

Student Perspectives of Experiential Learning in a Technical Education Program

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Abstract

This paper discusses students' perspectives of the impact that hands-on experiential learning laboratories have on both technical understanding and soft skill development. The hands-on experiential learning laboratory exercises provided opportunities for teams of students to build assemblies outside the classroom on full-scale projects by applying knowledge first learned in class. These exercises have been designed to reinforce course comprehension by combining them with additional instructional delivery methods allowing students to "learn by doing." Each hands-on experiential exercise followed a lecture and incorporated concepts learned in class; these exercises included wood and steel stud framing, exterior systems, door and window flashing and installation, and concrete. A survey was conducted to determine student's perspectives on how these exercises impacted and reinforced both technical skills and soft skills, including an increased understanding of systems and assemblies and greater appreciation for trades, interpersonal relationships and increased confidence. The results of the student surveys are presented and discussed. This information may assist technical education programs that are interested in developing hand-on experiential laboratory exercises to prepare students for careers.

Keywords: Experiential Learning, Hands-On, Project-Based, Curricula, Construction Management

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Introduction

The core subjects in construction management are scheduling, estimating and contracts, which are typically delivered in a lecture format in standalone classes (Chinowsky, Braown, Szajnman, & Realph, 2006). “The traditional segmented, topic-based approach to construction management curricula clearly has been successful at facilitating the attainment of specialized skills and concepts such as quantity surveying, estimating, or scheduling. However, the world does not always present problems that are topic specific and solved in a non-holistic manner.” (Montoya, Kelting, and Hauck, 2009, p. 66). These lecture style classes work well to deliver management theory (Pratt, 1998), but construction educators are charged with preparing students who can lead and manage the overall construction process, not just specific, stand-alone aspects (Davis and Cline, 2009). Students must “connect the dots” between classroom theory and practical application, which some universities accomplish through a single capstone course in the student’s senior year to “integrate multiple, interdisciplinary skills and abilities.” (Benhart, Cabral, Humnard, Metzinger, Morgan & Santon, 2017). In contrast, other universities have developed and integrated these capstone classes across the curriculum giving students additional opportunities to solve complex problems (Benhart et al., 2017).

Construction management education teaches both technical and soft skills. Technical skills, also known as hard skills, are subject-based competencies related to the context within which they are performed. These competencies are required to complete a specific task, process, or procedure, and can typically be measured by a tangible end result (Hendarman & Cantner, 2018). In construction education, a technical skill could be the completion of a project schedule using a work breakdown structure. Soft skills, alternatively, are more frequently related to skill development in social contexts (Cappelli & Won, 2013). There is no consensus on the definition of soft skills, but they can include communication, critical thinking, problem solving, teamwork, ethics, etc. (Mahasneh & Thabet, 2015). In a study completed by Mahasneh and Thabet (2019), communication skills, workplace thinking skills and workplace ethics skills were ranked highest in importance for construction school graduates.

Kolegraff, Kline and Kelting (2019) studied integrated laboratory style courses to determine the types of instructional delivery methods students perceived to be effective and preferred for student learning. Of the 14 delivery methods surveyed, 57% of students ranked hands-on building as the most effective delivery method; with 59% of students surveyed stating it was their preferred instructional delivery method. However, little information was provided on how students perceived the impact of hands-on building in relation to their soft and technical skill development.

This paper expands the earlier research by exploring students’ perceptions of how these experiential activities impact their skill development – both for technical skills and soft skills – by first describing the development of hands-on building exercises and the integration and expansion of those exercises into two project-based laboratory courses. The paper then provides survey results 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.

Methodology

A survey was developed to collect data and 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 in hard copy form to students at the end of the term. These anonymous surveys were conducted over two consecutive courses in six separate construction management classes. All surveys were anonymous, and the data received was input manually into a database for analysis.

The survey included four different types of questions: demographic information, skill development, instructional learning methods, and free response. Skill development is the focus of this paper, with additional demographic information presented. The demographic information included the course the student was taking, their gender, and if they had taken this survey before in another course.

Ten questions were asked about skill development. Three questions asked about soft skills exclusively, four questions asked about technical skills, and the remaining three questions combined both soft and technical skills. The questions included 5-point Likert scale responses, ranking their 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 5 being strongly agree and strongly disagree being a 1. Descriptive statistics are provided and discussed for the data collected.

Research Questions

The following research questions were generated for this study:

1. How did students perceive the impact hands-on experiential exercises had on their soft skills?
2. How did students perceive the impact hands-on experiential exercises had on their technical skills?
3. How did students' perceive the impact hands-on experiential exercises had on their construction management education?

Course Formats

The course formats remained the same as the previous study conducted by Kolegraff, Kline and Kelting (2019). The hands-on building activities took place at certain points throughout the ten-week quarter and were designed to augment learning achieved by the students through reading assignments, lectures, in-class activities and discussions, and homework assignments. Each week, students attended class for 13 hours to learn different aspects of construction relevant to either residential or commercial construction. The hands-on building activities varied depending on the course – residential or commercial - and the activities for each course are described below.

Residential Construction Course

The class sizes ranged from 20 to 25 students. The students were divided into teams of four to six people for both in-class assignments leading towards the final project and for building activities. The classes met 13 hours per week for a ten-week quarter

and were taught in a laboratory space dedicated to homebuilding education, specifically focusing on new-home construction in a residential tract environment. The class combined estimating, scheduling, residential methods, and contracts into one project-based class, where students worked towards the feasibility and analysis of all aspects of a new residential tract community. The following teaching methods were used in the class: reading assignments, in class activities and discussion, lectures, student presentations, quizzes, exams, homework assignments, peer review, working in a team, final project, hands-on building, field trips, and guest lectures.

The faculty strived to immerse the students in all aspects of residential construction through lectures and interactive discussions, covering topics from land acquisition to building materials, and the warranty process. Students prepared for class through reading assignments, then faculty reinforced main concepts through interactive lecture and in-class discussions and all lecture material was posted electronically. Relevant industry trends were also discussed, as well as means and methods, so students received the necessary information to work towards the completion of their final project incrementally throughout the quarter. The class was structured into weekly topic areas to reinforce the sequencing of installed components on an actual project.

For two weeks each quarter, students transitioned from the classroom to a hands-on building project to apply and reinforce their knowledge. During week four, students worked in teams to set anchor bolts and frame the floors, walls and roof of a small wood structure. This week's building expanded on the knowledge gained from the previous weeks' lectures on foundation and wood framing activities, and students were required to put into practice what they learned. During week seven, students continued work and completed the structure by applying house wrap, installing windows and a door, installing roofing materials including roof felt, flashing, and asphalt shingles, and completing exterior wood siding and trim. Again, these activities required the application of knowledge learned from the previous weeks' assignments and in-class discussions on water management, doors and windows.

Guest lectures from different departments of homebuilding companies were brought in from industry to discuss various topics of the course, based on their experience. Students also went on one field trip per quarter to tour a residential jobsite and witness the progression of a project. Each of these strengthened the relationship between industry and student.

The final project was a series of assignments that were to be completed throughout the quarter and then compiled into a comprehensive final project. For this final project, the students completed work in teams and were tasked to develop a feasibility analysis for a developed property. This feasibility analysis included funding and acquisition and required students to present a recommendation to proceed with the project or provide reasons why the project may be too risky for investors.

Commercial Construction Course

The commercial class sizes ranged from 20 to 25 students. The students were divided into teams of three to four people for the duration of the class. As a team they worked on in-class activities, final project deliverables, and hands-on lab activities. Classes met 13 hours per week for a ten-week quarter and were taught in a laboratory space

dedicated to commercial education. The course focused on Type I and II construction means and methods, estimating, scheduling, and contracts. Similar to the residential class, this class worked through a commercial project for the duration of the quarter. The following teaching methods were used in the class: reading assignments, in class activities and discussion, lectures, student presentations, quizzes, exams, homework assignments, peer review, final project deliverables, hands-on building, field trips, and guest lectures.

As a project-based class, the faculty led and taught the class through exercises dealing with preconstruction, construction, and post-construction activities throughout the quarter. Prior to class, students were responsible for completing reading assignments and quizzes focusing on the means and methods of construction that tied in to the class discussions. As the quarter progressed, students worked through final project deliverables, including: unit cost and historical cost estimating, preconstruction sequencing, request for proposal delivery, site logistics, safety management, scopes of work, subcontracting, self-perform estimating, bid packaging, and project scheduling.

For two weeks each quarter, students transitioned from the classroom to a building project to apply and further their knowledge. During week five, students worked in teams to prepare the existing grade, complete concrete formwork, place rebar, pour a footing and slab on grade, build CMU walls, and set temporary shoring (Pro-Shore decking) for second level construction activities. This week's building expanded on the substructure and superstructure knowledge gained in previous weeks' lectures, in-class activities, and final project deliverables. During week eight, students continued work on the structure, and built pre-fab light gauge metal stud walls, installed the walls on first and second floors, installed OSHA compliant safety rails on second floor decks, installed exterior sheathing, applied waterproofing, installed a window and door frame, and applied an exterior façade system. Again, these activities required the application of knowledge learned from the previous weeks' assignments and discussions on commercial framing assemblies, exterior façades, and waterproofing.

Guest lectures from different commercial building companies were invited to discuss various topics of the course, based on their experience. Students also went on two field trips per quarter to tour a commercial jobsite, witness the progression of a project, and view the different elements introduced through in-class lectures and activities.

The final project was a series of deliverables that were completed throughout the quarter and then compiled into a comprehensive final project. For this final project, the students prepared a request for proposal in week three presenting and delivering a project estimate, preconstruction schedule, and a management staffing plan; in week ten they presented and turned in a final packet compiled of: project buyout, subcontracting, site logistics and phasing, and a complete project schedule.

Survey Results

Survey data was conducted over two quarters in six separate classes, with six different instructors providing course instruction. Overall, feedback was obtained from 124 surveys. From those surveys, 61 surveys were for the residential construction course, 62 for the commercial course, with 1 left blank. Sixteen respondents were female

with 105 reporting as male; the remaining 3 surveys did not include gender data. Due to the sequential nature of the courses, it was possible for students to complete the survey two quarters in a row for two different classes. Of the respondents, 11 took the survey in multiple courses (once in the residential course and then, again, in the commercial course). The survey items are listed below, with a discussion of the analysis of the results.

Survey results are presented below in Table 1, with the percentage of responses for each Likert-scale category listed as well as the mean response rating. Ratings with “values of 4 and 5 were considered positive, 3 neutral and 1 and 2 negative” (Olbina, 2008, p. 55).

Table 1

Technical Skill Assessed	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Understanding of different building systems and components.	73%	22%	4%	1%	0%	4.65
Application of knowledge of the different systems.	67%	26%	6%	1%	0%	4.58
Understanding of how things are put together.	82%	12%	6%	0%	0%	4.77
Understanding the sequencing of activities for different construction project components.	74%	18%	7%	1%	0%	4.65

Students also agreed that experiential learning helped with the development of soft skills, with appreciation for different trades being the highest ranking (see Table 2).

Table 2

Soft Skill Assessed	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Appreciation of the different trades that complete the work.	71%	23%	6%	0%	0%	4.65
Enhanced my relationships with my team and other students	61%	28%	10%	1%	0%	4.48
Developed a stronger relationship with my instructor	58%	33%	8%	1%	0%	4.48

Finally, three questions combined both soft and technical skill development (see Table 3). From this, 97% of students either agreed or strongly agreed that experiential learning activities were a valuable part of a construction management experience. The lowest ranked item from the survey, development of professional

workplace skills, falls into this category, with 81% of respondents agreeing that it helped with the development, with 3% disagreeing and 16% neutral.

Table 3

Combined Technical and Soft Skill Assessed	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Greater confidence in my building abilities.	64%	27%	8%	1%	0%	4.55
Development of professional workplace skills	44%	37%	16%	3%	0%	4.21
Building is a valuable part of my construction management education.	82%	15%	3%	0%	0%	4.78

Discussion of Survey Results

Overall, students' perceptions of experiential learning activities on skill development were considered positive, with all activities receiving a mean rating over 4 (Olbina, 2008). Each of the different skill groups are analyzed below.

Technical Skills

Technical skills received mostly positive ratings across all four questions, with only 1% of respondents providing a negative rating for three of the four questions. The second highest mean score of 4.77 is present in this category, helping students understand how things are put together. In addition, 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 activities and lecture to application in real world environments.

Soft Skills

Soft skills also received mostly positive rating across all three questions, again with 1% of respondents providing a negative rating for two of the three questions. Ninety-four percent of students 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. Although still positive, both relationship questions reduced mean ratings of 4.48, the second lowest ratings across all questions.

Combined Soft and Technical Skills

This category yielded both the highest and lowest mean ratings for different responses. An overwhelming 97% of students agreed that building/experiential learning was a valuable part of their construction management education. However,

only 81% agreed that it helped with the development of professional skills. Upon further analysis, 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 91% agreed that building gave them greater confidence in their building abilities, only 64% strongly agreed with this statement.

Table 4 combines the results from the exclusively technical skills questions and soft skills questions. Reviewing this indicates that the experiential learning environment aids with the development of both skill sets, but students perceive greater development of technical skills with these hands-on activities.

Table 4

Summary of Technical vs. Soft Skills	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean Rating
Technical skills only	74%	19%	6%	1%	0%	4.66
Soft skills only	63%	28%	8%	1%	0%	4.54

Conclusion

Previous studies indicated that students prefer hands-on experiential learning opportunities, and find them effective as an instructional delivery method (Kolegraff, Kline & Kelting, 2019). However, the study did not provide insights as to the types of skills developed by students through these activities. This study provided students' perceptions of both technical skills and soft skills as a result of hands-on activities incorporated into coursework.

The survey offered reviewed the perceptions of students of these activities. Overall, student perceptions of both technical and soft skill development were positive, with 93% agreeing that the activities enhanced their technical skill development and 91% agreeing they enhanced soft skill development. Additionally, an overwhelming 97% considered the activities a valuable part of their construction management education. These positive responses support the faculty's decision to incorporate hands-on experiential learning into each course.

Upon review of the data, several areas became apparent for future research. First, since students complete these activities in sequential courses, do responses differ from course to course. Additionally, is there a difference in technical and soft skill development by gender. Finally, follow-up surveys could be gathered to determine what specific activities led to positive and negative results.

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