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A Pilot Study in Methodology for Operationally Defining Student Learning Outcomes

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In July of 2014 the American Council for Construction Education officially adopted a new outcomes-based curriculum standard centered on student learning outcomes (SLO's). Under the new standard construction education programs seeking accreditation by the organization will be required to provide evidence to show that graduates from the degree program have met the Learning Outcomes listed. Many construction educators have raised concern about the high probability for disagreement on interpretation of the ambiguous SLO's and the potential impact that disparity could have on program accreditation. This paper presents a suggested approach for addressing this issue through establishment of operational definitions for the SLO's. A pilot study using a "hybrid Delphi" methodology is presented. Results of the approach indicate potential promise to contribute towards the problem but have also identified some challenges to be overcome in execution of the method.

Key Words: Accreditation, Student Learning Outcomes, ACCE, Delphi, Performance Criteria

Introduction

In February of 2010 the American Council for Construction Education (ACCE) established a Task Force to evaluate the organization's approach to program curriculum. The purpose was to investigate if ACCE wanted to continue with their existing prescriptive-based curriculum standard or move to an outcomes-based standard (Burt, et al., 2013). After four years of investigation conducted by the task force, the ACCE Board of Trustees officially approved the measure at the ACCE Annual Meeting in July 2014 to adopt a new outcomes-based curriculum standard that is centered on Student Learning Outcomes (SLOs) (ACCE, 2015). Student Learning Outcomes are defined by ACCE in their Document 103 OBS (2015) as "statements that describe the level of student learning to be achieved prior to graduation and that support the degree program objectives." The section goes on to explain that "All degree programs shall provide evidence to show that graduates from the degree program have met the Learning Outcomes listed…" (Student Learning Outcomes section, para. 1). While the new standards encompass a number of changes, it is the previously stated requirement that is raising major concern by programs.

Demonstration of the SLOs are a major factor in achieving accreditation by the organization. ACCE has established 13 and 20 SLOs required to be met by Associate Degree and Bachelor Degree programs respectively. By intention, the student learning outcomes were developed in a vague format so as to allow flexibility for programs to adapt the outcomes to their specific mission and goals. As an example, SLO #18 in Document 103 OBS (2015) requires programs to demonstrate student's ability to "*Understand the basic principles of sustainable construction"* (Section 3.1.5.2). This outcome can be interpreted in a multitude of different ways which can be problematic when considering accreditation review. In recent ACCE meetings many construction educators have raised concern about the high probability for disagreement on interpretation of the SLO's and the potential impact that disparity could have on program accreditation. These concerns do carry some merit. When the Accrediting Board for Engineering and Technology (ABET) instituted their outcomes-based accreditation criteria (EC 2000), it left many engineering educators concerned about how best to operationalize each outcome (Besterfield-Sacre, et al., 2000). Rogers (2015) reinforces this concern in her presentation on "Defining Student Outcomes" stating:

"Faculty can usually agree on the general outcomes that students should demonstrate by the end of the academic program. However, without a common agreement as to what specific performances should be expected from students around each of the outcomes there is no way to have a systematic, efficient nor meaningful process of data collection to determine if the outcomes have been met" (Student Outcomes and Performance Indicators, para 2).

These concerns of ambiguity in the newly adopted ACCE student learning outcomes are significant to construction education. In January 2016, the new standards will become a requirement for all programs seeking accreditation by the organization (ACCE Moving Forward, 2014). Establishing further clarification of the SLOs, and a methodology

for doing such, will be important to the future of outcomes-based accreditation in construction education. The objective of this research is to establish operational definitions - in the form of performance criteria - for each of the 20 ACCE Student Learning Outcomes for Bachelor Degree programs as a means to more clearly identify tangible measurable attributes of each student learning outcome. This paper will present a description of the proposed methodology – termed "Modified Hybrid Delphi" – and results of the first stage of the study.
The first stage results presented in this paper provide opportunity for discussion on the efficacy of the approach. This research is expected to benefit programs accredited by ACCE through expanding understanding about how to address the new standards. The methodology, and resultant attributes, could be used by other programs as a means to more clearly define how they are measuring each outcome. As well, this research could provide a foundation for potential adoption of standard definitions of each student learning outcome. This is a significant contribution to the construction education community given ACCE is arguably the largest accrediting body for construction education programs in the United States. There are currently 86 programs accredited, and 18 programs in candidate status by the organization (ACCE Programs, 2015). Beyond construction education, outcomes of this research will also be beneficial to the engineering and architecture disciplines as their accreditation models also follow an outcomes-based approach.

Method

Approach

The approach for this study drew on a technique termed by Landeta, Barrutia, and Lertxundi (2011) as "hybrid Delphi" which combines the three research concepts of Focus Groups, Nominal Group Technique, and Delphi. These concepts are commonly used in studies aimed at drawing information from a group of professional experts. Used individually, they have identified weaknesses (Van de Ven and Delbecq, 1974). However, Landeta (2011) suggests that combining the three approaches offsets each one's individual problems and in turn elicits more robust results. Table 1 illustrates the proposed strengths and weaknesses of each approach and their potential contribution to identified problems associated with using professionals in research investigations.

Focus Groups

The purpose of the focus group is a brainstorming session to generate abstract ideas about a general concept. Educational research terms these abstractions as "constructs" (Frankel and Wallen, 2015). In the case of this study the general concept would be recognized as - establishing learning outcomes for students in construction programs. The resultant learning outcomes – or SLOs – are the "constructs" that would be generated from the focus group session. Given the student learning outcomes have already been established through an extensive research process conducted by the ACCE Task Force, the author felt it was unnecessary and redundant to conduct the focus group portion of the hybrid Delphi framework. Considering this, the study began with the next step in the technique – the Nominal Group Technique (NGT).

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Table 1

Strengths and Weaknesses of FG, NGT, and Delphi

Problems when using professional groups	Techniques potential to contribute to the identified problems		
	Focus Groups	Nominal Group Technique	Delphi Technique
Previous ignorance of technique for consultation and interaction	Low	High	High
Difficulty in obtaining group participants with needed variation of expertise	High	High	Low
Difficult to coordinate time and place for all group participants	High	High	Low
Little availability of time	Medium	Medium	Medium
Needs for relation and social recognition	Low	Medium	High
Need for learning and improvement	Medium	Medium	Medium
Need for immediate feedback and perceived sense of closure	High	Low	Medium
Misalignment between investigators view of study and participants	Low	Medium	High
Tendency to rush to immediate answers in questions without careful consideration	High	Medium	Low
Risk of inhibition due to dominant members or other causes	High	Medium	Low
Risk of behaviors that seek social approval	High	Medium	Low
Potential pressures to conform answers to dominant group members	High	Low	Medium
Potential for distraction due to group environment (off-task discussions between group members)	High	Low	Low
Fear to contribute new ideas in front of other group members	High	Low	Medium

Source: Adapted from Van de Ven and Delbecq 1974, and Landeta, et al. 2011

Nominal Group Technique (NGT)

The Nominal Group Technique (NGT) is described by it's creators as "a structured meeting which seeks to provide an orderly procedure for obtaining qualitative information from target groups who are most closely associated with a problem area" (Van de Ven and Delbecq, 1972). Since the technique's development in the 1960's, it has been widely adopted in many different research areas including business management, social sciences, education, and healthcare, to name a few. Similar to focus groups, the technique involves face-to-face interaction of professional experts situated in groups. The approach is intended to generate solution ideas toward a given problem or topic (Owen, A., Arnold, K., Friedman, C., and Sandman, L., 2015). NGT is structured in a four-step process organized and delivered by a facilitator (someone part of the research team). In the first step, participants are situated into groups of 5 to 8 people and asked to consider the problem/topic individually and right down their thoughts about the given issue. Step two involves each participant sharing their thoughts with their respective group about the topic. During this exchange there are no evaluations or comments being made by the other group participants. Each participant is simply listening and taking notes. After all group members have shared their ideas, round three begins. In round three the groups are talking together as a whole and discussing the different ideas generated. During this discussion, the group members attempt to rank the different ideas on level of importance related to the given topic. In step four after each group has arrived at a scaled list of ideas/solutions to the topic all groups are brought together by the facilitator for review of the generated ideas. In this final step each group is presenting their generated ideas and then all groups are evaluating those ideas together and working to arrive at the optimal synthesized solutions. Most likely each group will have generated some similar ideas and those ideas will typically hold the top spots in the final synthesized solution.

Dephi Technique

Delphi is a method that was developed in the 1950's as a means for identifying and prioritizing ideas through a

consensus based approach from a set of experts knowledgeable in a specialized area (Boberg & Morris-Khoo, 1992; Okoli & Pawlowski, 2004; Landeta, et al. 2011). The goal of the technique is to arrive at a group opinion through decisions made anonymously by individual participants without being influenced by other participants (Pan, et al., 1996). Typically, completion of the Delphi technique involves a couple rounds, or more, of rank order surveys intended to systematically arrive at the most important elements of a topic, problem, or idea.

Participants

The sample population for the study was delimited to members of the construction programs Industry Advisory Board (IAB), and faculty of the program. This was done purposefully because the desired results of the study are to arrive at operational definitions relevant to the needs of the industry sector that is hiring students from the program. Given the intent at this time is a pilot study of the approach, the author also recognized this population to be the most accessible and likely to be willing to participate given their interest in the program. Additionally, delimiting the sample to these groups helps reduce some of the potential problems identified earlier that are associated with using focus groups and NGT.

Advisory board members represent an accessible sample of n=20 individuals representing 15 companies. These companies cover a market sector over multiple states within the U.S. and a range of work areas from residential construction to large-volume (over $1Billion annually) commercial contractors. Program faculty include a potential of n=5 participants (including the author) encompassing a wide range of expertise areas and experience levels. This population provides opportunity for a wider range of viewpoints needed to effectively achieve the intent of the study.

Recruitment

One of the challenges recognized by the author when working with professional participants is difficulty in response rate. In an effort to alleviate this issue, the author used the programs regularly scheduled IAB meetings as a venue to facilitate the study. Two weeks prior to the scheduled meeting, members of the program's industry advisory board were sent an email with a letter informing them of the new accreditation criteria and the subsequent impact it meant for the program. The letter explained details of the accreditation changes and how the program would like to involve them in addressing those changes at their upcoming IAB meeting. Program faculty were provided the same information as the advisory board members and requested to participate in the study via faculty meetings and formal email invitation.

Data Collection

Round 1: NGT

Data were collected from program faculty at a different time than the industry advisory board members. This was done to help reduce potential bias resulting from influence the different backgrounds and perspectives could have on each other. As such, the program faculties were asked to participate in the study prior to the scheduled IAB meeting. Because the faculty population was only a potential of five, they were provided with a list of the 20 SLO's via email and asked to provide a response to each one and email those responses back to the author for analysis. The submitted responses would then be reviewed and ranked for importance by all program faculties in a face-to-face format.

Data collection for the IAB meeting was setup in a workshop scenario to facilitate the NGT. At the start of the workshop the author conducted a ten-minute presentation to the participants as an introduction/review to the new accreditation standards and the challenge faced with the student learning outcomes. This helped clarify the intent of the workshop and offered opportunity to clarify any confusion by the participants. Following the presentation a handout was issued to the participants that included descriptive information for them to complete, along with an agenda & instructions, and a list of the SLO's. Prior to separating the participants into small groups, as shown in figure 1, the author (acting as the facilitator) went through the agenda and instructions to clarify any misunderstandings about the NGT process (Table 2).

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Figure 1: IAB member participants organized in small groups for NGT workshop

Round 2: Delphi Phase 1

Round two of the study included completing the first phase of the Delphi study. In this round, a Likert-scale survey was developed that included various attributes for each SLO that were identified in the Round 1 NGT. Participants were asked to individually rank each attribute based on its level of importance in being relevant to demonstrating achievement of the specific SLO. As with the NGT round conducted with the IAB members, Phase 1 of the Delphi was conducted during the next IAB meeting. However, in this round it was deemed appropriate for the program faculty and IAB members to complete the survey during the IAB meeting rather than at separate places and times because the surveys were completed by all the participants individually. The completed surveys were then returned to the author for analysis.

Table 2

Agenda and Instructions Issued to IAB Participants for NGT

AGENDA & INSTRUCTIONS:

Task 1: Small Group Huddles (60 min.)

(Meeting attendees will divide up into small groups of 3 to 4 people)

Step 1 (30 min.) – On an individual basis think of descriptors for each of the 20 learning outcomes that you think define what each outcome means and write down the descriptor.

Step 2 (15 min.) – In this step each group will establish a recorder for the group. After a recorder has been established go around the group asking each member to identify the descriptors they rank as being the most important for each of the 20 SLO's. Do not debate the merits of each item at this time. The aim here is for the recorder to develop a list of descriptors quickly. Record the list on a piece of paper.

Step 3 (15 min.) – Over the next 15 minutes review the groups list and try to build a consensus on what the group believes are the most important descriptor items for each SLO.

- Rank the groups items from most important to least (number the items as you rank them), making sure to consolidate similar descriptor items for each SLO
- As you rank the descriptors, write each one on a separate sticky note with their corresponding ranking number
- Review the items one last time for anything the group feels may be missing and add those items as appropriate

Task 2: Group Consolidation (60 min.)

(Individual small groups will come together to display and discuss their results)

Step 1 – The facilitator will guide the groups through each of the SLO's asking each group to identify their

highest ranked descriptor and stick it on the wall. At this time if other groups have identified the same descriptor as their highest ranked, they should put it on the wall as well.
Step 2 – The facilitator will continue the process until the top 10 descriptors have been identified or all identified descriptors have been exhausted for each SLO (whichever is fewer).

Step 3 – After all descriptors are identified for one SLO the attendees will review for any potential missing items and add them as necessary. The process will continue until all SLO's are completed.

Step 4 – The facilitator will take the information collected and compare it with feedback from a separate faculty study to identify gaps and overlaps. Results from this information will be used in the development of a final survey that will be sent to all participants for a final round of feedback.

Results

Round 1 – Nominal Group Technique

In total there were five, program faculty and 32 individuals representing the various advisory board members invited to participate in the first round of the study. Of those, n=3 faculty and n=16 advisory board members representing 13 different companies participated. This represents a 60% and 50% response rate for faculty and IAB participants respectively. The IAB participants were broken into four different small groups for execution of the NGT. Unfortunately, due to time constraints two major alterations had to be made to the NGT format: First, rather than each member going through all 20 SLO's, the SLO's were split in half and two different groups completed SLO's 1 – 10 while the other two groups completed 11 – 20. This ensured that, while reduced, we would at least be able to collect data on all 20 outcomes. Secondly, we were only able to complete Task 1 of the NGT. While this was disappointing, Step 3 of Task 1 allowed opportunity to obtain some level of group consensus data on the different ideas generated by individual participants.

The data collected from faculty and IAB members were analyzed separately using a data reduction approach. Data reduction is an approach used in qualitative research attempting to breakdown the information into manageable parts to find related themes. An example of the results is illustrated for one of the SLO's (Table 3).

Round 2 – Delphi Phase 1

This round was conducted during the next IAB meeting that followed the previous one in which the NGT was conducted. During this meeting a total of 18 participants, n=5 faculty and n=13 advisory board members were invited to participate in the Delphi survey. In this survey four of the 20 SLOs were included. This was mainly due to time constraints during the meeting and to reduce potential mental fatigue from the participants trying to complete a very lengthy survey. The four SLOs included in the survey contained an aggregate of 79 different attributes - about an average of 20 for each SLO being reviewed. Unfortunately, after completing other business items on the meeting agenda, only 30 minutes was available for administering the survey. After distributing the survey and reviewing instructions, the participants had roughly 10 minutes to respond to all 79 items. Only three of the eighteen surveys were returned, representing a 17% response rate. Additionally, the responses that were completed were done so quickly it was near impossible for the participants to have adequately considered each attribute prior to delivering a response. As such these three responses were deemed invalid.

Follow-up comments from the participants indicated that they really like the approach "I really like what you're doing here" but suggest some adjustments "rather than trying to do this in our meeting why don't you send out a survey to us every couple weeks or so with a couple of the SLOs…that will make it less overwhelming for us to complete". They also indicated their appreciation for inclusion in the process "we appreciate you involving our thoughts on these items" "thanks for considering us in this process" and dedication to contribute "you just let us know what you need from us and we'll get it done".

Table 3

Example of Data Analysis Results Used to Generate Delphi Round 1 Survey

		Supporting Details	
Domain	Dimensions/Factor	Faculty Responses	IAB Responses
SLO #3 – Create a Construction Project Safety Plan	1. Hazard Analysis 2. Project Specific 3. OSHA 4. Management 5. Materials & Equipment 6. Guidelines	1. Identify hazards, major hazard involved in each phase of construction. 2. Common to construction job sites. Prepare a site utilization plan. 3. OSHA. Create a safety plan that is consistent with OSHA 10-hour certification. OSHA…guidelines 4. Identify basic abatement techniques and procedures. Write work rules, safety managers' goals decisions, managing injured employees. Assemble a report 5. Organizes materials, activities and services. OSHA materials 6. Safety challenges, safety trainings, topics/issues section	1. Identify possible safety issues specific to job. Job hazard analysis. How to write project specific. Risk assessment specific to jobsite. Job risk evaluations. 2. Specific to job. Jobsite specific safety plan. Specific to jobsite. Project specific. 3. Understanding OSHA guidelines. OSHA certified. OSHA 4. Operational emergency management. Implementation. 5. Crane/rigging plan. Hazardous Materials.

Discussion

From review of the literature and responses from participants in the pilot study, it is clear that a need exists to more clearly define the student learning outcomes to make them usable by programs and faculty. The hybrid Delphi methodology for achieving this outcome seems to be a valid option. However, some obstacles have presented themselves during the pilot. The approach to using IAB meetings could be a valid option as it is an ideal scenario for addressing the challenges of time and place coordination. That said, it is critical for anyone considering this approach that they allow enough time in the meeting schedule to fully complete the two stages of the NGT. Adhering to the schedule is of utmost importance. During our study we planned for two hours to complete the NGT but let other items of the meeting take more time than allotted, thereby reducing the available time for the NGT and having to make on-the-fly modifications to the method. As seen in the results, this had a detrimental impact. While we were unable to complete the NGT as intended, the information collected is usable to continue the study in a number of different directions - including completing Task 2 during another group meeting. However, the best approach would be to complete both steps during one meeting while the information is still fresh in the participants minds. The resulting data from the NGT that are used to develop the survey for Round 1 of the Delphi is lengthy. An average of 20 different attributes to consider for one SLO raises concerns when considering all 20 outcomes. Asking participants to consider more than one or two SLO's at a time would equate to over 40 items to consider and rank. This will result in a survey that is too long and the validity of the results will likely suffer from participant fatigue. Other options to most appropriately collect this data need to be evaluated.

The pilot study would be deemed a success from the standpoint of the initial data collected and the identified obstacles to the methodology. Moving forward, adjustments will be made to the study to incorporate the changes to the NGT process and Delphi approach. The surveys will be reduced to one or two SLO's at a time, and they will be distributed electronically on a regular interval for participants to complete. After the study has been completed with the initial sample population identified in this paper, it is the intent of the author to expand the study population to professionals and educators within the region, and then nationally.

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