

Student Perception of the Features of Studio-Based Construction Education

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Studio-based learning is emerging as a new pedagogy in many fields. Although the studio-based model has been dominant in a number of fields such as art, design, and architecture for many years, it is being adopted in other disciplines such as construction education. In the studio-based model, the curriculum is designed to optimize learning outcomes through individualized instruction achieved by low student-teacher ratios, lower students per section, hands-on integrative application of knowledge, and iterative processes. These are prioritized over criteria such as high space and seat utilization rates, high enrollment levels per section, and more systematic teaching, which are driven by economic goals. A significant consideration in any new curricular model is the degree to which student perception impacts learning outcomes and the success of the new curriculum. Studies demonstrate that student perception can positively—and negatively—affect learning. Studies also show that physical characteristics of the space in which education occurs and the curricular organization of that education significantly impact student performance. Understanding the ways in which students perceive the physical and curricular educational environment can be utilized to monitor the effectiveness of new pedagogical models and increase student performance. This paper briefly outlines the preliminary results of a study that investigates construction students' perception of various aspects of their studio curriculum. In the first phase of the study, a quantitative method was used to gather data and categorize factors that affect student perception. Results indicate that there is a consistent pattern between what students consider to be potential outcomes of studio and what they perceive as important features. In addition, students outlined the physical elements that influence their perception. Results of the research demonstrate that both cognitive and physical aspects of studio in a construction project-based curriculum at Mississippi State University appear to have a positive impact on student performance. The outcomes of this study can be applied to and incorporated in designing and implementing studio- and project-based construction education as well as this learning model in other disciplines.

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

Introduction

Project-based learning is increasingly recognized as an effective way to bring relevance to abstract concepts and information. It also provides an engaging way to allow students to learn, adapt, and synthesize skills through application and iteration. Despite its advantages, studio- or project-based learning is not widely applied outside design disciplines such as art, architecture, design, interior design, and landscape architecture. Disciplines such as construction provide an ideal field in which to apply and further develop studio-based learning. The main objective of this study was to investigate the perception of students regarding the studio-learning environment in a construction program at Mississippi State University. The program has developed and implemented a comprehensive studio-based curriculum in construction over a multi-year period and has graduated a sufficient series of students to provide data that supports an examination of its effectiveness. Student perception about the studio and its aspects provide a foundation for further educational methods. The ways in which students perceive their studios, both the physical space of the studios and the curricular organization and structure, has a direct impact on their performance.

The studio environment is distinct from a typical classroom or lecture hall. Students spend more time in the studio space than they do in typical classrooms due to the length of the studio meeting time—normally five- to six-semester credit hours held three days a week—and the fact that in most academic programs that employ a studio curriculum, each student is assigned an individual studio desk that is theirs to use throughout the academic term. As a result, their interaction with the objects and other people including their teammates, classmates, and instructors is largely determined by their perception of the studio space and activities that occur there. These include assignments, research, problem analysis, hands-on projects, presentations, discussions, and teamwork. Activities also include professional socialization, which is a large component of studio-based education that results from the length of time that students spend in the studio space. Students also have more contact with their studio instructor due to the low student-teacher ratio and the low number of students per studio section—on average 15 to 20 students. Knowledge how students perceive various aspects of studio and which are important to them are valuable inputs to consider when designing and planning educational activities, programs, and related details for studio curricula.

As the discussion of studios as an emerging approach in construction education becomes a subject of greater interest in higher education, Mississippi State University's Bachelor of Science in Building Construction Management program—one of only two studio-based construction programs in the US—has attracted increased attention. The program's mission statement asserts that the program's goal is to "arm graduates with a clearly defined management skill set as they prepare for careers in construction or construction-related fields where effective decision making, problem solving, and multiple forms and levels of management are required." The studio-based curriculum provides students with multiple opportunities to collaborate and acquire knowledge and skills about construction projects. Project-based education has allowed instructors to develop and incorporate a variety of activities and assignments beyond traditional academic activities. The expanded scope of activities includes hands-on building projects, interdisciplinary collaboration, site visits, and real-world problems defined by and led by industry professional as well as regular academic activities. Another advantage of the studio-based program is that it facilitates and supports student collaboration across the art and design college in which the construction program is located. This serves to bridge gaps between construction and other building-related disciplines and ensure that construction students gain the required knowledge and skills to effectively communicate, collaborate, and negotiate with a wide range of colleagues and constituents across construction and other industries. The core of the program is a series of eight construction studios that are offered sequentially, one each semester. Each studio is six-semester credit hours and meets three days a week for a total of 12 contact hours. Through these studios, students acquire knowledge of major areas of construction including, but not limited to, materials and methods, estimating, scheduling, project management, construction law and contract, delivery methods, building information modeling, and safety. Additional lecture-based courses supplementally address other construction topics that may be of interest to students in programs such as engineering, architecture, interior design, and business.

Literature Review

The studio-based educational model is widespread and accepted within many disciplines. Among programs in higher education, architecture and art programs have historically incorporated the studio-based method in their curricula as a core component. Schon (1983) defines the design 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 each of the twenty students has arranged his own drawing tables, papers, books, pictures, drawings and models. This is the space in which students spend much of their working lives." The size of studios varies from five to 35 students (Hostetler, 2014); however, it is typically planned for about 20 students. Studios might appear disorganized or messy due to the product creation process; however, this atmosphere helps students to comprehend the real-world problems (Hostetler, 2014). It also provides them with a relaxed and informal environment in which the creative process is the focus. Brandt et al. (2011) present a holistic framework that investigates the role of pedagogical approaches in the studio and concludes that the disciplinary underpinnings and academic culture strongly impact the structure and function of studios. De la Harpe et al. (2009) reviewed 118 journal articles on studio-based learning in the three disciplines of architecture, art, and design. He defined

dimensions of product, person, and process as three primary elements of each studio and suggests that each dimension should be emphasized while assessing the outcome of each studio. Although the studio-based approach is traditionally used in design programs, Bremer and Els (2016) address the studio pedagogy as a possible new method in the education of Built Environment students and show how the disconnection between traditional methods of academic instruction and industry practices can be addressed by the studio-based method. Boucharenc (2006) reports on teaching 'Basic Design' in schools of design and architecture across 22 countries and concludes that developing conceptual skills is a vital part of education for design students. These skills include manual modeling, working with different materials, and understanding the interaction between objects and materials. Simpson (2011) addresses four pillars of an effective model for visual education as studio-based experience, working with materials, relationships of trust, and applied aesthetic understanding. He states that to fulfill the concept of "learning by doing," hands-on experiences in studio is the core element to integrate different features of the creative design process. Through this process, students build relationships with their surrounding environment, instructors, and teammates. This promotes their confidence in the context of learning by doing. The skills developed in the culture of the studio are critical to artists, design professionals, and architects as well as other professionals, which indicates potential to implement this model in other disciplines.

Programs for other disciplines have attempted to convert traditional lecture-based curricula to studio-based. For example, the Bachelor of Information Management and Systems (BIMS) at Monash University has been offered in a studio-based curriculum, a non-traditional method for this discipline. By translating teaching methods to the studio-based model, the program has sought to enhance interpersonal skills such as communication, collaboration, and self-direction (Carbone, Lynch, Arnott, & Jamieson, 2000). To improve creativity, Jabi et al. (2008) explored the use of the studio model of learning as an integrated structure for students in an Architecture with Computer Science program to collaborate. The data for evaluating the impact of the studio-based approach were obtained through observations, interviews, and surveys. While Computer Science students perceived an increase in creativity and ability to create innovative artifacts, Architecture students perceived themselves as more creative. However, the study reported on the existence of significant differences among the two groups in terms of perception of creativity, originality, fluency, and new idea generation. Jabi et al. also addressed a number of challenges faced. Understanding the notion of problem-solving using a design studio setting for Computer Science students and faculty, setting up the actual physical space, inconsistencies between creative design in the Architecture side against the Computer Science's scenario-based methodology, scale, and nature of the project were examples of the challenges that the researchers encountered. Mathews (2010) used studio-based pedagogy to engage students in the design of mobile-based media (place-based mobile games and interactive stories using GPS technology) in which many students initially had difficulty adopting to the studio setting. However, as the studio project progressed, students responded positively to different aspects of studio learning. For example, students worked more collaboratively and showed a greater sense of ownership and responsibility for the overall success of the learning environment. Although the benefit of studio-based education is not always immediately evident within the academic term, long-term benefits are demonstrated with sequential studio programs. The physical layout of the studio is another consideration that can impact the outcome. Crichton (2014) reported on leapfrogging pedagogy as a design approach to making change in challenging contexts. She defined her new educational approach as a reciprocal and iterative collaboration between academics, educators, and industry in order to enhance the educational setting. Based on Crichton's suggestion, work space layout for learning studio should encompass five zones: Imagination, Collaboration, Creating, Tinkering/Testing, and Play. The Imagination area, which consists of a quarter of the educational space, should be furnished with soft seating to support informal conversations. The layout should be adjustable to accommodate different types of group activities. The collaboration area occupies the majority of a studio in which tables can be pulled together for larger groups' activities. Somewhat uncomfortable chairs encourage students to get up and move around. The Creating area utilizes one wall of the studio space. This allows students to use a continuous space, which is equipped with computers with large screen displays. The Tinkering / Testing area can be furnished with an interactive table, which enables small groups of students to sit and test ideas. Finally, the Play area is assumed to be the whole studio space in which students can freely move around and interact with each other and their instructors. The size of the studio is another factor that impacts student perception. In a study on the perception of students in an architecture program, Tumusiime (2013) stated that while student comments indicated that a studio that was sized to accommodate a multiplicity of activities, unoccupied space had a negative impact on students' interaction.

Methodology

Based on the educational goal of the construction program at Mississippi State University to support continuous revision and development of the curriculum, a research study was designed to obtain input and feedback for further curriculum enhancement. The first phase of the study was administered in Fall 2017. To provide a basis for further examination, the survey was designed to gather quantitative data. A quantitative research method was determined to be more appropriate and effective as the studied sample targeted all students who have experienced at least three studios. The questions were categorized in the following sections:

- Demographic information, which included general information regarding the year level, gender, GPA, and work experience, etc.,
- Studio potential learning outcomes, which included various aspects of studios,
- Comments in which students could express their perceptions and preferences on different layouts and features of studios, and
- Time and structure layout of studios, which presented various alternates to the current structure and layout of the program.

The survey focused solely on the studio experience to ensure that responses did not reflect attitudes about other aspects of the curriculum and to ensure that the broadest range of student perception was able to be obtained. The survey was distributed by paper to give students an opportunity to clarify any ambiguous items. Data were compiled, modeled, and analyzed with statistical software. Seventy-four undergraduate construction students, including 19 senior, 25 junior, and 30 sophomore students, participated in the study. Each year-level group of students was, respecetively, in its fourth, third, and second year of the studio-based construction curriculum.

Results

As in many construction programs, male students formed the majority of enrollment and of study samples (93%). On average, participants reported 21 months of work experience. Participants reported their overall GPA and their average GPA for studio. The weighted mean of the overall GPA is reported as 3.06 against the 3.46 of the studio GPA. The percentage of each letter grade is shown in Figure 1.

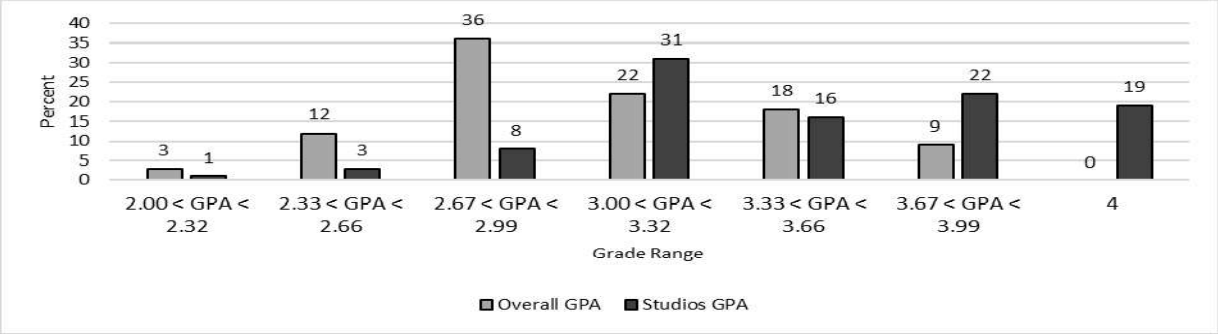

Figure 1: Percentage of Overall GPA vs Studios GPA

In the next section of the survey, students were asked to rate the effectiveness of studios' potential outcomes compared with conventional class-based courses. Fifteen potential outcomes were provided based on the literature review and a five-level Likert scale (1: Very Low, 5: Very High) was used to rate each item. The average score for all 15 outcomes was equal or greater than three (midpoint). Based on the average score of each outcome, two groups of high and low importance outcomes were determined. Group Work/Teamwork, Hands-on Experiences, Group Discussions, Professional Socialization, Encountering In-depth Problems, Application of Knowledge, and Learning in Different Ways were eight potential outcomes that students rated as high importance outcomes. Creativity, Adapting Procedures to Real Cases, Communications, Analysis of Problems, Increased Self-confidence, Evaluation of Ability, and Practical Work were the groups that were rated as low importance outcome group. Figures 2 and 3 show the percentage of each level of high importance and low importance outcomes respectively.

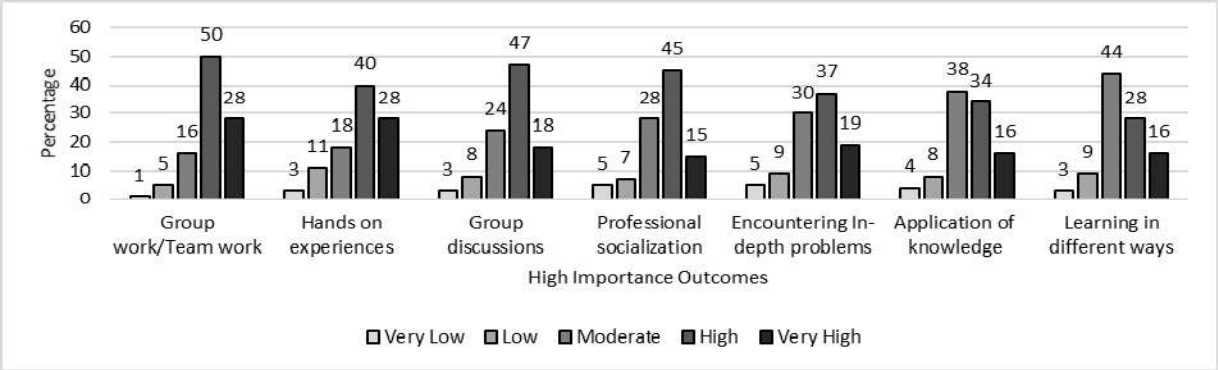

Figure 2: Percentage of each importance level of high importance outcomes

Students were asked to what extent they think studio-based curriculum is a good fit for the construction program. Seventy-seven students believed that studio-based curriculum is appropriate for the program (36% absolutely appropriate and 41% appropriate), while only eight percent stated that studio-based curriculum is inappropriate (3% inappropriate and 5% absolutely inappropriate). In addition, students were asked to rate their level of engagement as a self-reported measurement. Five levels of engagement including Not Engaged, Slightly Engaged, Moderately Engaged, Engaged, and Very Engaged were defined to quantify their self-evaluation. The percentage of each level of engagement is shown in Table 1. Statistical analysis indicates no significant correlation between the way in which students perceived the appropriateness of studio-based curriculum for their program and their level of engagement. In the next section, students were asked to rate to what extent, they rate the importance of each aspect of studios using a five-level Likert scale. Among the studio aspects, possibility of teamwork and having proper time to work on assignments and projects are determined to be the most important aspects of studios to students.

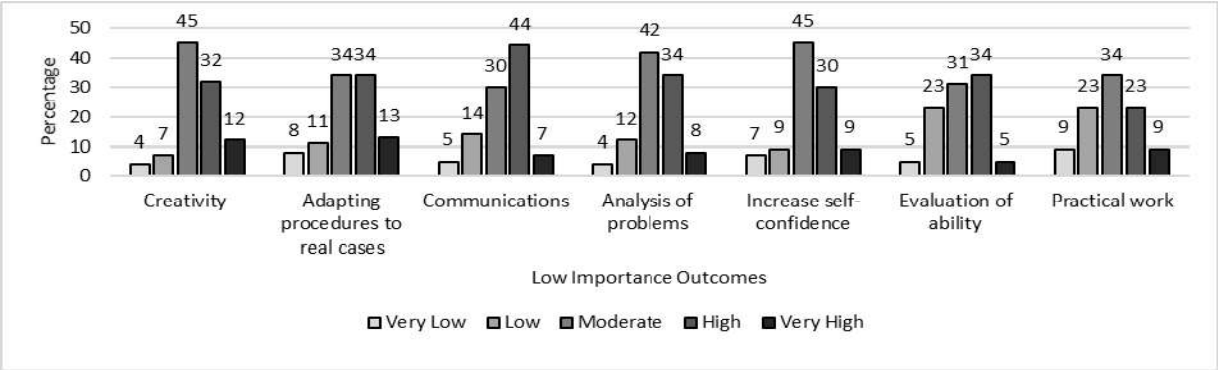

Figure 3: Percentage of each importance level of low importance outcomes

Table 1
Level of engagement

Not Engaged	Slightly Engaged	Moderately Engaged	Engaged	Very Engaged
3%	20%	36%	32%	9%

Table 2
Level of importance for each aspect of studio

	Proper time to work on assignments, projects, etc.	Having more time to be in the department and interact with people	Greater access to instructors	Broad range of topics covered	Doing various activities immediately after lectures were presented in studios	Having guest speakers from industry	Group discussions	Group work/team work
Very Low (%)	3	4	1	4	4	5	3	1
Low (%)	12	20	11	5	12	27	12	7
Moderate (%)	28	48	41	42	31	28	35	20
High (%)	26	24	42	35	46	24	39	52
Very High (%)	31	4	5	14	7	16	11	20
Total (%)	100	100	100	100	100	100	100	100
Average (out of 5)	3.7	3.04	3.39	3.49	3.39	3.19	3.43	3.82
Standard Deviation (out of 5)	1.12	0.88	0.81	0.94	0.93	1.17	0.94	0.88

The next portion of the survey was designed to investigate the perception of students regarding the level of physical comfort that they feel in their studio compared with traditional classrooms. A five-level Likert scale was used to rank the comfort level of students. The percentage of each level is shown in Table 3.

Table 3
Percentage of each level of comfort in studio atmosphere

Not at all comfortable	Slightly comfortable	Moderately comfortable	Very comfortable	Extremely comfortable
3	5	11	55	26

Comfort was then divided into subgroups. One main factor impacting this perception is the physical layout of the studio space. Moreover, the physical features of chairs and tables were additional factors that influence the feeling of comfort in studio. Students were also asked how they feel about these two factors. Figure 4 shows the percentage of each level on these two factors.

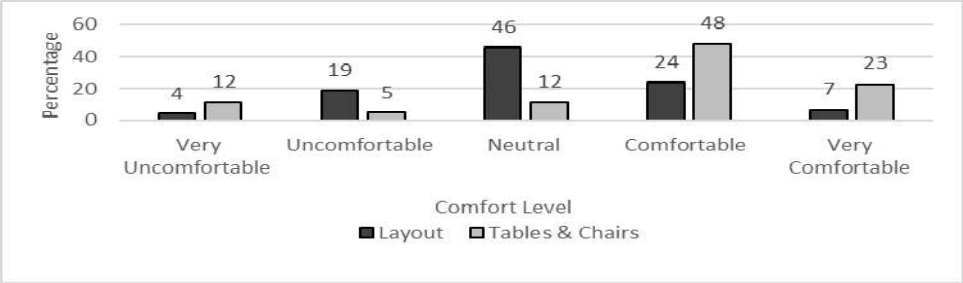

Figure 4: Percentage of comfort level regarding the studio layout and furniture

As shown in Figure 4, students were more sensitive to their feelings regarding the furniture than the layout of their studios. Another factor that students noted that impacts the feeling of comfort in studios is the degree of interruption that they encounter during working periods. The arrangement of rooms and the physical layout of studios in the construction program at Mississippi State University requires that students use common circulation paths and entrances to enter the studio spaces and to move from one space to the other. These paths are not separated from the

actual studio spaces. Although this layout provides opportunities for more interaction between students of different levels, it also results in significant visual and aural interruptions. In addition, concurrent activities within adjacent studio spaces often conflict. For example, students in one studio may be using tools and equipment to make models while students in another studio level may be discussing scheduling assignments. Students were asked to what extent visual and aural interruptions in their studios were an impact. While both visual and aural interruptions are reported as notable factors, the sensitivity of students to aural interruptions is more significant.

Table 4

Level of visual and aural interruption in studio

	Visually interrupted	Aurally interrupted
Never (%)	4	1
Rarely (%)	19	12
Occasionally (%)	46	38
A moderate amount (%)	24	27
A great deal (%)	7	22

Table 5

Overall satisfaction regarding the variety of subjects covered in the BCS studios

Level of Satisfaction	Percentage
Not at all satisfied	7%
Slightly satisfied	16%
Moderately satisfied	52%
Very satisfied	22%
Extremely satisfied	3%

Finally, participants were asked to evaluate to what extent they are satisfied with the variety of subjects covered in the construction studios compared with traditional lecture-based courses. This was used to determine impact on their perception. Table 5 shows the level of satisfaction regarding the variety of subjects in studio. The percentages indicate an overall satisfaction regarding the subjects; however, it also indicates that an increase in the diversity of subjects addressed in the studio can contribute to an increase in students' satisfaction.

Discussion

Studio-based curriculum in construction education is an emerging teaching method. Although this model is a dominant approach on the design side of the building professions, there are few programs that have incorporated studio-based learning as a standard, consistent curriculum-oriented approach. For these programs, and other construction programs interested in utilizing the studio-based method, the most immediate and available model to benchmark performance is architecture studios. While there are a number of similarities between architecture and construction programs that can be applied and translated to construction studios, there are significant differences in the discipline, educational content, and outcomes. Neglecting to consider, address, and monitor these distinct and inherent features and characteristics of construction education has the potential to jeopardize the effectiveness of the studio-based learning model. Replicating current structures and layouts in studio-based programs of other disciplines has the potential to overshadow the critical characteristics, requirements, and priorities of construction programs. The lack of best practices for studio-based learning in construction programs necessitates other inputs to establish a platform that would enable an iterative design, implementation, and revision of educational methods for studio-based learning. One substantial resource to help to fill this absence in construction education is student perception. Many research studies have shown a direct relationship between student perception and their learning performance and outcomes (Russell Calk, 2006; Ferreira & Santoso, 2008; Ma, Chen, & Ampountolas, 2016). Student perception is not limited to the cognitive factors. A variety of other factors shape student perception. An understanding and consideration of these contexts helps to gauge their impacts and identify means to ensure that educational models reflect these factors. For instance, a number of studies indicate ways in which physical conditions affect student perception (Hill & Epps, 2010; Yildirima, Capanoglub, & Cagataya, 2011; Asiyai, 2014). The results of this study indicate several points that are different from general assumptions regarding the studios. The analyses show that the average of grades in studios is about 0.5 points (out of 4.0) higher than the overall GPA. While a common assumption that core courses are more difficult for students and require more time and effort to earn high grades, the difference might indicate how students perceive main courses of their program and therefore spend more time and effort for them. This would eventually result in higher student performance levels. Another misleading assumption is the potential features of construction studios. For instance, the ways in which creativity is affected by the physical studio environment in other disciplines is discussed in different studies (Hargrove, 2007; Porter Lofaro, 2016; Lacy,

2014). However, construction students do not place creativity high on a scale of importance. Instead, construction students place greater importance and value on time to work on projects and assignments and time to interact with fellow students and instructors. Another feature of studios is the potential for collaboration and teamwork. Despite the fact that traditional studio curricula, particularly in architecture, art, and design, focus on individual creative outcomes, construction students rated the potential for collaborative teamwork as important. Comparing the "potential outcomes of studios" and "importance of studios' aspects to students" groups reveals a similar pattern . Another notable point from the data analysis is aural and visual disruptions. It should be noted that, without significant modification of studio layout and configuration, the nature of activities in construction studios has the potential to increase the degree to which visual disruptions as well as aural disturbances remain significant factors that impact learning. Means to monitor and limit their negative impact on studio activities requires attention and coordination.

Conclusion

This paper reported on preliminary results of the first phase of a study that seeks to investigate construction student perception of different aspects of studios. Overall, construction students expressed a positive attitude toward aspects of the studio such as layout, organization, physical space and setting, time required, and the level and variety of subjects they experience. On average, their level of engagement was mid to high. This, along with their construction studio GPA, demonstrated their enthusiasm for a project-based program. Students also reported how they perceive potential studio outcomes. Among a list of possible outcomes, they believed teamwork, hands-on experiences, group discussions, and professional socialization are important outcomes of studios. In rating the importance of the various features of studios, student comments indicated a similar pattern. This is further indication of a clear consensus. However, due to their large physical area and layout of spaces, studios are prone to interruptions. Although aural disruptions are common in large spaces, visual disruptions are also significant. Comparison of aural and visual disruption levels shows that studio spaces are especially vulnerable to unplanned and often uncontrollable external activities, factors, and behaviors. This paper provides valuable information, data, and insights that can help to design and plan construction studio curricula; however, interpretation of the results requires further, more detailed surveys, experiments, and analyses as well as consideration of the relevance to specific applications. Lack of best practices in construction studio curricula requires benchmarking from other programs, which places some risks to the validity of evaluation method. Ideally, it requires development of discipline- and program-specific benchmarks. In addition, a larger sample can improve the reliability of results. Likewise, administering similar studies in other schools can enhance the outcomes. Further examination and research including factors such as gender, level, studio subjects, and studio time will reveal additional valuable information, data, and insights that can further increase the relevance and value of studio- and project-based learning in construction education.

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