Paper ID #26480

Delivering Multidisciplinary Experiences in Education: A Study of Construction Program Practices to Meet Accreditation Requirements

Dr. Tom Michael Leathem, Auburn University

Tom Leathem is an Assistant Professor in the McWhorter School of Building Science at Auburn University where he teaches courses in Estimating, Construction Documents, Scheduling, and Project Delivery. He has 11 years industry experience in commercial construction management, holds a Ph.D. in Education, an M.S. in Integrated Design & Construction, and a B.S. in Construction Management. His areas of research include construction education, assessment, accreditation, instructional technology, and active learning.

Dr. Eric M. Wetzel, Auburn University

Delivering Multi-Disciplinary Experiences in Education: A Study of Construction Program Practices to Meet Accreditation Requirements

Abstract

Construction education is seeing an increased emphasis in demonstrating student achievement of learning outcomes. The recent move to outcomes-based accreditation by the American Council for Construction Education (ACCE) requires programs to utilize assessments to demonstrate student achievement of specific student learning outcomes. The standard dictates that at least one of these must be a direct assessment. This has caused many construction programs to consider different types of assessments to meet accreditation requirements. Arguably, the most difficult outcome to assess from the ACCE requirements falls under SLO #9: *Apply construction management skills as a member of multi-disciplinary team.* The outcome's vague nature and individual student assessment requirement has led many schools to approach the execution of this SLO in a multitude of different directions. This paper presents research that investigates the method in which ACCE schools are attempting to address teamwork and construction related accreditation requirements. Additionally, the research looked at schools that have both an ACCE program and an architecture program accredited by the National Architectural Accreditation Board (NAAB) to investigate the nature in which CM programs are using this connection in addressing SLO #9.

Introduction and Background

Construction education is seeing an increased emphasis in demonstrating student achievement of learning outcomes. The recent move to outcomes-based accreditation by the American Council for Construction Education (ACCE) requires programs to utilize assessments to demonstrate student achievement of specific student learning outcomes [1]. The standard dictates that at least one of these must be a direct assessment. This has caused many construction programs to consider different types of assessments to meet accreditation requirements. In order to execute the student learning outcomes for a given class, the instructor of record is charged to create a direct assessment that correlates to the cognition level required in the outcome. Arguably, the most difficult outcome to assess from the ACCE requirements falls under SLO #9:

> SLO#9: Apply construction management skills as a member of multi-disciplinary team.

The vague nature of the requirement has led many schools to approach the execution of this SLO in a multitude of different directions, causing visiting teams to evaluate programs inconsistently during accreditation reviews. Recent ACCE meetings have given particular attention to this specific SLO – providing training workshops and discussion sessions to consider appropriate and possibly inappropriate methods for addressing this SLO. Despite these efforts, there is still a great deal of question among construction programs about how to address this outcome. What is known is that many schools are attempting to address this SLO in a manner they see fit based on their interpretation of what SLO #9 means.

Similar to the ACCE, the National Architectural Accreditation Board (NAAB) [2] requires a number of student performance criteria (SPC) that share likeness to ACCE requirements. In particular, the following NAAB SPCs require architecture programs to demonstrate student achievement of the following:

> B.10: Understanding of the fundamentals of building costs, which must include project financing methods and feasibility, construction cost estimating, construction scheduling, operational costs, and life-cycle costs.
>
> D.1: Stakeholder Roles in Architecture: Understanding of the relationships among key stakeholders in the design process—client, contractor, architect, user groups, local community—and the architect's role to reconcile stakeholder needs.
>
> D.2: Project Management: Understanding of the methods for selecting consultants and assembling teams; identifying work plans, project schedules, and time requirements; and recommending project delivery methods.

Considering many of these performance criteria are fundamental skills taught in any construction program and that these skills are required of architecture and construction professionals, this appears to be a natural collaboration point.

Using survey data, the goal of this research was to identify how ACCE programs are addressing the accreditation requirements for SLO#9 and if they are collaborating with NAAB programs in pursuit of this requirement. Ultimately, the research would like to inform the development of learning experiences and assessment instruments that are authentic to the collaborative experiences students will encounter in their profession.

Literature Review

The design-bid-build (DBB) delivery method has been the traditional approach for construction project delivery in the Architecture, Engineering, & Construction (AEC) industry. This method situates a highly fragmented hierarchical system to building project delivery in which design and engineering are completed and then a bidding process conducted to select a contractor. Despite its segregated hierarchical structure, suggested benefits include: (a) Lower Project Cost, (b) Avoiding Contractor Favoritism and, (c) Improved Owner Clarity of Design Prior to Construction [3]. However, research suggests the approach includes flaws such as increased timelines, poor communication across disciplines, and adversarial relationships [4]. Burr & Jones [5], cite poor communication, differing backgrounds and cultures, and misunderstanding of the concept of collaboration as the main catalyst for contention among architects and construction professionals.

The AEC industry can no longer think in a singular discipline mentality [6]. The increased complexity of buildings has created larger project teams comprised of individuals with specialized skillsets. In response, other more collaborative delivery methods such as Design-Build, Construction Management (CM), and Integrated Project Delivery have been gaining popularity [7]. Current data suggests that the Design Build and CM delivery methods now account for 39% and 32% of all construction, respectively [8]. Along with this, industry has identified the need for key competencies of graduates to be, teamwork, collaboration skills, people skills, and communication as top importance [9].

Similar to industry, the AEC academies in the U.S. have historically been segregated [10]. Previous research indicates only a smattering of collaboration initiatives prior to 2000 [11] [12]. Since then, the disciplines have been increasingly making strides towards emphasis on collaboration.

The Architecture + Construction Alliance (A+CA) was formed in the early 2000's by educators and represents a consortium of 17 universities that contain degree programs in both architecture and construction within the same college [13]. Accrediting bodies for these disciplines have also implemented emphasis on collaboration [1][2]. Other academic initiatives have also attempted to overcome the phenomenon of segregated workflows in AEC education. Two early efforts situated design and construction undergraduate (mostly upper-level standing) and graduate students in intermittent short-form experiences lasting between 4 days to 5 weeks [14] [15]. A partnership in 2001 between the University of Illinois and University of Florida involved architecture, construction, and engineering graduate students in a capstone course collaborating via the internet [16]. The University of Oklahoma developed a semester long course pairing graduate landscape architecture students, junior level construction majors, and senior level architecture students [17]. Auburn University launched a one-year master's program in Integrated Design & Construction in 2009 pairing students with backgrounds in architecture and construction [10]. Mississippi State University began a similar type approach in 2013 where undergraduate students in architecture and construction work side-by-side collaboratively during two different semesters of collaborative design and construction experiences [18]. These previous initiatives have identified benefits to the collaborative approach related to relevance of profession, increased project success, improved communication, and better awareness of the AEC disciplines.

Despite the benefits, attempts to implement and maintain cross-disciplinary collaboration oftentimes falls short due to barriers related to communication, cultural divide, work ethic, course structure, and differing academic motivations [6, 10-12, 14-17]. Studies have indicated longer rather than shorter learning experiences are necessary to achieve the intended success of cross-disciplinary approaches [12, 19]. Implementing such invasive approaches may not be an option for many programs [18, 19]. However, the recent advent of multi-disciplinary collaboration requirements by accrediting bodies now means programs do not have a choice – they must implement student-learning experiences in this arena. Unfortunately, the literature indicates that drawing on previous experiences to identify how best to address this issue is not necessarily the most informative approach. In this vein, the research presented in this paper attempts to help answer the question of how programs are addressing the requirement of educating students on multi-disciplinary collaboration.

Methods

The research utilized a mixed methods Qualtrics survey in order to obtain data from 70 ACCE and NAAB programs. A list of universities that have both a NAAB and ACCE program were developed from online databases maintained by the accrediting bodies. The researchers filtered through the lists and identified 35 universities that have both an ACCE and NAAB program. The research team identified a point of contact at each program and sent out a recruitment email and a link to the Qualtrics survey. The survey utilized conditional logic depending on the respondents accrediting body – either ACCE or NAAB. Using this logic, researchers could ask joint questions in addition to ACCE and NAAB specific questions. ACCE respondents received 12 questions, while NAAB respondents received 9 questions. Table 1 presents a summary of the question types asked to respondents based on their accrediting body:

Table 1: A summary of Qualtrics survey questions by accrediting body

Joint Questions	ACCE Programs	NAAB Programs
Program information	Familiarity with 20 ACCE SLOs	Familiarity with NAAB Student Performance Criteria
Current position of respondent (e.g. full professor, asst. professor, lecturer, etc.)	How are the requirements of SLO #9 addressed	What disciplines participate in NAAB SPC for accreditation requirements B10, D1, D2 (particularly looking for ACCE collaborators)
	What assessment instrument is used for SLO #9	What type of collaboration is done and what is the assessment instrument
	Type of course SLO #9 is taught in	The challenges with collaboration
	What disciplines participate in SLO #9 (particularly looking for NAAB collaborators)	The positives and strengths of collaboration
	The challenges of addressing SLO #9	

The scaled and quantitative responses were analyzed using the data analysis tool in Qualtrics and exported to Microsoft Excel for graphics development. The qualitative data was exported to Microsoft Excel. The researchers used Excel to organize the data and qualitatively code the respondent answers, looking for patterns and commonalities in order to identify frequent practices amongst ACCE and NAAB programs.

Results

From the 70 potential respondents across ACCE and NAAB programs, 22 completed the survey for a response rate of 31%. Respondent demographics are provided in Figure 1 below.

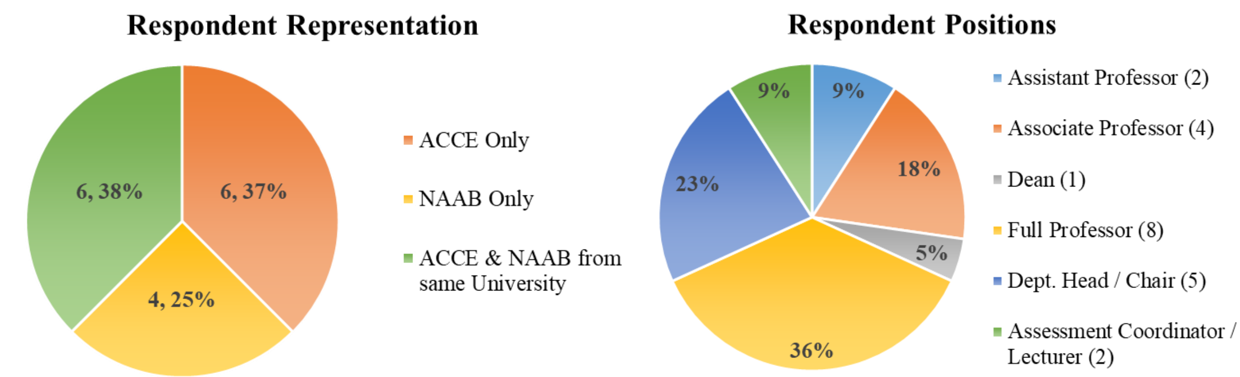

Figure 1: Respondent Demographics

Results indicated a wide array of how SLO#9 was included in curricula (Figure 2). Numerous course and topic areas were identified and depth of inclusion ranged from a single activity to a full course experience. Despite the array of inclusion approaches, all programs indicated including the learning experience within a required course. Responses from NAAB programs were less diverse, as most respondents indicated collaboration requirements within the "studio courses" of their curriculum.

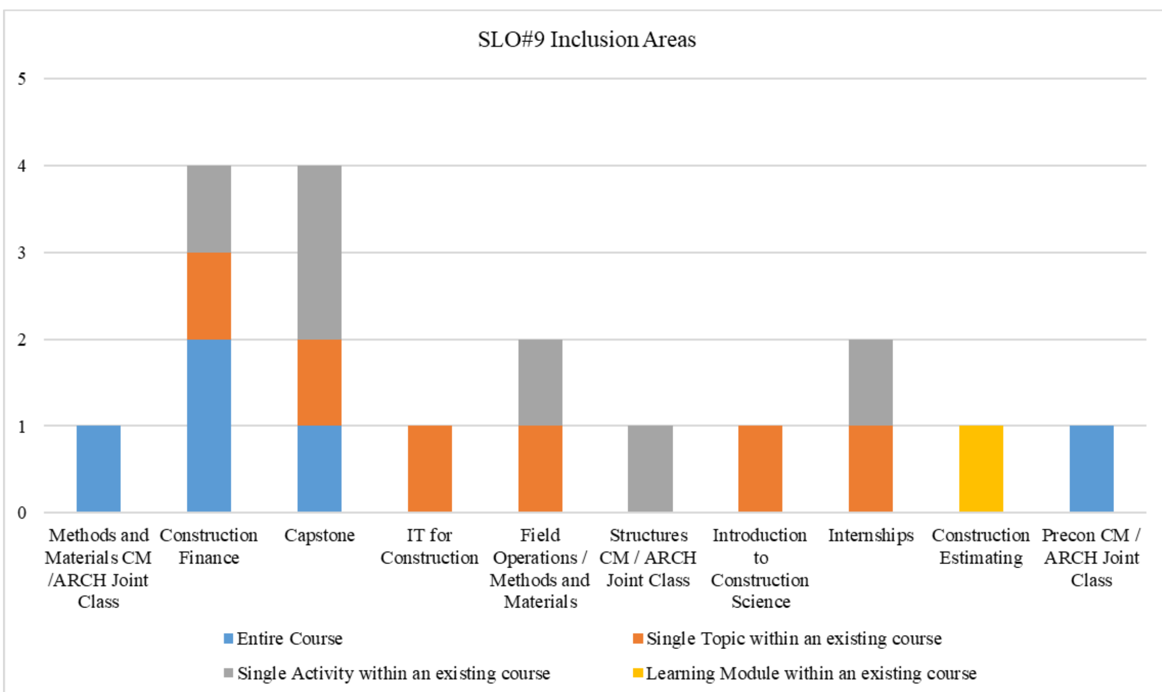

Figure 2: Courses/Topic areas where SLO#9 is included and to what intensity

Student Experiences

Responses indicated that the student experience for these SLOs involves various disciplines (Figure 3) however, the data shows that both ACCE and NAAB programs primarily collaborate within their own discipline. In other words, ACCE students meet this SLO by doing activities with their peers in the program. When there is collaboration outside of the discipline, responses showed that ACCE students collaborate with NAAB students more than other disciplines. This data makes sense as the inclusion criteria for the research was universities with both ACCE and NAAB programs.. In addition to ACCE/NAAB collaborations, both sides indicated collaborating with others, such as industry professionals, engineering programs, business programs, etc.

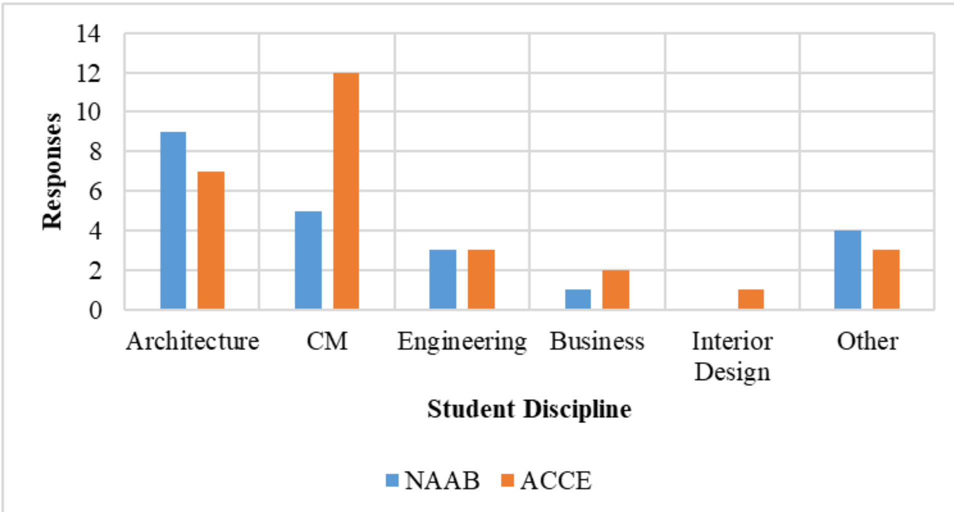

Figure 3: ACCE & NAAB Collaborations by student discipline

Qualitative responses related to the type of experience and instruments for assessment were analyzed using constant-comparative reductionist approach to identify themes within the responses. An example of this analysis is included in Table 2. Generally, the responses showed that all programs are using project-based approaches, except for one response. The types of projects range from tactile physical building type projects to conceptual analysis and investigation. The majority of projects were focused more on the pre-construction phase of a project where teams are tasked with addressing design and construction related skills such as estimating, scheduling, constructability analysis, and cost/value propositions. This approach was particularly true from respondents representing ACCE and NAAB programs that collaborated together.

Makeup of student teams was categorized into three distinct areas:

1. Within Discipline: CM or Architecture students assuming various different roles such as estimator, scheduler, superintendent, project manager, architect, engineer, owner.
2. Between Disciplines: CM and Architecture students assuming their discipline-specific roles and executing discipline-specific tasks within their team.
3. Other Disciplines & Industry: CM or Architecture students collaborating with other disciplines and/or industry representatives.

Table 2: Qualitative Analysis of Student Experience and Assessment Instruments Used

Domain	Dimensions/ Factor	Supporting Details	Researcher Notes
Instruments	1. Summative assessment 2. Formative assessment 3. Rubrics	1. Test (no further details) (3A); reflection after team project (10A); capstone (8A), final project (5A,N); final reviews from industry professionals (1N; 7A,N); jury of CM & Arch faculty doing reviews (9N) 2. Lab assignment/assignment (1A; 5A; 12A; 13A), Students grade each other throughout & faculty grade at milestones (5A), peer evaluation (8A), mid-term review from industry professionals (1N; 7A,N) 3. Rubric (no further details) (4A); AAC&U Teamwork rubric (8A,N), Rubric (10A), Project Specific Rubric (7A,N)	1N Arch that involves CM students are actually dual degree (Arch/CM) students so therefore may not be related to ACCE requirements.
Experiences	1. Group Deliverables 2. Project-based 3. On-the-job	1. Course setup with group deliverables (2A); team-based (11A); student teams (1A); group produce (10A); students…their construction firm (6A); 4-5 students in group, team (8A), Team (13A); Arch & CM Students Collaborate (1N; 7A,N); Arch & CM collaboration (9N) 2. Projects (11A); build steel structure (1A); proposal packet including estimate, schedule, change order (10A); prepare multi-disciplinary team management plan used in their constr. Project; project-based (12A), value-engineering (13A), arch & cm students (7A,N); Arch, CM, Engineering (1N); Collaborative Thesis (9N) 3. Internship (8A; 4A)	

Note. Coding for responses uses number and letter. Number is the university represented, A=ACCE program representation, N=NAAB program representation

Assessment of student teams was done in multiple ways. Regardless of the level of inclusion intensity (as shown in Figure 2), assessment utilized peer reviews by students, reviews by faculty, and reviews by industry professionals from the various disciplines. Reviews – especially involving faculty and industry - were indicated to occur mostly in a summative form at the end of a major project or final semester project review, using rubrics. Some of these more developed approaches also include formative reviews as the student teams hit milestone points in the development of their projects, culminating in a summative review with faculty and/or industry evaluators. Less intense approaches, such as single activities or topics within an existing course were assessed by the course instructor only. Responses suggested there were additional courses where students were exposed to different facets of multi-disciplinary collaboration in a more theoretical perspective, such as management theory, teaming theory, etc. Students in these courses were generally, tested on fundamentals of these theories in lieu of a team-based project.

Challenges & Benefits

The challenges the respondents identified were pervasive regardless of the exercise. Respondents indicated an inability to collaborate with other disciplines due to differences in schedules, student numbers, motivations on both sides, and curricular constructs, among others. Schools encountering these challenges often work within their program to create multi-disciplinary teamwork activities (e.g. role-playing, simulations, etc.). Although this meets the criteria for accreditation, this presents challenges as "*students do not have the background to understand the different roles involved"*, minimizing efficacy of the activity. In cases where a short-form approach such as a learning module or class activity is used, this makes digging deep into learning the roles virtually impossible, as one respondent stated, "*there is not enough for each student to play the role*".

Respondents indicate further challenges due to the accreditation requirement that all students must be assessed individually. When trying to implement work in teams "*assessing each student has made this SLO difficult*". Other responses identified challenges related to "*balancing teams*", "*equitable participation of…students*", getting "*exposed to other jobs in the team*", and incorporating "*industry participation*".

Even with the challenges, respondents from both construction and architecture indicated the benefits of addressing these accreditation requirements collaboratively. Most respondents conveyed the value of multi-disciplinary exposure to include "*experiencing a very real-world challenge*" when having to "*respond to each other's needs*". This fundamentally creates an awareness by the students that *"…working with other disciplines as a team is vital to success in industry*".

Conclusion and Discussion

While multi-disciplinary collaboration is not a new initiative to CM and Architecture education, the shift from voluntary to an accreditation requirement is relatively new. For ACCE programs, this requirement now forces the development of learning experiences that assess student abilities in a multi-disciplinary environment. The outcomes' vague nature and individual student assessment requirement has led many schools to approach the execution of this SLO in a multitude of different directions.

The results show that programs are primarily using project-based approaches in varying types of formats to address this SLO. Collaboration with other disciplines and/or industry is primarily influenced by ease of access to the parties, and the time allocated to the specific experience. Additionally, how the program defines multi-disciplinary may have some influence in choice of approach. In cases where multi-disciplinary is defined as roles within the CM discipline such as estimator, scheduler, project manager, etc., the approach is more isolated to students within the discipline. Programs defining multi-disciplinary as external to the CM discipline such as owner, architect, engineer, etc. are more likely to incorporate external disciplines in the experience.

Although the accreditation requirement has caused more programs to address multi-disciplinary collaboration, a number of known challenges to collaborative work appear to still be an issue. Attempts to collaborate outside the discipline are rife with challenges related to communication, cultural differences, work ethic, course structure, and differing academic motivations. While approaches isolated to within-discipline have been able to reduce some of the previous challenges, new barriers related to assessment and execution have emerged. The individual student assessment requirement has been identified as a major challenge as SLO #9 is largely based on how students interact within a collaborative team. Finally, developing experiences where all students on a team are getting equitable exposure to the type of learning has proven challenging.

With these identified challenges, the question remains how do ACCE programs comprehensively address SLO #9. There is still no clear "best practices" for addressing SLO #9. Challenges are inherent with the individual student assessment requirement in combination with the teamwork requirement. As well, the meaning of "multi-disciplinary" is unclear, creating confusion about appropriate versus inappropriate approaches for the SLO. Due to the ACCE programs inability to successfully design and implement around SLO #9, the researchers believe that accreditation intervention may need to take place. The following is a list of areas that should be addressed to create more understanding and ease of execution for participating programs:

1. Evaluating the validity of assessing this outcome using a team-based approach rather than individual approach.
2. Providing further clarification of what the profession defines as "multi-disciplinary".
3. Investigating what students truly need to know about multi-disciplinary collaboration after completing a four-year construction management degree.

References

[1] American Council for Construction Education. (2016). *Document 103 OBS (Revision 08/2016): Standards and criteria for accrediation of postseconday construction education degree programs*. Available: http://www.acce-hq.org/images/uploads/Doc_103_Updated_081116_final.pdf

[2] National Architectural Accreditation Board (NAAB). (2014, December 7). *2014 Conditions for Accreditation*. Available: http://www.naab.org/wp-content/uploads/01_Final-Approved-2014-NAAB-Conditions-for-Accreditation.pdf

[3] C. M. Gordon, "Choosing Appropriate Construction Contracting Method," *Journal of Construction Engineering and Management*, pp. 196-210, 1994.

[4] S. Kramer, Hering, J., & Arora, T., "A Case Study of Project Delivery Systems: Implementing Construction Management-Agency at Auburn University," in *43rd Annual Associated Schools of Construction International Conference*, Flagstaff, AZ, 2007.

[5] K. Burr, and Jones, C. , "The Role of the Architect: Changes of the Past, Practices of the Present, and Indications of the Future," *International Journal of Construction Education and Research*, vol. 6, no. 2, pp. 122-138, 2010.

[6] B. Gerber, Gerber, D., and Ku, K. , "The pace of technological innovation in architecture, engineering, and construction education: integrating recent trends in curricula," *Journal of Information Technology in Construction*, vol. 16, pp. 411-432, 2011.

[7] T. a. P. Duggan, D. , "Design-Build project delivery market share and market size report," ed. DBIA Website, 2014.

[8] F. Corporation, "Design-Build Utilization: Combined Market Study," Association Report June 2018 2018.

[9] Y. Ahn, Pearce, A., Kwon, H., and Shin, H. , "Key competencies for U.S. construction graduates: an exploratory factor analysis," in *Associated Schools of Construction Proceedings of the 46th Annual International Conference*, Boston, MA, 2010.

[10] P. E. Holley, J, "Changing the Culture of Design and Construction Education in the U.S.," in *Royal Institute of Chartered Surveyors COBRA Conference*, 2010.

[11] K. Robson, Caldwell, M., and Reynolds, J. , "Enhancing communication in the design and construction industry through multi-disciplinary education," *Journal of Construction Education*, vol. 1, no. 1, pp. 50-58, 1996.

[12] H. Elzarka, Suckarieh, G., and Dorsey, R., "Teaching Value Engineering Effectively: An Interdisciplinary Approach," in *Associated Schools of Construction Proceedings of the 34th Annual Conference*, 1998, pp. 21-28.

[13] A. C. Alliance. (2018). *Partners*. Available: http://www.aplusca.org/index.html

[14] D. Septelka, "The Design-Build Charrette – An Educational Model for Teaching Multidiscipline Team Collaboration," in *Associated Schools of Construction Proceeding of the 38th Annual Conference*, USA, 2002, pp. 85-96.

[15] T. Sulbaran, "An Experience of a Multidisciplinary Project Involving Architectural Design, Quantity Takeoff and Virtual Reality Framed Within TAC-ABET Accreditation Criteria," in *Associated Schools of Construction Proceedings of the 39th Annual Conference*, USA, 2003, pp. 185-192.

[16] W. O'Brien, Soibelman, L., Elvin, G. , "Collaborative Design Processes: An Active- and Reflective-Learning Course in Multidisciplinary Collaboration," *Journal of Construction Education*, vol. 8, no. 2, pp. 78-93, 2003.

[17] R. a. C. Ryan, M., "Developing and Teaching a Collaborative Design and Construction Administration Course," in *Associated Schools of Construction Proceedings of the 43rd Annual Conference*, Flagstaff, AZ, 2007.

[18] T. Leathem, McGlohn, E., Gregory, A., Herrmann, H., & Carson, L., "A Case Study in Pedagogy for a Cross-Disciplinary Architecture/Construction Program," in *51st Associated Schools of Construction International Conference Proceedings*, College Station, TX, 2015.

[19] G. Migliaccio, Dossick, C., and Golden, E. , "Enhancing interdisciplinary thinking, teamwork and collaboration across CM, Arch, and CE disciplines through a design-build competition," in *50th Annual Associated Schools of Construction International Conference Proceedings*, Washington, DC, 2014.