Exploring Students' Perception Toward Design-Build as an Educational Delivery Method

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Abstract

Over the past several decades, the construction industry has experienced significant growth. Consequently, the needs and opportunities to adapt to this growth in construction education are clear to academics. Learning and developing concepts like teamwork, effective communication, and interpersonal skills are equally important to construction technical concepts like estimating, scheduling, and project control since in the absence of interpersonal skills and relationships, it would be difficult to work and collaborate effectively in the construction industry. At Mississippi State University (MSU) Department of Building Construction Science (BCS), the first-year curriculum employs a design-build instructional delivery method to integrate fundamental knowledge in construction management. The BCS curriculum utilizes "studio" as the standard layout elicited from project-based learning (PjBL) for the core construction management content. Studios are typically longer than regular lab or lecture courses as they provide the opportunity to work on projects during the studio time.

In this study, we investigated the students' perception about this process as a model of learning and explored their experiences in the studio. We asked students about their perceptions of efficiency, productivity, their learning outcome, expectations of the construction industry, challenges they faced and opportunities they discovered. The study employs a quantitative approach via a survey instrument to collect data (n:58). The preliminary results indicated an overall positive trend in productivity and efficiency of learning using design-build. Students indicated various challenges namely, time management, conflicts between members of a team and intensity of building tasks and fabrication. Overall, design-build as an instructional delivery mode has shown to present merit in conveying construction fundamental knowledge, however, challenges with time and group size seem to impact the overall efficiency of the model.

Keywords: Design-build, Instructional Delivery Method, Construction Education, Student Perception

Introduction

Construction education has undergone significant evolution in recent years, responding to the ever-changing needs of the construction industry [1], [2], [3]. To adapt to this change, universities and construction programs have developed different approaches in their coursework and curricula, moving away from traditional teaching methods (e.g., seminars and lectures) to more integrated curriculums [4], [5]. Several research studies looked at the use of mixed reality technology as well as other tools and methods of delivery and their potential advantages, utilities, challenges, and opportunities in dissemination of construction and engineering content [6], [7], [8]. An important dimension of the construction industry is the close connection to related disciplines including architecture and engineering and therefore, the simulation of such relationships in construction education was investigated in numerous studies, revealing the value and significance of interdisciplinary and collaborative leaning environments [9]. However, evaluation of these instructional delivery methods and understanding students' perceptions toward them remain critical in establishing and maintaining effective teaching models.

At Mississippi State University (MSU), the Department of Building Construction Science (BCS) adopts a studio-based model across its four-year curriculum, grounded in project-based learning (PjBL) principles. This approach prioritizes hands-on learning and practical training, diverging from traditional lecture-based methods, and immerses students in the fundamentals of construction science and management right from the first year. The final product of the first-year studios is typically a "tiny building" which is basically a modular building made up of multiple wood and steel modules. Figure 1 showcases students working on completing the wall (wood) framing for the tiny building.

Figure 1. Students are working on completing the wood framing outside.

The first year studios' content are dedicated to teaching construction drawings and graphics, guiding students through the design and development of a modular/tiny house. This hands-on experience extends to material procurement and fabrication, culminating in the construction of a modular building. Through tasks like framing, sheathing, and installing weather barriers, interior and exterior finishes, placing windows and doors students acquire a thorough understanding of construction processes, complemented by lessons in construction management, such as project estimating and scheduling. Figure 2 shows students working on completing the placement of weather barrier for their building.

Figure 2. Students are working on completing the placement of the weather barrier on the building.

Another important element of the studio setting is teamwork and peer collaboration promoted by PjBL. The scholarly research on collaboration [13], [14], [15] suggests collaboration as a multifaceted skill set in construction education that is fundamental to effective and timely delivery of projects [16]. This experiential learning is complemented by a mix of hands-on work, demonstrations, lectures, and on-site fabrication and assembly, culminating in the construction of a small modular (tiny) building [17]. This process not only imparts technical knowledge but also fosters a deeper understanding of the practical aspects of construction management through direct application of the learned concepts in studio. Figure 3 shows the completed project (tiny building) at the end of the semester, while students are working on completing the exterior finishes.

Figure 3. Students are working on completing the exterior finishes at the end of the semester.

Distinctively, the BCS program caters to both regular and fast-track cohorts. The regular cohort progresses through this immersive experience during the fall and spring semesters, while the fast-track group completes the same curriculum intensively over June and July, allowing for accelerated learning and application so adjustment to the remaining curriculum is feasible. The studios typically have 15-20 students in each section, where they are organized in teams of 4-5 students to collaborate on various design and construction tasks. Figure 4 shows the studio layout where students are discussing design and construction details prior to starting fabrication tasks.

Figure 4. Students are discussing design and construction details in the studio prior to starting fabrication tasks.

This study examines the perception of students toward design-build as an instructional delivery method. The goal is to understand how students perceive learning and productivity of this method for construction science and management content. We investigate this teaching model's efficiency, the productivity levels it fosters, and the challenges and opportunities it presents. By focusing on the design-build approach as implemented in the MSU curriculum, our aim is to gauge its impact on students' learning outcomes as well as any potential impact on their expectations and perceptions of the construction industry.

Experimental Methods

The current study utilizes a quantitative approach via a survey instrument to carefully investigate students' perception of design-build as a learning model and assess its efficacy in delivering construction management content to students. A multi-section survey instrument was developed, to first collect information on various demographic variables as well as various dimensions of learning through multiple choice questions on aspects of design build. The rational for collecting this data was to assess any potential correlation between student demographics and background with learning levels and reported votes for all metrics questioned in the next phase as well as evaluating the possible linkage between such factors and student perception toward design-build as the delivery method. Following demographic, the questions were categorized into sections including learning and perception, productivity and progress, schedule and time management, teamwork and collaboration, teaching effectiveness, interest and understanding, and overall experience and understanding.

IRB approval was obtained through the Office of Research Compliance and Security at Mississippi State University (IRB-23-312) in July 2023 and consent was obtained electronically from all participants. The pool of participants is composed of two cohorts, the regular cohort who completed studios in fall 2022 and Spring 2023 and the summer group who completed the studios in June and July 2023. The survey was distributed to students in August 2023, so the students remember their experience from the previous semester when they finished the design-build studio. Upon the completion of data collection (n:58), duplicates were removed, data was cleaned and merged, a data model was created, and various statistical analyses were performed with statistical software SPSS to examine research questions and investigate students' perception of design-build as learning method for construction management content.

Results

In the first section of the survey demographic data were gathered. Male participants comprised 88% of all participants and the rest were identified as female. In the next question, participants reported the semester they took the studio with the design-build content. The department offers the studios with the design-build topics in either regular fall and spring semesters or intensive summer sections. The majority of participants (78%) had the relevant content in the fall-spring layout and the rest had the content during summer. In the next question, participants reported their GPA in groups "under 2.00", "2.00-2.49", "2.50-2.99", "3.00-3.49", and "3.50+", for which the percentages were 0, 14, 38, 31, and 17, respectively. Also, 57% of participants entered the program directly after high school, while 36% transferred from another major and 7% reported a different transition route. Moreover, 59% of participants reported prior construction knowledge before entering the academic program.

In the next section, the main expectation of students was explored in which predefined options were "Learn about construction materials", "Learn about construction methods", "Gain practical building skills", and "Understand the design-build process". A five-level Likert scale was used to rate each question. The percentage of each level is shown in Figure 5, for the main expectations above.

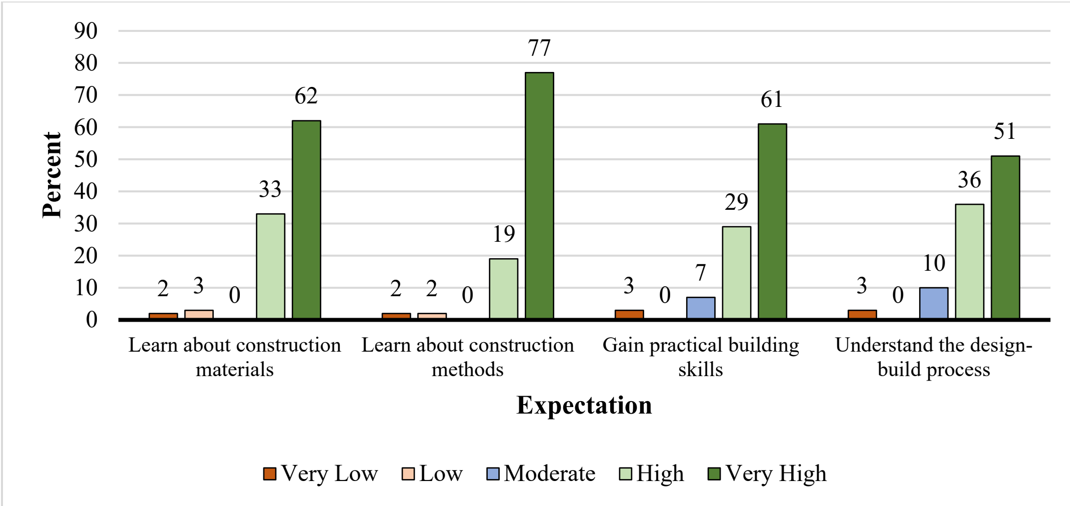

Figure 5. Participants' main expectation prior to starting design-build studios.

The change in participants' expectations was the subject of the next section, in which participants first reported how their expectations changed after completing the first part of the course. Options provided for this question were "My expectations were met", "The course exceeded my expectations", "The course did not meet my expectations" and "others – please specify". The percentages of these four options were 56%, 34%, 7%, and 3%, respectively. These percentages indicated a relatively high level of meeting expectations in participants.

The next section was focused on the changes of expectation in the second half of the course, in which the type of intensity of class work (assignments, projects, building activities, etc.) shifted from mainly individual-based to group-based ones. In response to "*Entering the second part of the course, how did your expectations change from your initial ones",* options provided to participants to evaluate were "I expected more practical work", "I expected more theory-based learning", "I expected more teamwork", and "I expected more individual tasks". A five-level Likert scale was used to rate each expectation situation. The percentage of each level is shown in Figure 6, for the desired scenarios mentioned before.

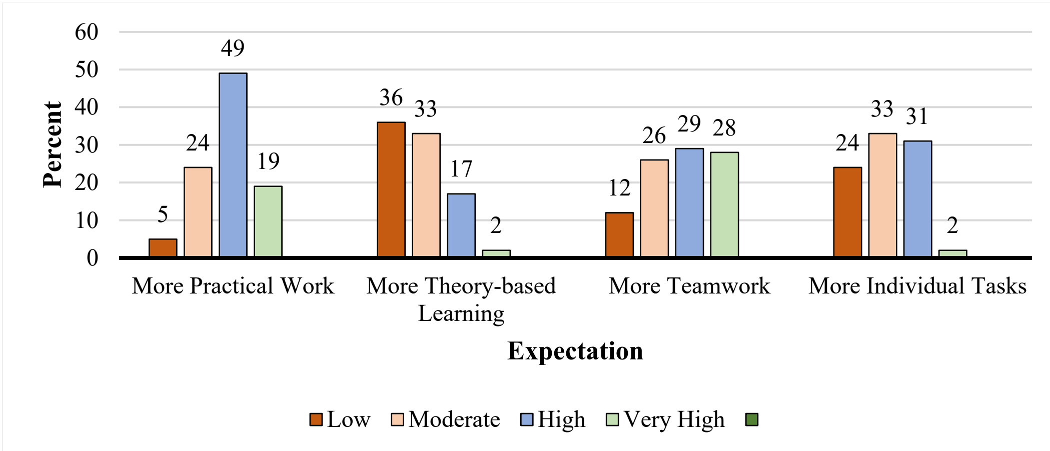

Figure 6. Participants' expectation in the second half of the course.

Participants were also asked to rate their understanding of the different construction materials and methods taught in the course. A five-level Likert scale, denoting "No understanding", "Slight Understanding", "Moderate Understanding", "Good understanding", and "Full understanding'. The percentage of each level for construction materials and construction methods subjects is shown in Figure 7.

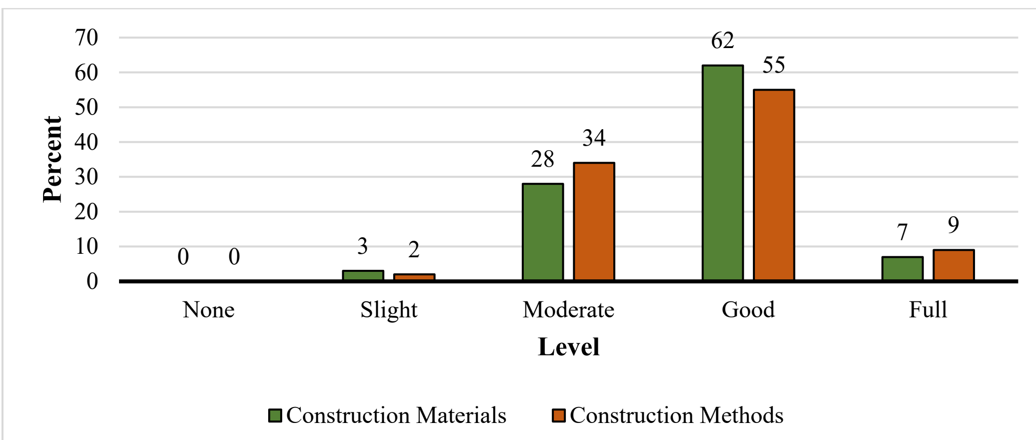

Figure 7. Participants' understanding towards construction methods and materials upon completion of studio.

The next section of the survey covered factors related to student productivity. Participants rated their productivity using five levels of "Not Productive", 'Slightly Productive", "Moderately Productive", "Very Productive", and "Extremely Productive". The percentages of levels were 0%, 2%, 21%, 61%, and 16%, respectively, which indicated a relatively high self-reported productivity. In the same section, participants reported their perception about the extent to which, they found the studio working hours manageable, using five levels, including "Unmanageable", "Barely Manageable", "Somewhat Manageable", "Manageable" and "Very Manageable". The percentages of these levels were 9%, 22%, 38%, 29%, and 2%, respectively. Overall, the rating indicated participants struggle in managing their time for studio activities. In the next question, participants were asked to rate to what extent they felt they had been able to balance the demands of their design-build studio with other aspects of their life such as other courses or personal time. A five-level Likert scale included "Not At All", "Slightly", "Moderately", "Very", and "Extremely". As shown in Figure 8, the percentage of each level is shown, indicating participants' challenge in coping with their studio times.

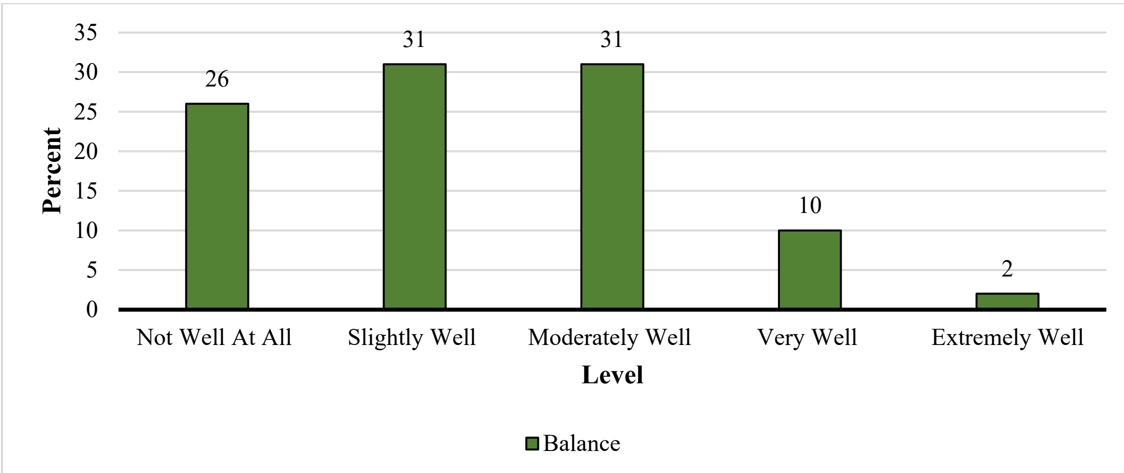

Figure 8. Time balance between studio time and other daily activities.

Participants were also asked to rate "the effectiveness of teamwork and collaboration within the studio" and the extent to which they found "working in a team in the studio was beneficial".

Table 1. Perceived effectiveness and benefit of teamwork and collaboration within the studio.

	Very Low	Low	Moderate	High	Very High
Effectiveness	3	7	36	44	10
Beneficial	0	3	19	49	29

Additionally, participants were asked to specify the optimum number of team members. The possible team size included 3 members or fewer, 4 members, 5 members, and 6 or more members. The percentages of each team's size in shown in Figure 9.

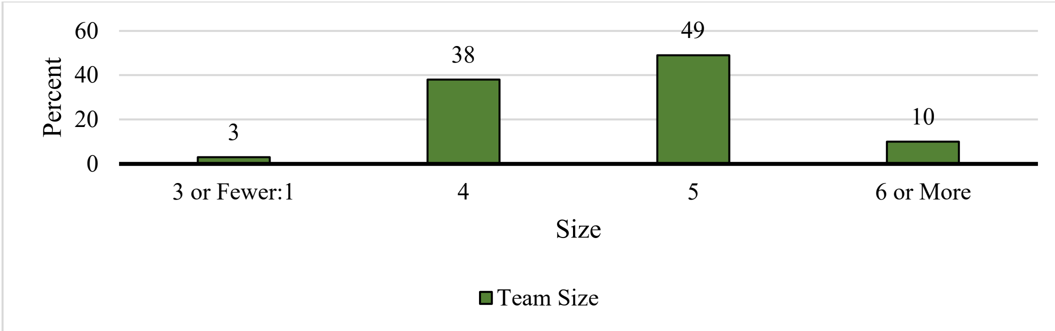

Figure 9. Optimum team size.

Finally, participants rated the extent to which they found various learning tools helpful for their learning in their studios. The methods included “Lectures”, “Demonstrations”, “Hands-on Work”, and “Peer Collaboration”. Similarly, a five-level Likert scale was used to rate each learning method. The percentage of each level is shown in Figure 10.

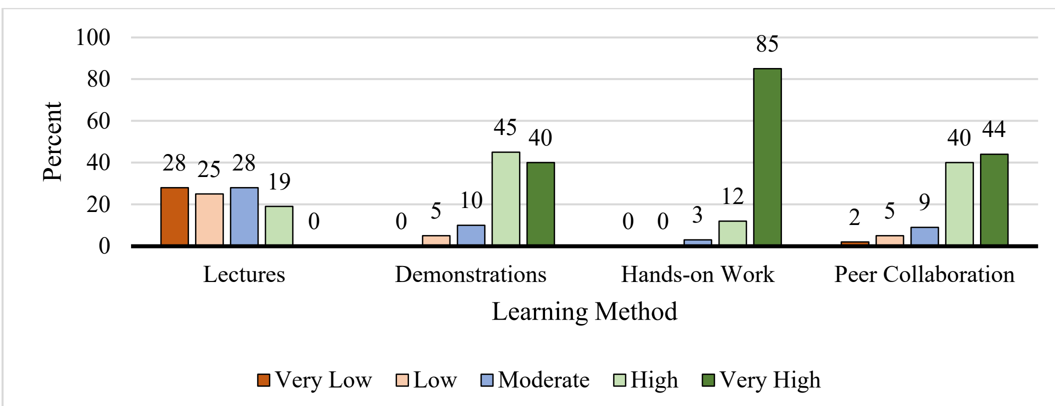

Figure 10. Learning method helpfulness.

Discussion

This study offers valuable insights into the design-build method as a mode of content delivery within construction education. It is essential to acknowledge that the study's scope was limited to a single academic year, and perceptions may indeed vary among different cohorts. Specifically, the contrasting experiences between students who undertook the first-year studio during the regular academic year and those in the intensive summer session highlight the diversity of student experiences and perceptions within the program.

A significant finding of the research was the identification of students' primary expectations at the onset of the course. The BCS program has a reputation due to the hands-on model and it is characterized by the design-build of modular buildings as the product. Therefore, many students choose the BCS program because of this feature and many of them have prior construction experience. The findings of the study indicated that the majority of participants prioritized learning about construction methods, closely followed by gaining practical experience and an understanding of the design-build process. This preference aligns closely with the hands-on approach for which MSU's BCS program is renowned and likely influenced the students' decision to enroll. The fact that many students entered the program with prior construction experience also suggests that the program's practical orientation and alignment with previous experiences were key factors in setting their initial expectations.

With the progression of the studio in its second half, shifts in student expectations were observed, especially during the initial design process and early stages of fabrication such as concrete pouring and wall construction. Students increasingly anticipated a greater focus on practical work and teamwork, which correlated with their experiences in the first half of the studio. This shift in expectations seemed to contribute to higher levels of satisfaction and comfort among students as they advanced through the course.

The students' understanding of construction materials and methods was rated highly, indicating the effectiveness of the initial lectures and demonstrations, and their subsequent application during the hands-on fabrication and assembly phases. This approach was greatly valued as it allowed students to directly apply and consolidate theoretical concepts. The survey results also indicated a preference for hands-on work, peer collaboration, and demonstrations over traditional lectures and classroom settings, underscoring the comprehensive and immersive nature of the studio-based, design-build learning model.

Another key aspect that emerged from the study was productivity. The participants reported high productivity levels, which could be attributed to the visible progress made during the fabrication process and the satisfaction of completing the modular building. The study also found that smaller to medium-sized teams were optimal for facilitating task coordination and completion, while larger teams sometimes struggled with efficiency and group dynamics.

However, the study also brought to light several challenges, particularly regarding the management of working hours. This was a significant concern, especially for students in the intensive summer session who often faced long studio hours in addition to their regular coursework. Such a schedule could potentially lead to overburdening the students, impacting both their productivity and overall learning outcomes. These findings underscore the need for a more balanced approach in the design-build studio model, one that carefully considers students' time management and overall well-being to enhance the learning environment effectively.

Conclusion

The present study provides valuable insights into the effectiveness of the design build studio model in construction education. The findings reveal that students generally perceive this approach as more efficient and influential in shaping their understanding and facilitating their learning with construction management content. The hands-on activities, practical nature of work, coupled with the emphasis on teamwork and peer collaboration aligns well with students' expectations and preferences for learning. Furthermore, the high levels of reported productivity and satisfaction with the learning tools and methods utilized in studio, particularly the hands-on tasks, affirm the value and significance of this immersive educational model.

However, the study also highlights significant challenges. The intensity of studio work and the impact it has on students' personal lives, along with difficulties in time management indicates opportunities for improvement and areas that can be optimized for higher efficiency and better balance. The optimum team size findings suggest a need for careful group dynamics management to maximize collaborative learning while minimizing potential conflicts or inefficiencies.

Overall, the design-studio model at the Department of BCS at MSU demonstrates considerable merit in delivering fundamental construction management skills and knowledge. Yet, it is evident that continuous careful evaluation and adaptation of this model is necessary to ensure that it remains responsive to both students' needs and the constantly evolving demands of the construction industry.

References

[1] R. Soetanto, M. Childs, P. Poh, S. Austin, and J. Hao, "Global Multidisciplinary Learning in Construction Education: Lessons from Virtual Collaboration of Building Design Teams," *Civ. Eng. Dimens.*, vol. 14, no. 3, pp. 173–181, 2012, doi: 10.9744/ced.14.3.173-181.

[2] N. Lee, R. Ponton, A. W. Jeffreys, and R. Cohn, "Analysis of industry trends for improving undergraduate curriculum in construction management education," in *ASC Proceedings of the 47th Annual International Conference, Omaha, NE*, 2011.

[3] A. L. Olanrewaju, A.-R. Abdul-Aziz, A. L. Olanrewaju, and A.-R. Abdul-Aziz, "An overview of the construction industry," *Build. Maint. Process. Pract. Case Fast Dev. Ctry.*, pp. 9–32, 2015.

[4] B. Becerik-Gerber, D. J. Gerber, and K. Ku, "The Pace of Technological Innovation in Architecture, Engineering, and Construction Education: Integrating Recent Trends Into the Curricula," 2011, Accessed: Oct. 22, 2021. [Online]. Available: https://vtechworks.lib.vt.edu/handle/10919/92598

[5] Z. Torbica, "Design and Implementation of an Integrated Curriculum: A Case Study," *Proc. Int. Conf. Future Teach. Educ.*, vol. 2, no. 1, Art. no. 1, Aug. 2023, doi: 10.33422/icfte.v2i1.59.

[6] W. Wu, A. Tesei, S. Ayer, J. London, Y. Luo, and V. Gunji, “Closing the Skills Gap: Construction and Engineering Education Using Mixed Reality – A Case Study,” in *2018 IEEE Frontiers in Education Conference (FIE)*, Oct. 2018, pp. 1–5. doi: 10.1109/FIE.2018.8658992.

[7] Y. Huang, “A review of approaches and challenges of BIM education in construction management,” *J. Civ. Eng. Archit.*, vol. 12, no. 6, pp. 401–7, 2018.

[8] P. Wang, P. Wu, J. Wang, H.-L. Chi, and X. Wang, “A critical review of the use of virtual reality in construction engineering education and training,” *Int. J. Environ. Res. Public. Health*, vol. 15, no. 6, p. 1204, 2018.

[9] A. K. Ali, “A case study in developing an interdisciplinary learning experiment between architecture, building construction, and construction engineering and management education,” *Eng. Constr. Archit. Manag.*, vol. 26, no. 9, pp. 2040–2059, Jan. 2019, doi: 10.1108/ECAM-07-2018-0306.

[10] S. Rokooei, M. Garshasby, and A. Hatami, “Cross Review of Collaboration in a Design-Build Studio,” in *2022 ASEE Annual Conference & Exposition*, 2022.

[11] S. Rokooei and M. Garshasby, “Collaboration as a Multifaceted Skill Set in Construction Education”.

[12] M. Garshasby and S. Rokooei, “Investigating Effectiveness of Construction Education in Collaborative Environments: Learning Within Discipline vs. Across Disciplines,” *Proc. 13th Int. Conf. Constr. 21st Century CITC 13*, pp. 615–621, 2023.

[13] W. L. Bedwell, J. L. Wildman, D. DiazGranados, M. Salazar, W. S. Kramer, and E. Salas, “Collaboration at work: An integrative multilevel conceptualization,” *Hum. Resour. Manag. Rev.*, vol. 22, no. 2, pp. 128–145, Jun. 2012, doi: 10.1016/j.hrmr.2011.11.007.

[14] J. L. Steele and M. A. P. Murray, “Constructing the team—A multicultural experience,” *Proc Chart. Inst. Build.*, 2000.

[15] D. J. Wood and B. Gray, “Toward a Comprehensive Theory of Collaboration,” *J. Appl. Behav. Sci.*, vol. 27, no. 2, pp. 139–162, Jun. 1991, doi: 10.1177/0021886391272001.

[16] A. A. Tabassi, M. Ramli, and A. H. A. Bakar, “Training, motivation and teamwork improvement: The case of construction firms,” *Afr. J. Bus. Manag.*, vol. 5, no. 14, p. 5627, 2011.

[17] I. W. D. Team, “MSU Building Construction Science students complete construction of a modular home in Studio A and B courses,” College of Architecture, Art, and Design. Accessed: Feb. 08, 2024. [Online]. Available: https://www.caad.msstate.edu/news/2023/09/msu-building-construction-science-students-complete-construction-modular-home-studio