment Committee that summarized:

1. Changes made to the courses, and reasons for the changes (referencing the previous year's report where applicable
2. Assessment summary results for the current year (Summary – details are documented in Student Survey Results and Student Work Sample Summaries)
3. Recommended changes for next offering of the course.

During fall 2014 and early spring 2015, the Assessment Committee and faculty members reviewed all CMGT course for content and course learning outcomes. This review led to the final approved Course Learning Outcomes (CLO) based on the appropriate SLO. In March 2015 the Assessment Committee and faculty met to determine the means of assessment for each of the CLO of each program class, since each class selected to be assessed for an SLO that are required

to have a minimum of two forms of assessment; or a minimum of one for each class when two classes are selected for assessment.

In conjunction with the CLO assessment, faculty developed an Introduce, Reinforce and Assess matrix to determine where each class had significance in the Student Learning Outcomes. After lengthy discussions and analysis of the course SLOs, the final courses were determined for the final assessment for each SLO.

By May 2015 a completed Quality Improvement Plan (QIP) was developed providing the guidance for the CMGT program, which quantified all assessment requirements for the program. Per ACCE requirements, these documents are available for public information [10]. The documentation includes the Program Mission, Quality Improvement Plan, Information Obtained from Assessment Measures, Actions Taken as a Result of Assessment Data Collected, Student Achievement, and Rates and Types of Employment of Graduates. (See Figure 1)

Undergraduate Program Implementation and Review								
Measures	Target	Person responsible for data collection	Due Date for data collection	Review by Assessment Committee – Met Target	Suggest action item	Review and approved by CMGT faculty	Implement changes (minor)	Implement changes (major)
			May 15th	June 10th	June 20th	August Faculty Retreat	This academic year	Next academic year
Average SAT score and GPA of Lower level CMGT courses	1100/3.0	Advising Center / CMGT Secretary-Student Admin.						
Percentage of underrepresented groups	20%	Advising Center / Registrar						
Direct Student Learning Outcome Assessments	At least 75% of class score "C" or above	Faculty						
Number of CMGT students participating in competition teams annually	10	Faculty / CMGT Secretary-Student Admin.						
Number of courses with hands on experiments	4	Chair						
Number of courses that effectively integrate technology	6	Chair						
Number of construction site visits annually	8	Faculty						

Graduating seniors exit survey (Knowledge, Skills, Personal Growth)	90%	IPAR						

Fig. 1 QIP Undergraduate Program Implementation

Spring 2015 was the first semester for a systematic reporting of all class CLOs, Assessed Course SLOs and Program Learning Outcomes (PLO). The attempt to collect the CLOs using an excel spreadsheet and individually analyze the data was found to be too cumbersome and was determined not to be a sustainable method. It was paramount that a more organized and robust system of data collection was essential.

In fall 2015 the author met with the Institutional Planning, Assessment and Research (IPAR) group to develop an organized collection process incorporating the revised TracDat program used by ECU. Since IPAR was in the process of introducing the revised entities created by TracDat to the university community, it was a favorable opportunity for the CMGT program. With ECU CMGT in need of a data collection method to fully collect all CLOs with systematic collection of selected class CLO/SLOs it was determined that CMGT program would become the Beta Program to assess the capability of TracDat to meet the needs of the university-wide program assessment.

The Assessment Committee responding by completing a spreadsheet that included each CMGT course with its CLOs listed, with the noted SLO that it referenced, and the method of assessment In addition each CLO was designated as being either an assessed CLO or not. This document was used to create the individual course assessment process for each course. Faculty would be required to document for each CLO the Actions Taken in assessing the course, Results of the determined assessment, Analysis of Results, and Actions Planned for the Next Semester. In addition to the individual course assessment, a collection of assessed CLO SLOs was also created. (See Figure 2)

Fig. 2 Course Assessment Document

Working with IPAR the final working model was implemented in fall 2015 in anticipation of creating a minimum of two semesters of the data collection for the ACCE Accreditation visit in fall 2016. The initial results showed that faculty members were not following all requirements for data input. A review by the Assessment Committee with each faculty member assisted in providing the faculty members the needed direction for future assessment activities at the completion of each semester.

The IPAR process for transfer of SLO documentation efficiently collected the needed data. It is this data the ACCE Accreditation teams use in determining the valid assessment of each program. In addition to the direct course assessment, two other means of indirect assessment are also included for each SLO. They are a One and Four-year alumni survey, and Employer Survey that are assessed each summer.

With the completed SLO documentation, that information is transferred to the yearly required ECU SACS Program Learning Outcomes (PLO). The six PLOs incorporate the 20 ACCE SLOs. (See Figure 3) The final report is created as a four-column document. (See Figure 4)

Program Learning Outcomes	Associated Student Learning Outcomes
PLO 1: Apply knowledge of engineering, materials, methods, equipment, and processes to safely construct buildings and structures.	SLO 3, 8, 11, 18, 19, and 20.
PLO 2: Survey and quantify building components to estimate project costs, analyze progress, and control expenditures.	SLO 4 and 14.
PLO 3: Create an effective planning, scheduling, and control system by identifying, evaluating and	SLO 5 and 15.

organizing the diverse elements of a construction project.	
PLO 4: Set up and manage project administration and management systems to document efficiently and monitor the construction process.	SLO 7, 9, 10, 12, 13, 16, and 17.
PLO 5: Communicate technical and financial data effectively in speech and in writing to all stakeholders in the construction process.	SLO 1, 2.
PLO 6: Exhibit an understanding of professional and ethical responsibility.	SLO 6.

Figure 3 ECU CMGT Program Learning Outcomes

CET Program - Construction Management (BS)

Department: Construction Management
Program: Bachelor of Science in Construction Management
Date of Most Recent Accreditation: 02/26/2011
Date Next Accreditation Due: 02/25/2017
Program Purpose - Unit Mission: Construction management is a diverse discipline focused on the delivery of projects that compose the world's built environment. As construction managers, our graduates plan, organize, and control construction projects of various types and sizes. The purpose of the BSCM program is to equip the students with the knowledge and preparation needed to initiate and supervise a construction project from inception to completion. Some of the major topics covered include plans and documents analysis, building codes, building information modeling, construction materials and methods, sustainable construction, estimating, scheduling, contracts and, safety and quality.
National Accreditations: American Council for Construction Education (ACCE). Full accreditation by ACCE was obtained in 1994. Subsequent reaccreditations followed in 1999, 2005, and most recently in February 2011. The next scheduled reaccreditation review is 2017.

Outcomes	Means of Assessments	Actions Taken, Results & Analysis of Results	Actions Planned
PLO 1. Application of Principles - Apply knowledge of engineering, materials, equipment, and processes to safely construct buildings and structures. **Outcome Status:** Currently Being Assessed **Outcome Type:** Student Learning Outcome **Start Date:** 09/22/2015 **5-Year Assessment Cycle:** 2015-2016, 2016-2017, 2017-2018, 2018-2019, 2019-2020	**Course Embedded -** Final SLO Assessment for classes used to access SLOs 3, 8, 11, 18, 19, 20 include course assignments, tests and papers. For SLO 3 evaluation of a Safety Plan will be used. For SLOs 11, 18, 18, 19, and 20 will use examinations and examination questions to evaluate. SLO 8 will use examinations and lab activities reports to evaluate. **Criterion for Success:** At least 75% of individual class scores will receive a score of 73% or above on each of the course embedded assignments. **Means of Assessment Status:** Active	**Result Status:** Criterion Not Met **Reporting Year:** 2016-2017 **Actions Taken:** Faculty were required to assess all CMGT classes at the end of the Fall 2016 semester and Spring 2017 semester. Analysis of Results indicated needed plans of action for the following semester. The CLO assessments are required for our ACCE accreditation, which are then translated to the Program Learning Outcomes (PLOs) as noted. This PLO deals with SLO's 3, 8, 11, 18, 19, and 20, and the subsequent classes assessed. Results: SLO 3: Create a construction project safety plan. CMGT 2900: Construction Project Safety Management Assessment Tool (1): Quizzes Fall 2016: 24/39 (62 %) students received a grade of 75% or higher. Criterion Not Met	**Actions Planned:** Actions Planned for Next Reporting Year: SLO 3: CMGT 2900: More open-ended questions will be incorporated into quizzes and exams to help evaluate student understanding. Hazard recognition exercises will continue to be a part of lectures, and additional JHAs will be added. In addition, students will be encouraged to become more active in discussions during class. Group development of a safety plan will be considered, given the size of the course section and the desire to have more in-depth information included in the plans. Using a campus project is

Figure 4 – PLO Final Report

The CMGT assessment process is undertaken at the completion of each semester with the PLO report completed at the end of each spring semester. As changes to the course requirements take place, faculty must present modifications to the Assessment Committee for approval and implementation into the IPAR database. Each year specific SOLs are assessed about the requirements and results of the specified SLO course assessments. Beginning in the fall 2017 semester Industry Advisory Board (IAB) members were asked to participate as industry mentors for each of the SLOs. The mentors work each semester with instructors that include their SLO in a course. Also, mentors work with the Assessment Committee and each SLO faculty for a through full review of the given academic years. (See Figure 5) At that time, if it determined

changes are required, subsequent course preparation is undertaken with submitted modifications to IPAR for inclusion into the database.

Year	Industry Focus Group	SLOs to be Reviewed	SLO Emphasis
2016-2017	IAB Group SLO Mentors	1, 2, 6, 7, 9	Communication, Ethics, Management
2017-2018	IAB Group SLO Mentors	4, 13, 14	Estimating, Risk, Cost Control
2018-2019	IAB Group SLO Mentors	5, 8, 11	Scheduling, Methods, Surveying
2019-2020	IAB Group SLO Mentors	3, 10	Safety, Electronic Technology
2020-2021	IAB Group SLO Mentors	12, 15, 16, 17	Project Delivery, Quality, Project Control, Legal
2021-2022	IAB Group SLO Mentors	18, 19, 20	Sustainability, Structural, MEP

Figure 5 – SLO Review Sequence

With the noted changes of using IAB Mentors, the continuing process of program development has been improved. Semester and yearly analysis of classes have enhanced the measurement of our student progress improvement.

Results and Continuing Development

In preparation for the fall 2016 accreditation visit, a complete Program Learning / Student Learning Outcomes / Course Learning Outcomes notebook was created for both the fall 2015 and spring 2016 semesters. The IPAR documentation process and report creation capabilities were essential in completing this documentation.

Areas or concern and need for continued improvement is the yearly review by the IAB Mentors, Assessment Committee and course instructors of the course learning outcomes and measures of assessment. It has been in continual development to increase the level of rigor in each course learning outcomes assessment method. As an example, even though a group of test questions can be used as a direct measure of assessment, the type and difficulty of the questions can be made more rigorous. Even in lower level courses, this level of rigor is expected. Faculty are charged in each semester to improve on assessment measures and to report the changes and outcomes in the following semester reports. This needed improvement continues to be an area of development.

The use of Industry mentors has strengthened our assessment and course learning outcomes. With the continual changes in the industry, the mentors are providing faculty with a wealth of information that they feel are relevant for our students. Because each mentor(s) are identifying their level of expertise, the learning curve to understand the course topics and assessment measures of all classes identifying with that SLO. Faculty meet, either face-to-face or through

Skype to discuss documentation. This a new process and initial results have proven beneficial. However some faculty are less enthusiastic as they feel the process is an invasion of their teaching. That problem continues to be a condition the author and the Assessment Committee continue to improve.

The interface with assessed SLOs and the PLOs continues to be a work in progress. The author is working with IPAR to develop a more seamless interface with the final reports. Discussions are leading to a less rigorous SLO reporting on the PLO. The current report is 45 pages that the author creates each spring by cutting and pasting of SLO reports results. Simplification to a level of 20 pages is under development, with the goal of direct transfer from the SLO reports to the final PLOs. This process is scheduled for a spring 2018 test.

The development of a quality assessment program as directed by the new ACCE accreditation standards has been shown to be a significant hurdle for most construction management programs. Numerous information sessions have been given at recent ACCE meetings, including the presentation of the ECU program. Continued improvement for other construction management programs, no matter their current data collection processes is needed as they develop new methods of assessment. The author desires to improve upon our system and disseminate those practices and procedures to other programs during their development cycles. This paper can be used as a beginning point of reference as other construction management programs develop their revised assessment methods.

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