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How is a Construction Curriculum Built from a Set of Learning Outcomes?

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A major shift has occurred in construction education as accrediting bodies have shifted from an "hours based" subject content requirement to a set of student learning outcomes. Twenty specific student-learning outcomes have been provided by the American Council of Construction Education's accreditation standards. Each of the student learning outcomes is intended to be an outcome of a complete undergraduate education in construction management. Most learning outcomes will involve a variety of classes across the curriculum. Each class will provide "building blocks" that will move the student toward the overall learning outcome. Universities have been tasked with developing their own set of "building blocks" or course learning outcomes as they seek to achieve the required student-learning outcome. This paper presents a case study of Auburn University attempt to develop the course learning outcomes given the overall student learning outcomes. Initially, faculty populated learning outcomes necessary to achieve the overall student-learning outcome. Then, industry was engaged through two focus groups to further refine and enhance the course learning outcomes within a given student-learning outcome. Results are presented for the ACCE learning outcome related to "Create construction communication appropriate to the construction discipline." Additional work is recommended to further refine and enhance the course learning outcomes that build to the overall set of student learning outcomes.

Key Words: ACCE, Construction Management, Construction Education, Curriculum, Learning Outcomes

Introduction

Prior to 2014, the American Council of Construction Education (ACCE) detailed requirements for construction education based on subject matter and a required number of hours of material within each subject. The curriculum was relatively direct as specific courses corresponded directly to a given subject matter with the required number of hours based on the contact hours for the course. Industry input on this curriculum was direct and quantitative. Industry feedback using the "hours based" accreditation approach often recommended focus areas or specific content within a given subject matter. With ACCE's shift to learning outcome based accreditation standards in 2015, minimum standards were set for desired outcomes in a variety of subject matters. Essentially, ACCE provided a list of what students graduating from Construction Management programs should be able to do at the time of graduation. Universities must determine the steps for students to receive this learning outcome and how to measure the student's achievement in the specific area prior to graduation. While the standards were clear and direct, no specific path was provided as to how Universities would develop a construction curriculum based on the minimum standards provided.

This paper explores one possible approach to developing a curriculum from the learning outcomes provided in a case study format. First, faculty were asked to develop course learning outcomes that would be required to achieve the overall student learning outcome dictated by ACCE. For example, if an overall objective was to "create communication appropriate for the construction industry" (ACCE learning outcome), one must first "understand relevant communication tools within the construction industry" (Class level learning outcome). Construction faculty developed these class level-learning outcomes for all twenty ACCE learning outcomes in the Fall of 2014 and the Spring of 2015.

Then, industry input was sought in the summer of 2015 using two focus groups of industry participants in two key markets the school serves. Industry input helped further develop the class learning outcomes developed by the faculty for specifically selected learning outcomes. In the area of "written communication appropriate for the

construction industry", the focus groups further defined the documents they would expect students to be able to create at the time of graduation. The combination of initial faculty work plus the industry focus groups produced a "framework" of class level learning outcomes for each subject-learning outcome that may be used to begin to develop an overall curriculum.

Focus groups were collection of industry partners in two major cities. Participants from a variety of professional backgrounds were purposely selected so that a wide sample of companies that hire our students participated. Focus groups were held in industry offices within the selected cities. With only two focus groups, results remain anecdotal in nature. By disseminating this information, it is hoped that the authors can receive feedback on the approach and use this to develop a more detailed survey that can be widely distributed to the wider construction industry. If successful, such a survey could help better refine required course learning outcomes within the curriculum in the years ahead.

Literature Review

The need for transparency and more accurate assessment of student performance in post-secondary degree programs has brought on changes at the accreditation level. Accrediting organizations and universities are responding to a request by the US Department of Education in 1989 to examine the use of learning outcomes as a condition of institutional accreditation process (Gallagher 2010). This process has been a slow and widely debated in the United States for the past 3 decades (Kuh & Ewell 2010). This time lag appears to be due in part to competing perspectives, misunderstandings, and incorrect assumptions of the various stakeholders in the accreditation process (Proitz 2010). Curriculum based on student learning outcomes has been more accepted and used in other countries compared to the United States educational system. The Spelling Commission in 2006 emphasized the need to improve Higher Education performance and the ability to compare student progress. Some concerns expressed by the commission were the declining ability of our higher education system to develop a workforce capable to competing in a global market and the United States' ability to keep pace with competitor countries (US Department of Education 2006).

Implementing learning outcome in the accreditation process has shifted the assessment paradigm from content exposure to measurable and appropriate student performance outcomes. Assessment of learning outcomes serves two purposes. First, university and accrediting organization are accountable for meeting or exceeding student performance levels. Second, the learning outcomes provide guidance in improving the quality of teaching and curriculum development for each program in the future (Kuh & Ewell 2010). Outcomes describe what the student actually achieves, as opposed to what the institution intends to teach (Allan 2006). Learning outcomes define the knowledge the student will have and the ability to apply that knowledge at the end of the learning process. To maximize the quality of student learning outcomes, programs need to develop courses in ways that provide students with teaching, learning materials, tasks and experiences that do the following (Meyers & Nulty 2009):

1) are authentic, real-world and relevant;
2) are constructive, sequential and interlinked;
3) require students to use and engage with progressively higher order cognitive processes;
4) are all aligned with each other and the desired learning outcomes; and
5) provide challenge, interest and motivation to learn.

To achieve item two listed above, an outcome based design sequence should be adopted in which the exit outcomes for the curriculum are first specified (Spady 1988). For construction industry programs at the post-secondary level, which are accredited by the American Council of Construction Education (ACCE), the governing board implemented 20 student learning outcome (Figure 1) for program assessment at their 2014 annual meeting. These SLO's, which were developed by ACCE Task Force (ACCE-SLO Task Force Commentary 2013), will be used to assess the quality and student performance of each program during the accreditation or reaccreditation process (ACCE – Document 103, 2015):

1) Create written communication appropriate to the construction discipline.
2) Create oral presentation appropriate to the construction discipline.
3) Create a construction project safety plan.
4) Create construction project cost estimate.
12) Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.
13) Understanding construction risk management.
14) Understand construction accounting and cost

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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.
15) Understand construction quality assurance and control.
16) Understand construction project control process 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 principles of structural behavior.
20) Understand the basic principles of mechanical, electrical and piping systems.

Figure 1: ACCE – 20 Student Learning Outcomes (ACCE-Document 103, pp. 14-15)

To facilitate the progression of cognitive learning from basic understanding and memorization to being able to create new ideas, ACCE student learning outcomes used the Bloom's (1956) taxonomy model. Each of the 20 student learning outcomes are written to meet a minimum hierarchy level of intellectual skill and understanding for students' thinking. The first word, (in increasing order – remember, understand, apply, analyze, evaluate or create) in each SLO indicates the level to be obtained. Higher level learning requires professors to progressively structure concepts to enhance their understanding (Meyer & Nulty 2009).

Outcome based education does not represent an easy option and adopters will find difficult challenges (Harden, Crosby & Davis 1999). What outcome-based education provides for the student and specifically the construction program is opportunity to customize their curriculum to meet stakeholder and industry needs. These needs can be based on the local, state, regional, nationally or international levels. Some examples of the stakeholders are shown in Figure 2. It is important for a program to get as much feedback from the stakeholders as possible, but stakeholders must understand that not all needs can be met. It is the responsibility of the faculty and administration to filter the information and incorporate industry needs appropriate for their curriculum.

- Students at the Associate, Bachelor and Graduate levels.
- Parents
- Faculty
- Construction Firms
- Specialty Contractors
- Owners
- Design Professionals
- Collaborating – Universities, Colleges, Schools or Departments
- Manufacturers
- Facilities Managers
- University Administration
- Alumni
- Vendor
- Industry Organizations – ABC, AGC, DBIA, MCAA, NECA and others
- Labor Organizations
- Community Organizations
- Local, State and National Government Unit
- Code and Standards Organizations
- Academic Professional Associations

Figure 2: Examples of program stakeholders

Student learning outcomes foster customizable, flexible and creative approaches to curriculum and teaching to meet individual program and industry needs while maintaining student performance requirements. "Critical to the success of any curriculum revision is stakeholders' willingness to start with a clean slate and throw out everything that's been done in the past" (Olsen & Burt 2010). To provide the best curriculum revisions to meet the industry needs and facilitate student performance, it is imperative for effective collaboration between the major stakeholders during the process. Collaboration can enhance the visibility of the university to industry and meet industry's education and training goals (Beckman, Khajenoori, Coulter & Mead 1997).

Methods

In the Fall of 2014, Auburn University Building Science faculty were presented with a sequence of resources regarding the use of course learning outcomes to construct on overall student learning outcome. ACCE learning

outcomes were reviewed, and discussions on the learning outcomes were held in a variety of settings including faculty meetings, conferences, and structured presentations on items like hierarchy of Bloom's taxonomy. The Writing Center at Auburn University was consulted, and they provided a specific example of using Bloom's Taxonomy to build to an overall course-learning outcome. In that example, the learning outcome addressed communication, and the pyramid was constructed so that the highest form of achievement in the pyramid involved the student's creation of an e-portfolio. All items below this "create" level tended to provide students the tools needed to reach the higher levels of the pyramid. This approach was essentially copied with a pyramid created for each of the twenty learning outcomes identified by ACCE.

After the concept was introduced and faculty began to consider the required learning outcomes, a series of large posters (one for each of the 20 learning outcomes) was posted in the faculty area of the construction building. Each poster included a triangle showing the various levels of Bloom's taxonomy coupled with the overall student outcome. Faculty were then asked to populate each of the ACCE learning outcomes with the required class level learning outcomes. Faculty used large "Post It" notes to add suggested class level learning outcomes to achieve the overall class learning outcomes (Figure 3).

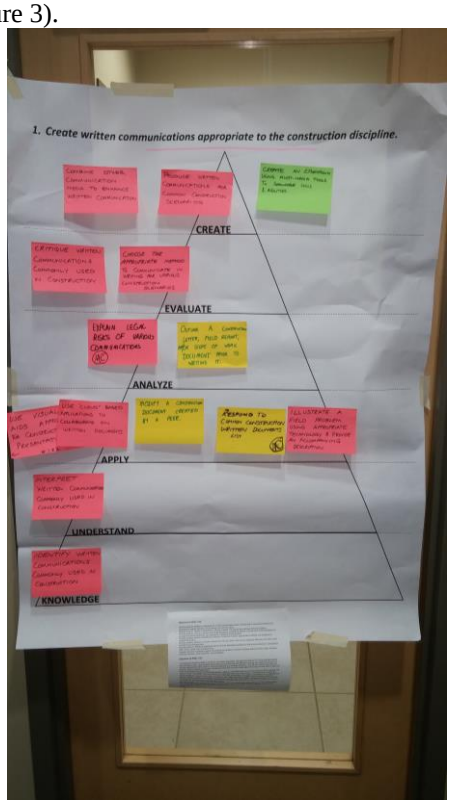

Figure 3: Graphical triangle used to construct class level learning outcomes that build to overall ACCE learning outcome for "Create written communication appropriate to the construction discipline."

The outcomes developed by faculty appeared complete in some areas but lacked sufficient detail in other areas. In the area of "written communication", one of the items missing was the specific construction documents a student should be able to produce at the time of graduation. In order to further refine the required course learning outcomes, two focus groups were developed in separate metropolitan areas that engaged industry in the learning outcomes development. The visits were coordinated through construction organizations and the schools industry advisory council. Participants included many graduates of the university's program, but they also included industry professionals who simply had an interest in the curriculum. The majority of the participants were seasoned professionals with many years of industry experience.

The focus groups with industry included the development of the strengths, weaknesses, opportunities, and threats for the construction management program. Then, a short presentation educating the industry on the ACCE learning outcomes was given. Following the ACCE learning outcomes presentation, a discussion was held as to how lower levels of Bloom's taxonomy were required by students before higher levels of learning could be achieved. Once the overall system was understood by the participants, and a clear identification of strengths and weakness of the program were identified, industry was tasked with revising or adding to the course learning outcomes provided by

faculty. Industry worked in groups of three to five people to arrive at conclusions for each student learning outcome discussed.

Results

Faculty were initially challenged with populating the course learning outcomes necessary to achieve the overall student learning outcome. For higher-level student learning outcomes like "create", a major focus was put on establishing lower level outcomes of Bloom's taxonomy in an effort to build toward higher-level outcomes. As shown in Figure 4, course outcomes to develop knowledge and understanding are required before students can evaluate or create within the same student-learning outcome. Results were presented in a stair-stepping ladder format in an effort to formally represent the idea that lower level course outcomes work together to prepare the student for higher levels of learning and achievement within the overall student-learning outcome.

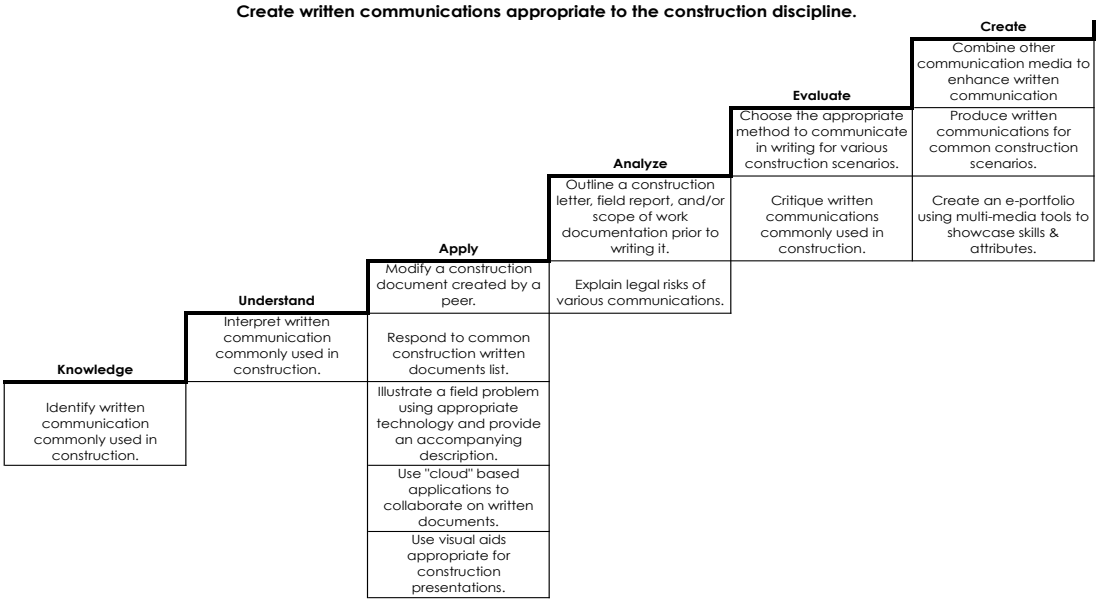

Figure 4: Course level learning outcomes created by faculty for "Create written communication appropriate to the construction discipline."

Efforts were made to use verbs appropriate for each of the learning outcome levels. Verbs were developed from (Anderson 2014). For example, verbs used in the learning outcome level of "apply" included "modify", "respond", and "illustrate". Higher-level learning outcomes require verbs for course learning outcomes such as "produce" and "create". These verbs illustrate the higher level of learning required of the student as one moves from left to right in Figure 5.

Industry input on the "create written communication" student-learning outcome was focused in two key areas. First, industry groups indicated the specific construction documents they expect students to be able to create at the time of graduation. These documents included the following: meeting minutes, internal monthly project reports, external monthly project reports, change orders, RFIs, e-mail, bid invitations, scope statements, clarifications for pricing, notice letter to sub-contractors, and value engineering documents. Second, they identified other communication issues thought to be critical for new graduates. These items included using appropriate rules of engagement for

meetings, analyzing "notification" and its impact on construction contracts, identifying methods of evaluation including giving and receiving feedback in industry, writing personal goals, and developing content for social media appropriate for the construction industry. These changes are illustrated in the shaded area of Figure 5.

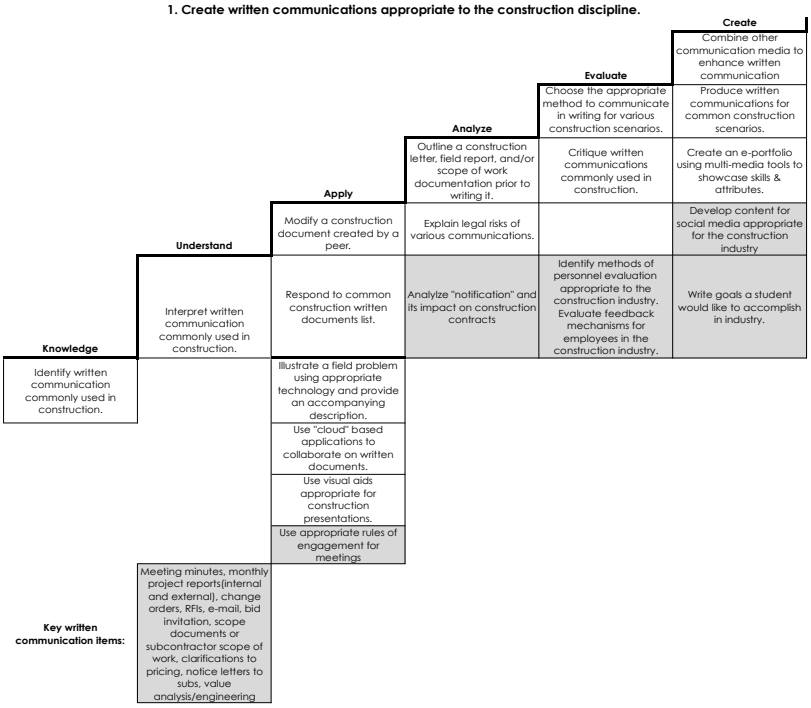

Figure 5: Course level learning outcomes refined through industry focus groups for "Create written communication appropriate to the construction discipline."

Authors' Analysis and Conclusions

Given the ACCE student learning outcomes, individual University programs must determine how they achieve the required outcomes. The outcomes represent a clear shift away from an "hours-based" subject content approach and allow Universities to tailor specific regional and industry needs to provide a solution that meets both the learning outcome and the needs of the region and industry. This initial case study engages faculty and industry at a single University in an effort to better understand how student-learning outcomes will be achieved. Faculty were used to initially populate the course learning outcomes required to meet the overall student learning outcome. Two industry focus groups in two metropolitan areas then engaged in discussions to improve the work completed by faculty and add content they believe relevant for new graduates that come to work for the firms.

The resulting work yielded a series of course level learning outcomes that build toward the overall student learning outcome. These course level learning outcomes can now be adopted directly into a given class or divided among several relevant classes. For higher level learning outcomes, it is anticipated that multiple classes will be required to fulfill all the relevant course level outcomes identified.

The authors believe it is critical to engage industry in the discussion of course level outcomes. Additions of relevant, current items that new graduates face in industry make the student learning outcomes more tangible and direct. They also help individual universities interpret the student learning outcome in a way that most benefits the students and the firms for which they may ultimately work.

A potential negative of the approach is that the focus group discussion from industry may have yielded more of a "shopping list" of desired outcomes as opposed the outcomes required to simply meet the student-learning outcome. Further study is needed to consider the items identified to determine if a classroom or industry setting may be best for individuals to learn the material. Industry general suggested that items such as the 30-hour OSHA training or shop drawing review might be best handled by industry as compared to a classroom. However, this discussion was considered outside the scope of this study and needs further development and consideration.

In addition, only two focus groups totaling approximately 28 people were engaged in the discussion. Such a sampling of industry partners may not be indicative of all student employers and may unnecessarily connect students with only some sectors of the industry. Further study is needed to expand engagement with industry. The authors suggest a written survey distributed to a wider section of industry partners to further refine and improve the course outcomes required to achieve overall student learning outcomes.

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