

Comparison of Industry and Students' Perceptions in a Studio-based Construction Program

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Studio-based learning is establishing itself in many programs as a new educational method. Thus far, this model has been mostly limited to art-based fields such as architecture, interior design, and art. However, it is gradually finding its place in other areas such as construction. Low student-instructor ratios, lower numbers of students per section, hands-on integrative application of knowledge, and iterative processes are advantages of studio-based models which can be effectively exploited in construction education programs. To establish a solid foundation for this model, construction program administrators need to determine the model's intrinsic and extrinsic features and develop, deploy, or revise these features, as necessary. However, due to the lack of published best practices, the model refinement will inevitably be a self-originating process. To achieve the foundational goal, a study was initiated in the Building Construction Science Program at Mississippi State University to identify all individuals involved in forming the general structure of the studio model. This research project was implemented in phases to comprehensively focus on the perceptions of each of the groups involved in the study. This paper briefly describes the results of the second phase of this project and how they correlate with previous phases. The first phase focused on the perceptions of construction students toward different features of studios. In the second phase, construction professionals and advisory board were the focal point of the study. A quantitative research method was employed to identify challenges, potentials, importance, and gaps in the studio-based construction education. The results indicate a series of differences and similarities between the perceptions of students and industry groups. These results warrant construction program learning objectives design which considers industry feedback while incorporating students' perceptions in the delivery and assessment tool creation. The results of this study can be utilized in the design and implementation stages of a studio-based construction educational program.

Keywords: Studio, Construction, Education, Curriculum design, Project-based learning

Introduction

Studio-based learning is a delivery method in higher education in which learning experiences are greatly influenced by the physical space called studio. Studios possess physical and cognitive characteristics that require a different set of content deliveries and evaluations. These includes a mixture of lectures, assignments, projects, and tests designed for the studio-based model and in many cases, it would be too difficult to replicate a studio's educational components in a lecture- based course without necessary modifications. This has led programs with studio-based cores such as those found in architecture, art, and interior design educational programs to provide a very distinct educational delivery system. Therefore, replacing traditional lecture courses with studio courses demands an extensive level of educational adjustments, revisions, and creations. Knowing studio and its features in any context is the key to success. The Building Construction Science (BCS) Program at Mississippi State University provides studio-based curriculum in construction and has graduated numerous students over a multi-year period and thus, enough information is available for a cyclic curriculum revision and update. This study has been defined, organized, and conducted to primarily produce required inputs for any program development, and ultimately present applicable guidelines and norms for other construction programs that are trying to incorporate the studio model in their curricula. The core of the BCS program is a series of eight construction studios that are offered sequentially. Each studio is six-semester credit hours which meets three days a week for a total of 12 contact hours. Studio courses are included in each of the eight semesters of the program. In addition, students on average spend about twelve hours outside the class time for their studio activities and projects. Due to the large number of meeting hours, studios have a great potential for covering not only construction subjects but may be used to stimulate multidisciplinary collaboration with other programs such as architecture which are also studio-based programs. Each studio covers a series of topics with an appropriate level of detail, and this continues into the next semester studio with more and more in-depth activities as a student progresses through the program.

Literature Review

Industry-Academia Relations

Industry advisory boards (IABs) are growing in presence in higher education. Based on 12 case studies, one can agree that industry-university relations have developed considerably in recent years (Martin, 1999). In 2007, a mailed survey of 3,080 academic life science researchers found that 52.8% had some form of industry relationship (Zinner, Bolcic-Jankovic, Clarridge, Blumenthal, & Campbell, 2009). A decade later, industry advisory boards are still advancing and sorting out best operating practices. The main factors supporting the development of university-industry relationships are external needs to impact economic development, incentives such as grants and tax benefits, and the pressure to supplement resources with private sector funding (Martin, 1999). One influential way IABs and universities can mutually benefit from their partnership is through the development of research. University resources (labs, equipment, libraries, etc.) could be of great value to the industry if collaboration between these two entities fully develops (Oyebisi, Ilori, & Nassar, 1996). With these resources, researchers can have the tools they need to develop new studies. According to Garcia et al. (2014) “intellectual benefits and academic results are important drivers to research groups to collaborate with industry and transactional firms” (p. 1). Development in research was shown to increase with joint efforts of industries and universities. It was shown that high performing research teams tended to be more to collaborate with firms (Garcia, Araújo, Mascarini, dos Santos, & Costa, 2014) . Perkmann and Walsh believed that “in the contexts of open and networked innovation, inter-organizational relationships between public research organizations and industry play an important role in driving innovation processes” (Perkmann & Walsh, 2007, p. 17).

Industry Advisory Boards have provided significant impact to university programs in academic accreditation processes. Accreditation can be a long and often rigorous process considering the guidelines and learning objectives they must meet. However, according to Craig (2009), IABs are a source for advice and unique knowledge and skills, which complements that of the program's leadership and faculty. IABs can go further than helping pass the accreditation process. Sener (1999) in a publication entitled “incorporating industrial advisory boards into the assessment process” addressed how IABs and the Accreditation Board for Engineering and Technology (ABET) rank skills differently. The number one skill foreseen by ABET ranked by the IAB member body is the ability to “demonstrate an appropriate mastery of knowledge, techniques, skills and modern tools of their disciplines” (p.2). Sener believed that communication, commitment, critical thinking, responsibilities, and other personal skills follow the critical skills for industry students. With knowledge and expertise, universities can develop well-rounded programs that not only meet the needs of formal assessments and accreditations but also the needs to the ever-changing industry. Numerous papers define models and guidelines for creating and operating the most effective and cohesive IAB. The industry-university collaboration can take on different forms: producer-consumer interaction, collaboration in continuing education, and collaboration in research (Jalote, n.d.). It is recommended to take a holistic approach when researching industry engagement activities as it provides analytical finds and can be used to determine which activities best increase student learning. Burns and Chopra (2017) stated for continuous improvement creating the most effective industry engagement, such as implementation of plan-do-check-act (PDCA), is vital. Dimensions of an effective model for an effective board include human relations, internal process, rational goal, and an open system. The most effective IAB will benefit the students, the faculty, and the board members. Changing the relationship with an IAB from one-directional where the board is only advisory to a mutually-beneficial industry-academy partnerships has impacted the students' pride and ownership in the success of their academic program (Guggemos & Khattab, 2015). Taylor, Hartman & Baldwin (2017) noted that a multi-day industry tour helped raise students' knowledge of their aspiring profession, deepened their understanding of course subjects, and developed a professional network and relationships. With an established IAB, activities such as these can be offered to students. Good working relationships, communication, sound organization, and defined roles are the core of an effective board. Other keys for success include strong leadership, diversity and experience, organization, and explicit fundraising initiatives (Genheimer & Shehab, 2009). In developing a high-impact industry advisory board, McIntyre (2015) mapped a self-assessment for a program to determine what changes need to be enacted to aid the IAB structuring and staffing, planning systems, and quality systems. The most efficient meetings with engaged IAB members are produced from utilizing emerging technology and understanding the hierarchy of needs to transfer information and event preparation and coordination (Michel, 2014). Genheimer and Shehab (2009) found factors of the effectiveness of an advisory board include culture, value, and priorities of the institution by conducting a survey of 90 engineering school directors and advisory board members. Greenlaw (2009) stated key items to efficiently use industry advisory board include strong faculty leadership for the advisory board committee, knowledgeable staff, recruiting local people, holding two meetings each year, and the passion to improve the program. Although the relationship between industry and academia is a difficult one to make, it is of value. Proprietary knowledge, intellectual property rights, contrasting motivations, and different languages are cornering factors that may get in the way of a healthy relationship. Establishing trust and encouraging collaboration is critical to forming win-win relationships (Lameman, et al., 2010). Industry advisory boards' benefits far outweigh the negatives. From an educational standpoint, IABs serve to benefit all those involved in the collaboration. Nevertheless, it is essential to operate the IAB effectively to ensure students are not negatively impacted by lack of focus from their researching professors, and, therefore, universities can create or modify their boards to be the most efficient and effective. Overall, the inputs from the advisory board and professionals are critical components of successful programs in research and teaching areas.

Studio-based Learning

The studio-based learning method is a commonly accepted content delivery method in programs such as architecture, interior design, and art. Also, there is a long history behind the studio-model in the art-based programs, but there is no uniform definition of the studio model in the education realm. Different researchers have considered varied features of studios in their definitions. For example, Schon (1983) described studio as "a type of professional education, traditional in schools of architecture, in which students undertake a design project under the supervision of a master designer. Its setting is the loft-like studio space in which anywhere from twelve to as many as twenty students arrange their own drawing tables, papers, books, pictures, drawings and models. In this space, student spends much of their working lives, at times talking together…" (p.3) but Hostetler (2014) believed the range the students' number is five to 35 students. Physical features of studios have been studied and discussed too. This includes the layout of the studios in regard to the tables, chairs, and hang-in walls, visual characteristics of physical spaces, and wall color and height (Porter Lofaro, 2016; Izobo-Martins, Aboderin, Abah, & Ilolo, 2017). These studies explained how physical features impact students' performance and to what extend students' perception, creativity, and performance interact with physical aspects of studios. The use of studio-based models has not been limited to architecture and art programs. In the last decade, there are some instances in which different types of programs have incorporated studio-based models in whole or part into their curricula. Bremer and Els (2016) used a studio-based model in their Built Environment program in the hope of providing a new learning method for graduates' education and thus improving traditional methods of academic instruction. Jabi et al. (2008) utilized a studio-based model to create a collaborative environment in which Architecture with Computer Science students were integrated into one team and reported an increase in creativity perception in both groups of students. Carbone et al. (2000) provided a studio model in an Information Management and Systems program to increase interpersonal skills including collaboration, self-management, interaction, and effective communication. In a similar study, Mathews (2010) incorporated a studio-based learning model in the design process for a GPS-oriented technology of mobile-based media which resulted in positive feedback from students. Although the examples of studio-based learning are not limited to the above instances, there are few cases of successful uses of studio-based models in construction education area reported so far. This is an unexpected situation with respect to the nature of construction education. Construction programs have a common ground with architecture and interior design areas, and therefore studio-based methods can be effectively employed for that area. Additionally, learning by doing paradigm in the construction education can efficiently take place in studio environments.

Methodology

Curriculum development is an ongoing process in which new insights, learning methods, up to date concepts, and technological advancements are embraced to produce a sound program. For this purpose and after practicing a studio-based model for over 10 years, a research project was designed to incorporate all involved individuals' opinions in curriculum refinement. As the core components of the studio-based model, four groups including students, professionals and industry advisory board members, construction faculty, and other programs collaborators were identified. The first phase of this research was initiated in the Fall 2017 semester focusing on students' perceptions (IRB-17-540). This phase was continued in Fall 2018. Following the first phase initiation, the second phase began in Spring 2018 concentrating on professionals and advisory board members (IRB-17-740). To gather quantitative data, a survey was designed for each target group. The student group population included all students who have the experience of at least three studios. The survey for the student group consisted of four sections: demographic information, studio potential learning outcomes, studio preferences, and studio layouts. The industry group survey included demographic and professional information, studio perceptions, and graduate evaluation. The surveys were administrated in Fall 2017, Spring 2018, and Fall 2018 will all population subjects. Data were compiled, modeled, and analyzed with statistical software. Through three instances of survey administration, ultimately107 construction students and 32 industry professionals participated in the study.

Results

A model was created by integrating all data gathered. The data model consisted of two groups. One of students and one of industry professionals. The following sections summarize the comparisons between these two groups:

- Demographic and Professional Experience

Like other areas in construction, females formed the minority of participants as only 7% of students and 22% percent of industry groups. Percentages of sub categories in each group are shown in Table 1.

Table 1

Percentage of male vs. female participants in each sub category

Student	Male	Female
Sophomore	44	57
Junior	38	14
Senior	18	29

Industry	Male	Female
Technical	36	14
Human Resource	4	57
Management	60	29

- Studio Perception

In the main part of the survey, both student and industry groups were asked to rate the importance of studio features on a five level Likert scale. Studio features included professional socialization, encountering in-depth problems, adapting procedures to real cases, creativity, application of knowledge, analysis of problems, evaluation of ability, hands-on experience, communication, group discussion, team work, practical work, increasing self-confidence, and learning in different ways. Each group rated all studio features' importance ranging from Very Low (1) to Very High (5). The average weight of each feature in both groups was quantified and calculated. Figure 1 shows three most important (highest scores) features of studio-based model from the viewpoint of students compared with the average of industry score in the same items. As shown in Figure 1, team work (4.07 out of 5), hands-on experiences (3.99 out of 5), and group discussions (3.8 out of 5) were specified as the most important features of the studio-based model by students. The average of those three items were 4.34, 3.78, and 3.94 in the industry group, respectively. The order of those three features in the industry group were 1, 12, and 7, respectively. This shows both groups expressed a similar opinion regrading the importance of teamwork as a studio feature, however, the industry group did not find hands-on experiences and group discussions as important as the student group did. Similarly, Figure 2 shows three important features of studio-based model through the lens of industry group in which teamwork, professional socialization, and communications were rated higher among other features (4.34, 4.31, and 4.28 out of 5, respectively). The rank of these three features in the student group was 1, 7, and 12, respectively.

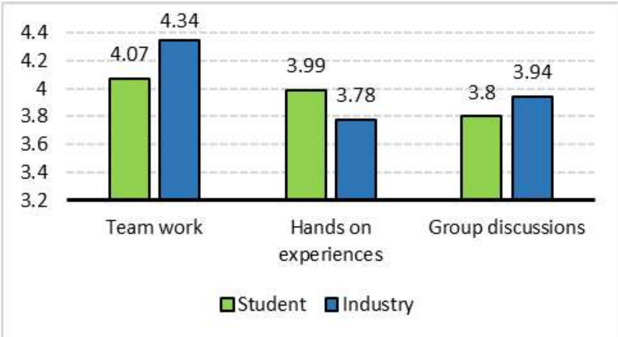

Figure 1: Most important features of studio rated by student group

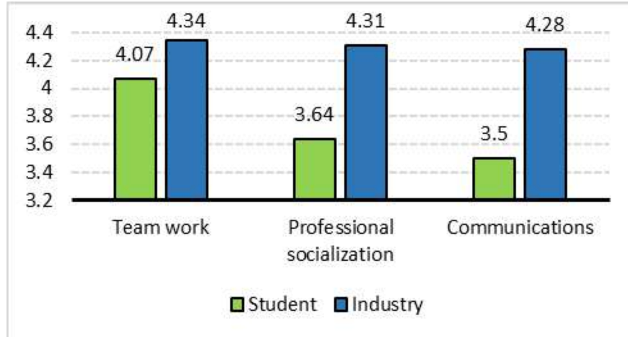

Figure 2: Most important features of studio rated by industry group

A similar approach was employed to perform a comparison between the lowest scores of features in each group. In the student group, practical work, evaluation of ability, and communications were rated as the least important features. The rank of those features in the student group was 5, 13, and 3, respectively. In the industry group, creativity, evaluation of ability, and hands-on experiences were rated as the least important studio features. The ranks of those features were 8, 13, and 2, respectively.

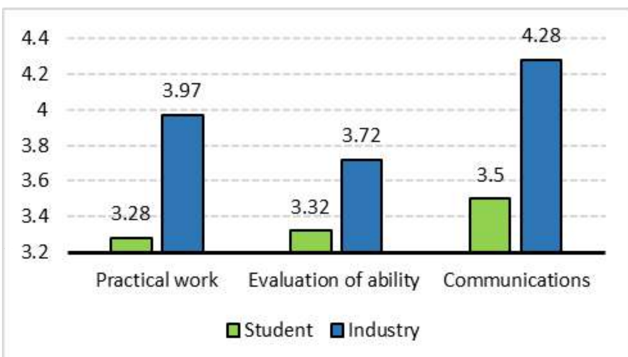

Figure 3: Least important features of studio rated by student group

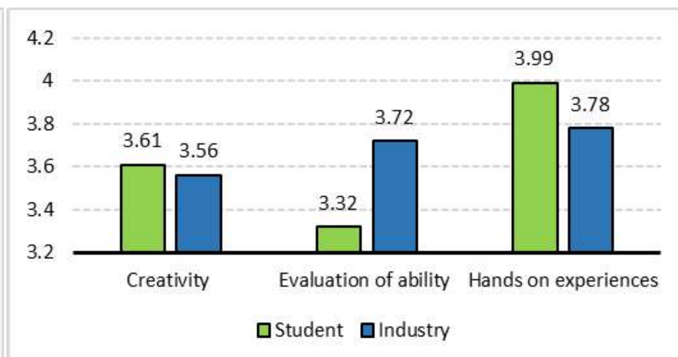

Figure 4: Least important features of studio rated by industry group

In the next step, the scores of studio features in the student group were compared with corresponding ones in the industry group. An independent samples t test was utilized to determine the mean difference between the studio features scores in student and industry groups at a significance level of 0.05 as shown in Table 2, assuming the normality of samples. The results indicate that in five areas, the means of scores in the student and industry group are significantly different. These areas include professionalism, problem analysis, evaluation of ability, communications, and practical work. These areas are mainly those that scores highest or lowest scores as shown in Figures 1-4.

- Construction Content Knowledge

In the next section, the industry group was asked to rate the knowledge and capabilities of students in following subjects when they began their internship using a five-level Likert scale (1: Very Low, 5: Very High). The percentage of each level for 11 subjects/skills is shown in Figure 5. Among those items, Communication and Safety (3.75 and 3.47 out of 5) obtained the highest scores against 3D Modelling and Contracts & Bids (2.66 and 2.84 out of 5) as the lowest scores. The industry group did not express any particular concern lacking in the curriculum, however, they emphasized the importance of soft skills to be covered along with the construction technical subjects. Additionally, the industry group was asked what topics or areas they consider as the main strength of the BCS program in an open-ended question. While the responses varied, the studio-based model in the curriculum was highlighted more than other strengths.

Table 2

Student and Industry Independent Samples t Test

Studio Features	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Significant Difference
Professionalism	1.450	.231	-3.815	137	.000	-.66764	Yes
			-4.422	66.401	.000	-.66764	
Encountering in Depth Problems	2.282	.133	-.778	137	.438	-.15216	
			-.879	62.975	.383	-.15216	
Adaptability	4.858	.029	-1.511	137	.133	-.29848	
			-1.812	71.441	.074	-.29848	
Creativity	2.662	.105	.259	137	.796	.04498	
			.305	68.537	.761	.04498	
Knowledge Application	8.381	.004	-1.633	137	.105	-.29264	
			-1.959	71.514	.054	-.29264	
Problem Analysis	3.178	.077	-2.767	137	.006	-.50789	Yes
			-3.064	60.601	.003	-.50789	
Evaluation of Ability	6.615	.011	-2.112	137	.037	-.40099	Yes
			-2.586	74.984	.012	-.40099	
Hands on Experiences	.037	.848	1.099	137	.274	.20940	
			1.198	58.843	.236	.20940	
Communications	8.196	.005	-4.494	137	.000	-.78592	Yes
			-5.743	83.069	.000	-.78592	
Group Discussion	.785	.377	-.759	137	.449	-.13376	
			-.835	59.798	.407	-.13376	
Teamwork	.008	.927	-1.641	137	.103	-.26898	
			-1.814	60.373	.075	-.26898	
Practical Work	3.555	.061	-3.349	137	.001	-.68838	Yes
			-3.857	65.491	.000	-.68838	
Self Confidence	7.756	.006	-1.693	137	.093	-.32039	
			-2.079	75.528	.041	-.32039	
Learning in Different Ways	7.047	.009	-.880	137	.380	-.15829	
			-1.037	68.690	.303	-.15829	

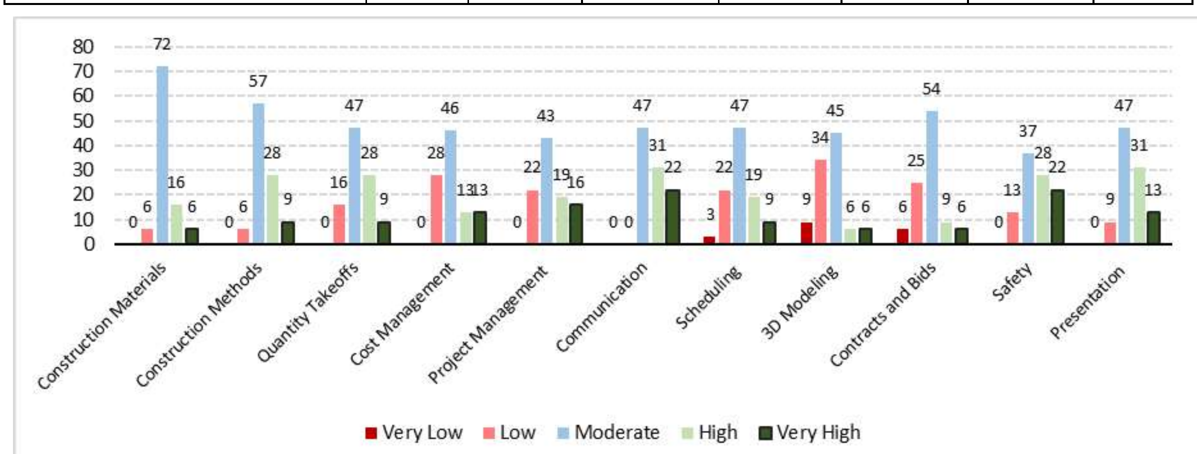

Figure 5: Percentage of construction content knowledge level

Discussion

The studio-based learning method is being increasingly introduced to non-architecture programs and getting more educators' attention. The studio in its general definitions and scope has several unique features that make it appealing to different program administrators. Although this method has a long history in the design side of building-related programs, it has been rarely incorporated in construction education. The emergence of a studio-based model in a construction educational program represents a similar paradigm as past well-received models and methods such as "learning by doing" and "project-based learning" and is an excellent opportunity to define, structure, and organize it as necessary. Lack of best practices in the use of a studio-based model has led the construction education planner to benchmark their studio model from architecture. While there are several similarities between the training the architecture student and the construction student, construction customization seems essential. There are several naturally distinct features in the construction education area that should be meticulously discussed and analyzed to be applicable in the curricula. In order to reach this objective, significant effort must be made to define the studio-based model in construction and specify its characteristics. Since no external evidences from best practices are available, all entities' inputs act as feedback to the curriculum development system.

In the first phase of this study, students' perceptions were obtained and analyzed. The next phase, which is briefly described in this paper, was conducted to get professionals' perceptions toward studio. The comparison between the student and industry groups indicates meaningful and interesting similarities and differences. One major agreed-upon feature of studios is teamwork as it was reported the most important characteristics of the studio model. Teamwork is inherently a critical skill in any type of projects, especially construction ones. Another similarity is evaluation of ability which, obviously, is not exclusively a studio aspect. On the other hand, differences between these two groups are considerable. For example, the way the industry group sees the importance of soft skills such as professionalism, communication, and presentation, is greatly different from the student group's perception. Similarly, some non-construction or characteristics such as creativity were not rated as important by the industry group. Considering the differences and similarities between these two groups helps construction educators to plan, analyze, and embrace studios – entirely or partially – in a more effective way.

Conclusion

This paper addressed preliminary results of a construction studio study in its second phase. Like the first phase, the results generally indicated the positive attitude of professionals toward the studio-based model. Similarities and differences between students' and professionals' perceptions were discussed and analyzed. Obviously, similarities indicate the need for highlighting specific aspects of studios while the curriculum is being developed or revised. With the same emphasis, differences between perceptions require defining learning objectives that respond to industry needs and devising educational tools and methods that empower students. The statistical t test supported the descriptive analyses performed. The results summarize key points for studio-based curriculum development. Additionally, the industry group explicitly expressed their evaluation of construction students' knowledge levels and challenging areas. Although this paper used almost all subjects in its population, the generalization of results is not guaranteed. This necessitates more similar detailed studies to come to a consensus about an effective studio-based models for construction education that can be employable in any institution of higher education. A follow up with those respondents who indicated active/collaborative learning strategies were "unlikely" or "slightly likely" to align with ACCE SLOs will be considered. Moreover, having inputs from other individuals involved in studios such as construction faculty (with or without studio teaching experience) and other programs collaborators can enrich the outcomes of the studio model learning in construction.

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