Student Perspectives of Hands-on Experiential Learning's Impact on Skill Development using Various Teaching Modalities

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Abstract: Due to the Coronavirus pandemic, traditional university classes, and any associated experiential hands-on learning laboratories, adapted to comply with safety standards for public health, transitioning from a traditional classroom environment to a virtual one. This paper discusses the impact hands-on experiential learning laboratories have on both technical understanding and soft skill development utilizing different teaching modalities: completely asynchronous online delivery or a hybrid delivery incorporating synchronous virtual lectures and in-person hands-on building activities. Hands-on experiential learning laboratories have been used in conjunction with other instructional delivery methods, helping students connect the dots between theory and application. These hands-on laboratories provide opportunities for students to "learn by doing" by building full-scale assemblies, developing both technical and soft skills. A survey was conducted to determine students' perspectives on how hands-on experiential exercises impacted both technical and soft skill development, and responses were analyzed for the different teaching modalities employed. Overall, all technical skills and most soft skills were positively impacted by these activities under both modalities, with hybrid courses having higher ratings than both asynchronous courses and traditional pre-COVID course delivery. This information may assist construction management programs that are interested in developing hands-on experiential laboratory exercises using various teaching modalities.

Keywords: Experiential learning, Hands-on, Project-based, Curricula, Construction management

Introduction

Higher education institutions often utilize lecture-style course to deliver management theory (Pratt, 1998). Construction management educators employ the lecture format to deliver foundational knowledge for subjects

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such as estimating, scheduling, and contracts (Chinowsky et al., 2006), which develops specialized knowledge within that subject area. However, since problems are rarely presented in silos, construction educators are charged with preparing students who can lead and manage the overall construction process (Davis & Cline, 2009), not just discrete components. In response, some higher education institutions have developed capstone courses in the student's senior year to "integrate multiple, interdisciplinary skills and abilities" (Benhart et al., 2017). Alternatively, some universities have developed and incorporated these integrated project-based classes across the curriculum giving students multiple opportunities to solve complex problems (Benhart et al., 2017).

In addition to technical skills such as estimating and scheduling, construction management education also teaches soft skills. Technical skills, also known as hard skills, are subject-based competencies which are required to complete a specific task, process, or procedure, and can typically be measured by a tangible end result (Hendarman & Cantner, 2018). Soft skills, alternatively, are more frequently related to skill development in social contexts (Cappelli & Won, 2013). Mahasneh and Thabet (2019) found that the most important soft skills for construction management graduates included communication skills, workplace thinking skills and workplace ethics skills.

Students perceive that hands-on building activities positively impact both technical and soft skill development (Kline et al., 2020). However, with the arrival of the Coronavirus Disease (COVID) in the Unites States in the first quarter of 2020, over 1300 universities and colleges cancelled in-person classes in the spring term. In fall, "44% of institutions developed fully or primarily online instruction, 21% used a hybrid model and 27% offered fully or primarily in-person instruction" (Smalley, 2020). Since construction management students find hands-on building activities to be the most effective and preferred way to learn (Kolegraff et al., 2019), construction management educators were challenged to develop new ways to deliver these types of experiences. To continue with these activities, educators either had to adapt these experiences to a virtual learning environment, or provide in-person exercises that met COVID-19 safety standards for public health.

This paper documents students' perceptions of skill development, both for technical skills and soft skills, comparing student perceptions from typical pre-COVID hands-on building activities with those of students taking classes in the midst of COVID modifications, both in-person and virtually, synchronously and asynchronously. A description of the exercises will be provided for two project-based laboratory courses that utilize hands-on building activities for instructional delivery. Survey results will be presented from both courses to gain students' perspectives on how participation in these hands-on building exercises reinforced or developed both their technical and soft skills, with additional analysis comparing virtual instructional exercises, in-person exercises with COVID safety measures in place, and pre-COVID perceptions.

Research Questions

The following research questions were investigated in this study:

1. How did students perceive hands-on experiential exercises impacted their technical skills?
2. How did students perceive hands-on experiential exercises impacted their soft skills?
3. How did students perceive the value of hands-on experiential exercises as part of their construction management education?
4. Did students' perceptions of skill development for technical and/or soft skills differ when different teaching modalities were employed?

Methodology

An anonymous online survey was developed to assess students' perceptions of experiential learning and its impact on skill development. A total of 16 questions were included in the survey, which was distributed electronically to students at the end of the term. These surveys were distributed to 83 students in four separate construction management course sections, and the data was extracted for analysis. The survey included four types of questions: demographic information, skill development, instructional learning methods, and free response. This paper focuses on skill development.

Skill development was investigated with ten questions developed by Kline and colleagues (2020) offering 5-point Likert scale responses, ranking student perception of the activity's impact on skill development, in the following order: strongly agree, agree, neutral, disagree, and strongly disagree. These rankings were coded to quantify perceptions, with a five corresponding to strongly agree and strongly disagree a one. Of the ten questions, three questions asked about soft skills exclusively, four questions asked about technical skills, and the remaining three questions combined both soft and technical skills. Instructional delivery modality was differentiated using one single selection question listing the modalities.

Course Formats

The residential construction course and the commercial construction course are two project-based laboratory courses that utilize hands-on building activities for instructional delivery. Both courses are structured into weekly topic areas to reinforce sequencing of installed components on an actual project. Classes were delivered using two separate modalities: (1) synchronously with both virtual class meetings and face-to-face, in-person building activities (hybrid format), and (2) asynchronous online course delivery with independent building activities (asynchronous format). Both modalities utilized a learning management system (LMS) to deliver course materials.

The hybrid format utilized video conferencing for virtual, synchronous class meetings and lecture multiple days per week. The hands-on building activities, which varied by course; residential or commercial, took place at certain points throughout the ten-week quarter and were designed to augment learning achieved by the students through reading assignments, lectures, video content, class activities, discussions, and homework assignments. Only the hands-on building exercises were delivered face-to-face; all other instruction and meetings were

delivered virtually.

The asynchronous format utilized recorded video content, reading assignments, activities and online asynchronous video discussions. The hands-on building activities took place each week during the final six weeks of the quarter, and utilized a kit of materials, delivered to students, which provided opportunities for students to utilize different building components, expanding on the material learned through assignments, reading, discussions, homework assignments, and video lectures.

Residential Construction Course

The residential construction course is typically taken at the end of the student's second year. Two different residential course sections met during the study period; one utilized the hybrid format while the other employed the asynchronous format. The course combined estimating, scheduling, residential methods, and contracts into one project-based integrated lab, immersing students in all aspects of residential construction. Classes were structured into weekly topic areas to reinforce the sequencing of installed components on an actual project. The following teaching methods were used in the class: reading assignments, activities and discussion (online), lectures (live or recorded), quizzes, exams, homework assignments, working in a team, final project, and hands-on building.

Hybrid Course Format

The hybrid section had twenty students, with students divided into teams of four to six people for team assignments and building activities, with virtual synchronous lectures held several times each week for a ten-week quarter. Students prepared for virtual lectures through reading assignments then faculty reinforced main concepts through online lectures and discussions. For two weeks each quarter, students transitioned from the virtual classroom to an in-person hands-on building project to apply and reinforce their knowledge learned from the previous weeks' assignments and discussions. During week four, students worked in teams to set anchor bolts and frame the floors, walls and roof of a small wood structure. During week seven, students completed the structure by applying house wrap, installing windows and a door, installing roofing materials, and completing exterior wood siding.

Asynchronous Course Development

The asynchronous section had twenty-three students, with students divided into teams of three to four students for team assignments. All course content was delivered through the LMS. Optional times for students to meet synchronously online with the instructor were also provided to review content and ask questions, but there were no regularly scheduled times for the entire class to meet and discuss content for the course. For the final six weeks of the quarter, students completed independent building activities in their own space to reinforce the knowledge learned each week. The six different building activities included (1) a formwork assembly; (2) a

framing exercise for stud layout and shear wall nailing; (3) a plumbing and electrical installation; (4) exterior waterproofing; (5) the installation of batt insulation; and (6) drywall installation. Students recorded their completed work utilizing an online video discussion board, inspecting the necessary code required items for construction as well as quality control items at the end of each exercise.

Commercial Construction Course

The commercial construction course is typically taken towards the beginning of a student's third year, with the residential course being a prerequisite. Two sections of the commercial course met during the study period; both sections utilized the hybrid format. The course combines estimating, scheduling, construction means and methods, project planning, and contracts into one project-based integrated lab, immersing students in all aspects of large commercial and institutional construction operations.

Students were divided into teams of four or five students for group assignments and building activities, with virtual synchronous lectures held several times each week for a ten-week quarter. Students prepared for virtual lectures through reading assignments then faculty reinforced main concepts through online lectures, discussions, and activities. For ten days each quarter, students transitioned from the virtual classroom to an in-person hands-on building project to apply and reinforce their knowledge learned from previous assignments and discussions. During weeks four through seven, students alternated in-person building with virtual instruction, meeting on campus twice per week where each group built a ten-foot-long, ten-foot-tall commercial exterior wall system including forming and pouring concrete, installing CMU, metal studs, exterior sheathing, waterproofing, siding, stucco, and trim, with at least one corner and one window system, braced to an existing structural steel frame. In week nine, students deconstructed their wall section and reclaimed, recycled, or disposed of the materials.

Survey Results

Survey data was conducted over one quarter in two separate classes, each with two sections. Surveys were distributed to 83 students, with 36 responses received, a response rate of 43%. The number of responses received by course and teaching modality are summarized in Table 1. The survey items are listed below, and are sorted by the course delivery modality.

Table 1. Survey Responses Received by Course and Instructional Delivery Modality

Course	Hybrid Delivery	Asynchronous Delivery	Total
Residential Course	8	13	21
Commercial Course	15	N/A	15
Total	23	13	36

Survey results for technical skills are presented below in Table 2, with the percentage of responses for each Likert-scale category listed as well as the mean response rating.

Table 2. Students' Perceptions of Technical Skill Development

Technical Skill Assessed	Course Delivery	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Understanding of different building systems and components.	*Hybrid*	87%	13%	0%	0%	0%	4.87
	Asynch.	78%	22%	0%	0%	0%	4.78
Application of knowledge of the different systems.	*Hybrid*	78%	17%	4%	0%	0%	4.74
	Asynch.	67%	22%	11%	0%	0%	4.56
Understanding of how things are put together.	*Hybrid*	91%	9%	0%	0%	0%	4.91
	Asynch.	62%	38%	0%	0%	0%	4.62
Understanding the sequencing of activities for different construction project components.	*Hybrid*	91%	9%	0%	0%	0%	4.91
	Asynch.	62%	38%	0%	0%	0%	4.62

As shown in Table 3, students agreed that experiential learning helped with the development of soft skills but asynchronous delivery had the lowest mean rating in this category, with less than half of all respondents agreeing that building activities enhanced their relationship with their team or other students. In contrast, hybrid course responses were almost all positive, with only 4% being neutral when asked if building activities helped them develop a stronger relationship with their instructor.

Table 3. Students' Perceptions of Soft Skill Development

Soft Skill Assessed	Course Delivery	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Appreciation of the different trades that complete the work.	*Hybrid*	83%	17%	0%	0%	0%	4.83
	Asynch.	47%	38%	15%	0%	0%	4.31
Enhanced my relationships with my team and other students	*Hybrid*	83%	17%	0%	0%	0%	4.83
	Asynch.	15%	31%	31%	15%	8%	3.31
Developed a stronger relationship with my instructor	*Hybrid*	79%	17%	4%	0%	0%	4.74
	Asynch.	46%	31%	8%	15%	0%	4.08

Finally, three questions combined both soft and technical skill development (see Table 4). From this, 95% of students in the hybrid courses and 100% in the asynchronous course either agreed or strongly agreed that experiential learning activities were a valuable part of their construction education. One of the lowest ranked items from the survey, development of professional workplace skills, falls into this category, with a mean rating of 4.57 in the hybrid delivery and 3.77 in the asynchronous course.

Table 4. Students' Perceptions of Combined Technical and Soft Skill Development

Combined Tech. & Soft Skill Assessed	Course Delivery	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Greater confidence in my building abilities.	*Hybrid*	87%	13%	0%	0%	0%	4.87
	Asynch.	38%	54%	8%	0%	0%	4.31
Development of professional workplace skills.	*Hybrid*	70%	17%	13%	0%	0%	4.57
	Asynch.	23%	46%	23%	0%	0%	3.77
Building is a valuable part of my construction management education.	*Hybrid*	91%	4%	4%	0%	0%	4.87
	Asynch.	69%	31%	0%	0%	0%	4.69

Discussion of Survey Results

Using Olbina (2008), "values of 4 and 5 were considered positive, 3 neutral, and 1 and 2 negative" (p. 55), students' perceptions of experiential learning activities on skill development were mostly considered positive, with all skills from hybrid courses receiving a mean rating over 4, and eight of ten skills ranked above 4 for the asynchronous course. Each of the different skill groups are analyzed below. Results will also be compared to the pre-COVID standard in-class course delivery, which were analyzed in six separate traditional project-based courses (Kline et al., 2020).

Technical Skills

Technical skills received mostly positive ratings across all four questions. When compared to the pre-COVID in-class delivery results, as shown in Figure 1, the hybrid method has the highest overall ratings, and the asynchronous delivery has very similar ratings that vary within one-to-two tenths of a mean rating. This category received the highest overall ratings in all course modalities, showing that students agreed that the experiential learning activities helped with their understanding of the different systems and components presented in class, could apply their knowledge, and helped with the understanding of activity sequencing. This information indicates that experiential learning helps students connect the dots between classroom theory to application in real world environments.

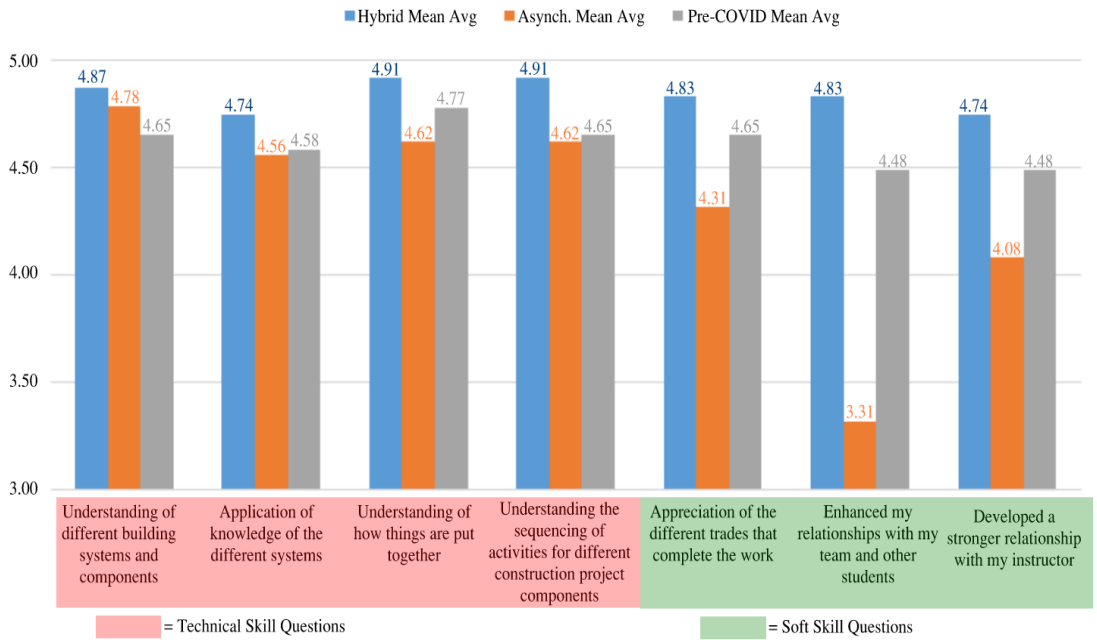

Figure 1. Technical and Soft Skills by Mean Score and Teaching Modality

Soft Skills

Soft skills received mostly positive rating across all three questions for hybrid and pre-COVID in-class delivery, but received the lowest averages for asynchronous delivery. This indicates that face-to-face interaction is important when developing soft skills. In the hybrid course, 100% of students, and 85% in the asynchronous course agreed that the activities gave them an appreciation of the different trades that complete the work. However, the activities' impact on relationship building with both their team members and the instructor were slightly lower in the hybrid course, and the asynchronous course received the lowest mean rating overall in developing relationships with team members.

Combined Soft and Technical Skills

This category yielded both the highest and lowest mean ratings for hybrid course delivery. An overwhelming 95% of students in the hybrid course and 100% in the asynchronous course agreed that experiential learning was a valuable part of their construction management education. However, only 87% in the hybrid course and 69% in the asynchronous agreed that it helped with the development of professional skills. This response may be due to different interpretations by the students on the definition of professional skills; no definition was provided so this open interpretation could lead to varied results. Additionally, although 100% in the hybrid course and 92% in the asynchronous course agreed that building gave them greater confidence in their building abilities, only 83% in the hybrid course and 38% in the asynchronous course strongly agreed with this statement. Similar to previous categories, the hybrid's average ratings were the highest, followed by traditional pre-COVID delivery, with asynchronous delivery receiving the lowest rankings. Reviewing this indicates that the experiential learning

environment aids with the development of both skill sets, but students perceive greater development of technical and soft skills with these hands-on activities in all course deliveries.

Conclusion

Previous studies indicated that students prefer hands-on experiential learning opportunities, and find them effective as an instructional delivery method (Kolegraff et al., 2019). Additionally, students perceived that these in-class hands-on building activities improved both their technical and soft skills (Kline et al., 2020). However, with the arrival of the COVID-19 pandemic in 2020, construction management programs pivoted instruction to either fully asynchronous delivery or hybrid course formats. This study compared students' perceptions of skill development – both for technical skills and soft skills – in typical pre-COVID hands-on building activities with perceptions of students taking classes in the midst of COVID, both in hybrid courses and asynchronous courses.

The survey offered reviewed students' perceptions of these activities on both technical and soft skill development. Overall, skill development was mostly positive with both modalities, but the hybrid format with in-person building activities had higher mean rankings for all skills surveyed. An overwhelming 99% of students agreed that hands-on building improved their technical skill development, with little difference in students' perceptions across the different modalities. For soft skill development, 88% of students agreed that hands-on building improved their soft skill development, but there were noticeable differences across the modalities; 99% of hybrid students agreed compared to only 62% of students enrolled in an asynchronous course. Of the soft skills measured, the greatest difference was the impact of relationship building with other members of the class. Additionally, an overwhelming 97% considered the activities a valuable part of their construction management education, which is consistent with pre-COVID survey results.

The results from this study may be useful for construction management or technical training programs that are interested in developing hands-on experiential laboratory exercises using various teaching modalities. Upon review of the data, several areas became apparent for future research. First, since students complete these activities in sequential courses, do responses differ through course maturity? Additionally, is there a difference in technical and soft skill development through hand on building by gender? Finally, follow-up surveys could be gathered to determine what specific activities led to positive and negative results or account for the differences experienced between the modalities.

References

Benhart, B., Cabral, J., Hubbard, B., Metzinger, J., Morgan, P, & Santon, S. (2017). Construction Management Curriculum Transformation through Project-Based Learning; Part 1 of a Progressive Case Study. *Associated Schools of Construction International Proceedings of the 53rd Annual Conference*, 19-27.

Cappelli, P., & Won, S. (2013). Soft Skills. In S. Reference, Sociology of Work: An Encyclopedia (p. 813). Thousand Oaks: SAGE Publications, Inc.

Chinowcky, P., Braown, H., Szajnman, A., & Realph, A. (2006). Developing knowledge landscapes through project-based learning. *Journal of Professional Issues in Engineering Issues and Practice,* 132 (2), 118-124.

Davis, K., & Cline, R. (2009). Improving Course Comprehension through Experiential Learning. *Construction Research Congress 2009: Building a Sustainable Future, 339,* 1409-1418.

Hendarman, A., & Cantner, U. (2018). Soft skills, hard skills, and individual innovativeness. Eurasian Business Review, 139-196.

Kline, A., Kolegraff, S., & Kelting, S. (2020). Students Perspectives of Experiential Learning in a Technical Education Program. IICE Hawaii 2020. Honolulu: IAFOR.

Kolegraff, S. A., Kline, A., & Kelting, S. (2019). Hands-On Building as an Instructional Delivery Method in an Integrated Lab Curriculum. *55th ASC Annual International Conference Proceedings* (pp. 33-40).

Mahasneh, J. K., & Thabet, W. Y. (2019). Benchmarking soft skills among construction school graduates. *55th ASC Annual International Conference Proceedings* (pp. 125-130).

Olbina, S. (2008). Improving the Delivery System for Teaching the Project Planning and Feasibility/Site Development Course to Building Construction Undergraduate Students and Real Estate Graduate Students. *International Journal of Construction Education and Research,* 4 (1), 46-64

Pratt, Daniel D., 1942. Five Perspectives on Teaching in Adult and Higher Education. Malabar, Fla.: Krieger Pub. Co., 1998.

Smalley, A. (2020, December 17). Higher Education Responses to Coronavirus (COVID-19). Retrieved from: https://www.ncsl.org/research/education/higher-education-responses-to-coronavirus-covid-19.aspx