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The Physical Learning Environment's Impact on Higher Education Programs: Student Perception of Learning, Satisfaction, and Sense of Belonging in a Construction Management Program

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Introduction:

A principal goal of any legitimate academic program is to sustain learning environments and facilities which positively influence student achievement and success. More recently, an increased emphasis on providing flexible spaces which enrich cooperation and amplify opportunities for productivity has been widely endorsed. A student's ability to grasp information and work in tandem with each other is significantly affected by the built environments in which they study and train. This includes such influences as the available classroom technology as well as aesthetics, furniture, and other equipment being used within the learning space or laboratories. A well-designed instructional environment can also aid in recruitment and retention, enhance collaboration between scholars, and contribute to encouraging diversity, equity, and inclusion practices. As budgetary restrictions and time constraints challenge us to do more with less, it is critical that we stay mindful of the student's point of view as it relates to satisfaction and a sense of belonging, particularly in engineering technology classrooms and labs.

Purpose:

This paper was derived from the observations of one construction management program in the Midwest that noticed an immediate need for change related to the way that their primary classroom and laboratory appeared and functioned. The educators aspire to improve these facilities in the best interests of faculty, students, and visitors alike. The authors of this paper outline the observations which revealed the shortfalls, explain the exploratory steps which were subsequently taken to identify the overarching problems that existed, highlight the ways in which funding and resources were obtained to improve the teaching space and discuss the anticipated renovations and improvements which will soon be in place. Surveys that were administered to students, faculty, and advisory board members will highlight key findings which serve as a basis for the transformation, and future plans for additional steps are also included in this study. It should be noted that this is an ongoing project which plans to analyze the long-term effects of change and improvement in one particular classroom, therefore final conclusions may be issued in future publications.

In addition, this paper reviews the literature which discusses similar research and observations from comparable studies to evaluate student learning environments embedded within other majors as well as additional higher education institutions. The publication review also provides a basis for this paper by means of reflection and evidence and seeks to draw out strategies for other similar programs that wish to examine their facilities, not only in conjunction with student and faculty satisfaction but also as it supports everyday function and usefulness correlated to teaching and learning. The ultimate goal is to inspire academic programs in any discipline to carefully analyze and thoughtfully create academic spaces which support program objectives and the highest level of education at our respective institutions.

Ultimately, it is the authors' intent to discuss this topic within the framework of a pilot study which may serve as a template for others to follow as they travel through the confusing and unfamiliar territory of modern learning environments. Continued advancements in technology, furniture innovations, curricular change, and other factors which support academic progression will most certainly drive future assessment and outcomes.

Literature Review:

Higher education institutions are increasingly focused on providing classrooms that support the twenty-first-century learner, requiring flexible spaces that incorporate new instructional technologies and active learning environments. With rising student numbers and decreased budgets, universities are struggling to optimize the use of classroom space [1]. Research has proven that students and instructors are positively impacted by the existence of teaching and learning environments that support the end users' curricular functions. An improved learning environment has proven to support improved student/teacher relationships and attitudes about teaching and learning when it is designed to be part of a culture of collaboration and productivity [2].

Creating spaces that foster collaborative and active learning within STEM (science, technology, engineering, and mathematics) programs continues to be studied [3]. According to Jamieson [4] campus learning environments designed for flexible, individual, and group learning experiences can have a positive impact on student achievement and collaboration. A study by Ashley and Patrone [5] evaluated learning spaces and collaboration skills. Key attributes identified that positively impacted instructor and student collaboration included comfortable and flexible (movable) furnishings, sufficient space between collaborative groups, an abundance of white-board surfaces, and digital technology for sharing ideas. Providing a flexible, open design allows for easier movement and encourages social interaction among peers and students, enables students and instructors to share knowledge, and creates a feeling of community and engagement [6].

Flexibility in the university classroom is becoming increasingly important to meet limited classroom space needs and support multiple learning and instructional methods. Studies have indicated positive perceptions of students and instructors when furnishings allow for moving and adjusting to different learning activities, and collaboration [6], [3], [7]. However, Adedokun *et al.* [3] also identified challenges perceived by students and instructors including the need to constantly re-organize furniture, too much furniture and the room feeling crowded, and difficulty accessing electrical outlets. Electrical accessibility is extremely important in engineering educational laboratory spaces and requires integrating flexible electrical access and furnishings.

Research by Wilson and Cotgrave [8] identified features of the physical learning environment most important to university students. Findings indicated student preferences are dependent on individual personalities and the identity of university discipline or community. However, a consistent factor rated most important was "access to current technology and comfortable

temperature." Indicating these basic features is expected by students for meeting satisfaction with their learning environment.

Upgrading of learning environments at the university level face various constraints including available budget and space. New buildings and upgrading existing facilities can create a large disparity in classroom environments. A study conducted by Brewer and Carnes [9] analyzed the potential impact that a brand-new facility with modern technology and furnishings may have on students' perceived satisfaction with their educational experiences. Student and faculty surveys concluded the new facility was perceived to have an overall positive impact. Students reported they perceived their classes as being more enjoyable, the environment facilitated student teamwork, and improved motivation to learn. Students also perceived the new facility to have a positive impact on their determination to complete their majors and would be less likely to consider transferring to another university.

Research indicates the classroom environment can significantly impact student perception of concentration levels and learning. Physical environmental factors directly impact students' psychological needs and perception of comfort. Hill and Epps [7] studied student perceptions regarding classrooms with upgrades versus existing classrooms without. Results suggested "students do perceive differences in classroom environments" specifically seating attributes, amount of desk space, lighting, and noise levels. Students indicated these factors affected their perceived level of learning and general sense of satisfaction.

Providing appropriate types and amounts of work surface for individual writing and computer space is also important. A study by Yildirim *et al.* [10] indicated flexible interior furnishings and placement of equipment for clear sightlines, encouraged collaborative learning and motivation. Findings also suggest classrooms and laboratories with a predominance of technology and equipment should consider incorporating natural elements, woven textiles, and appropriate colors to provide a warmer quality environment and enhance user perception and mood.

The United States engineering and construction industry lags behind other professions in their diversity, equity, and inclusion of women and racial-ethnic minorities [11], [12]. Research indicates a significant factor deterring underrepresented minorities from pursuing construction-related careers is the lack of a sense of belonging. An individual's perceived sense of belonging within a particular space can be influenced by the physical materials or "artifacts" within the environment. A study by Burgoon, *et al.* [11] suggest artifacts (e.g., art, signage, photographs) with exclusionary nonverbal messaging about "who is valued and who belongs" within a construction school may decrease students' sense of "fitting in," and reduce retention of women and racial-ethnic students in the degree. Furthermore, the sense of belonging can be impacted by the physical layout of a space. Creating the opportunity for positive diverse peer relationships is extremely important. Within the learning environment, fostering collaborative and group activities can help to improve minority students' feelings of belonging, which enhances their success and overall well-being in school and entering the professional industry [12].

Interestingly, and also related to DEI efforts, it has been observed by Del Puerto *et al.* [13] that there is a need for recruitment programs in construction management to tailor to women. The reasons why women decide to pursue a career in the construction industry are different than those of men. Women are attracted to construction because they want to help others. Programs such as Habitat for Humanity and other programs that benefit the community must be highlighted when recruiting women, therefore this should be considered as we seek improvements related to student perceptions of the classroom environment, learning satisfaction, and sense of belonging.

At the 2021 ASEE virtual conference, Asgarpoor *et al*. [14] proposed that it is the obligation of engineering leadership educators to consider that our role extends beyond the transmission of technical knowledge and that it is our responsibility to help engineering students develop a growth mindset and discover the sophistication of mind to celebrate diversity, equity, and inclusion in their daily lives, school, and workplace. This requires us to consider how our classrooms and laboratories themselves must retain an accessible approach to physical facilities which positively impact team workspaces, performance, collaboration abilities, and motivation of students with a multitude of pre-existing disabilities or special needs.

Similarly, the current criteria for the Accreditation for Construction Education (ACCE) [15] states in Standard 6 that physical resources should "ensure the availability of safe and appropriate facilities, equipment, and services necessary to accommodate all activities in support of the Degree Program's mission, goal, and objectives to enable students to attain required Learning Outcomes; and provide faculty and staff with adequate space [15]". In addition, the furniture, equipment, and software available to students are required to be tallied and reported. This clearly relays a need for educational spaces which support students of diverse abilities with conducting multi-functional activities and support a multitude of learning styles, body types, and skill levels.

Methodology

The purpose of the survey was to capture the perceived impact of the physical learning environment on higher education programs and if the specific space designated for a Construction Management program met student and program needs. Surveys were developed and delivered using Qualtrics (https://www.qualtrics.com) targeting 3 specific focus groups, students, faculty, and industry advisory board (IAB) members. The student group survey was delivered in 2 parts due to the constraints of the survey application licensing. The first part of the student survey consisted of 4 demographic questions and 19 questions specific to the physical condition of the construction lab. The second part of the survey consisted of 4 demographic questions, 16 physical learning environment impact questions, and 1 open-ended response question. Both the faculty group and the IAB group surveys consisted of 31 questions including 12 physical learning environment impact questions, 17 condition assessment questions, and 2 open-ended questions. Survey questions were developed utilizing a 4-point Likert scale (1-strongly agree, 2-agree, 3- disagree, and 4-strongly disagree). A 4-point scale was selected to remove the neutral dumping ground and require students, faculty, and advisory board members to choose a side.

The institutional review board (IRB) approved the study prior to solicitation. An email was sent out to inform each focus group of the survey subject matter, the format, the approximate time to complete it, and provided an anonymous link employing Qualtrics. The email also disclosed that no monetary or financial reward would be gained through participation and that participation was completely voluntary. Once published, the surveys remained open for 2 weeks. The goal of the study was to identify critical student and program needs for the space in support of an internal Learning Environment Grant and to prioritize improvements based on available funding.

A total of 63 undergraduate students within the Construction Management program were solicited to participate in the survey. A 92% response rate was achieved for part 1 of the student survey for a total of 58 including 14 freshmen, 13 sophomores, 11 juniors, and 19 seniors). Participation included 86.21% male and 13.79% female. Only a 55.6% response rate was achieved for the second part of the student survey for a total of 38 including 8 freshmen, 4 sophomores, 7 juniors, and 16 seniors. Participation included 88.57% male and 11.43% female. Additionally, all 5 full-time faculty members for the program participated in the survey and 9 of the 40 Industry Advisory Board (IAB) members were responsive.

Results

Tables 1 through 3 provide the collected survey result of students, faculty, and IAB members providing a response to how well the identified physical attributes of the construction lab met their performance expectations.

Construction Lab Physical Attributes Performance Based on Student Responses				N=58
Construction Lab Physical Characteristics	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
provides enough space to perform the necessary lab activities, project work, and student collaboration	29.31%	41.38%	27.59%	1.72%
equipped with the latest computer technology	17.24%	17.24%	48.28%	17.24%
provides a sufficient number of easily accessible power outlets for charging laptops, and other mobile devices	32.76%	48.28%	13.79%	5.17%
utilizes leading-edge technology through its use of lab tools and equipment	18.97%	37.93%	34.48%	8.62%
offers the latest audio-video equipment and other technologies used for presentations	17.24%	48.28%	29.31%	5.17%
projector screen in the lab can be easily viewed from every seat	23.21%	55.36%	16.07%	5.36%
provides comfortable, adjustable, and accommodating seating for all body types	25.86%	27.59%	25.86%	20.69%
voices and other noises from outside of the space are a major distraction	12.07%	25.86%	50.00%	12.07%
temperature is always set at a comfortable level	15.52%	62.07%	20.69%	1.72%
table and seating arrangement options enhance the learning environment	22.41%	44.83%	24.14%	8.62%
lighting is sufficient for classroom and lab activities, and for viewing presentations	20.69%	62.07%	13.79%	3.45%
color scheme creates an environment conducive to studying and learning	15.52%	55.17%	22.41%	6.90%
houses or displays other items in the space that are a distraction to the learning environment	10.34%	31.03%	44.83%	13.79%
all presenters can be easily heard and understood from any location within the space	27.59%	50.00%	20.69%	1.72%
provides sufficient whiteboard space for lectures as well as student collaboration	22.41%	43.10%	31.03%	3.45%
the whiteboard(s) can be easily viewed from every seat	27.59%	41.38%	29.31%	1.72%
the lab is a good representation of the cultural diversity within the CM program	22.41%	51.72%	24.14%	1.72%

Table 1 Construction Lab Physical Attributes Performance Based on Student Responses

In response to the size of the space and furnishings, the results shown in Table 1 reveal that 70.69% of the students responding agree that the construction lab provides sufficient space for activities, 67.24% agree that the table and seating arrangement options enhance the learning environment, 53.45% agree that the lab offers comfortable, adjustable and accommodating seating for all body types, and 65.51% agree that there is sufficient whiteboard space for lectures and student collaboration.

When asked about the technology present in the lab, 34.48% of the students agree that the lab is equipped with the latest computer technology, 56.9% agree that the lab utilizes leading-edge technology through its use of lab tools and equipment, 65.52% agree that the lab is furnished

with the latest audio-video equipment and other technologies used for presentations, and 81.04% agree that there are a sufficient number of accessible outlets for charging laptops and other devices.

Students were also asked questions related to the layout of the space, lighting, color scheme, displays, noise, and temperature for the construction lab. 78.57% of the students agree that the room is laid out in a way that the projector screen can be easily viewed from anywhere in the lab, 77.59% agree that presenters can be easily heard from anywhere within the space, 68.97% agree that the available whiteboard space can be viewed from any seat in the space, 82.67% agree that lighting is sufficient, 37.93% agree that noises outside of the classroom setting are a distraction, 77.59% agree that the temperature of the space is set at a comfortable level, 70.69% of students agree that the color scheme is conducive to learning, 41.37% of the students agree that additional items housed or displayed in the space are a distraction, and lastly, 74.13% of the students agree that the construction lab provides a good representation of cultural diversity within the construction management program.

Construction Lab Physical Attributes Performance Based on Faculty Responses				N=5
Construction Lab Physical Characteristics	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
provides enough space to perform the necessary lab activities, project work, and student collaboration	0.00%	20.00%	60.00%	20.00%
equipped with the latest computer technology	0.00%	0.00%	20.00%	80.00%
provides a sufficient number of easily accessible power outlets for charging laptops, and other mobile devices	0.00%	80.00%	20.00%	0.00%
utilizes leading-edge technology through its use of lab tools and equipment	0.00%	0.00%	40.00%	60.00%
offers the latest audio-video equipment and other technologies used for presentations	0.00%	0.00%	60.00%	40.00%
projector screen in the lab can be easily viewed from every seat	20.00%	80.00%	0.00%	0.00%
provides comfortable, adjustable, and accommodating seating for all body types	0.00%	0.00%	100.00%	0.00%
voices and other noises from outside of the space are a major distraction	0.00%	40.00%	60.00%	0.00%
temperature is always set at a comfortable level	0.00%	60.00%	20.00%	20.00%
table and seating arrangement options enhance the learning environment	20.00%	60.00%	20.00%	0.00%
lighting is sufficient for classroom and lab activities, and for viewing presentations	0.00%	60.00%	20.00%	20.00%
color scheme creates an environment conducive to studying and learning	0.00%	20.00%	60.00%	20.00%
houses or displays other items in the space that are a distraction to the learning environment	0.00%	20.00%	80.00%	0.00%
all presenters can be easily heard and understood from any location within the space	0.00%	60.00%	40.00%	0.00%
provides sufficient whiteboard space for lectures as well as student collaboration	0.00%	80.00%	0.00%	20.00%
the whiteboard(s) can be easily viewed from every seat	0.00%	60.00%	40.00%	0.00%
the lab is a good representation of the cultural diversity within the CM program	0.00%	60.00%	40.00%	0.00%

Table 2 Construction Lab Physical Attributes Performance Based on Faculty Responses

In response to the size of the space and furnishings, the results shown in Table 2 reveal that 20% of the faculty responding agree that the construction lab provides sufficient space for activities, 80% agree that the table and seating arrangement options enhance the learning environment, 0% agree that the lab offers comfortable, adjustable and accommodating seating for all body types, and 80% agree that there is sufficient whiteboard space for lectures and student collaboration.

When asked about the technology present in the lab, 0% of the faculty agree that the lab is equipped with the latest computer technology, 0% agree that the lab utilizes leading-edge technology through its use of lab tools and equipment, 0% agree that the lab is furnished with the

latest audio-video equipment and other technologies used for presentations, and 80% agree that there are a sufficient number of accessible outlets for charging laptops and other devices.

Faculty were also asked questions related to the layout of the space, lighting, color scheme, displays, noise, and temperature for the construction lab. 100% of the faculty agree that the room is laid out in a way that the projector screen can be easily viewed from anywhere in the lab, 60% agree that presenters can be easily heard from anywhere within the space, 60% agree that the available whiteboard space can be viewed from any seat in the space, 60% agree that lighting is sufficient, 40% agree that noises outside of the classroom setting are a distraction, 60% agree that the temperature of the space is set at a comfortable level, 20% agree that the color scheme is conducive to learning, 20% agree that additional items housed or displayed in the space are a distraction, and lastly, 20% of the faculty agree that the construction lab provides a good representation of cultural diversity within the construction management program.

Construction Lab Physical Attributes Performance Based on Industry Advisor Responses				N=8
Construction Lab Physical Characteristics	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
provides enough space to perform the necessary lab activities, project work, and student collaboration	0.00%	12.50%	50.00%	37.50%
equipped with the latest computer technology	0.00%	0.00%	37.50%	62.50%
provides a sufficient number of easily accessible power outlets for charging laptops, and other mobile devices	12.50%	25.00%	62.50%	0.00%
utilizes leading-edge technology through its use of lab tools and equipment	0.00%	0.00%	50.00%	50.00%
offers the latest audio-video equipment and other technologies used for presentations	0.00%	12.50%	50.00%	37.50%
projector screen in the lab can be easily viewed from every seat	12.50%	50.00%	25.00%	12.50%
provides comfortable, adjustable, and accommodating seating for all body types	0.00%	12.50%	62.50%	25.00%
voices and other noises from outside of the space are a major distraction	12.50%	25.00%	50.00%	12.50%
temperature is always set at a comfortable level	12.50%	75.00%	12.50%	0.00%
table and seating arrangement options enhance the learning environment	0.00%	37.50%	50.00%	12.50%
lighting is sufficient for classroom and lab activities, and for viewing presentations	12.50%	62.50%	25.00%	0.00%
color scheme creates an environment conducive to studying and learning	0.00%	37.50%	62.50%	0.00%
houses or displays other items in the space that are a distraction to the learning environment	0.00%	37.50%	62.50%	0.00%
all presenters can be easily heard and understood from any location within the space	0.00%	75.00%	25.00%	0.00%
provides sufficient whiteboard space for lectures as well as student collaboration	0.00%	25.00%	75.00%	0.00%
the whiteboard(s) can be easily viewed from every seat	0.00%	62.50%	37.50%	0.00%
the lab is a good representation of the cultural diversity within the CM program	0.00%	50.00%	50.00%	0.00%

Table 3 Construction Lab Physical Attributes Performance Based on Industry Advisory Board Member Responses

In response to the size of the space and furnishings, the results shown in Table 3 reveal that 12.50% of the IAB members responding agree that the construction lab provides sufficient space for activities, 37.50% agree that the table and seating arrangement options enhance the learning environment, 12.50% agree that the lab offers comfortable, adjustable and accommodating seating for all body types, and 25% agree that there is sufficient whiteboard space for lectures and student collaboration.

When asked about the technology present in the lab, 0% of the IAB members agree that the lab is equipped with the latest computer technology, 0% agree that the lab utilizes leading-edge technology through its use of lab tools and equipment, 12.50% agree that the lab is furnished

with the latest audio-video equipment and other technologies used for presentations, and 37.50% agree that there are a sufficient number of accessible outlets for charging laptops and other devices.

IAB members were also asked questions related to the layout of the space, lighting, color scheme, displays, noise, and temperature for the construction lab. 62.50% of the IAB members agree that the room is laid out in a way that the projector screen can be easily viewed from anywhere in the lab, 75% agree that presenters can be easily heard from anywhere within the space, 62.50% agree that the available whiteboard space can be viewed from any seat in the space, 75% agree that lighting is sufficient, 37.50% agree that noises outside of the classroom setting are a distraction, 87.50% agree that the temperature of the space is set at a comfortable level, 37.50% agree that the color scheme is conducive to learning, 37.50% agree that additional items housed or displayed in the space are a distraction, and lastly, 50% of the IAB members agree that the construction lab provides a good representation of cultural diversity within the construction management program.

Table 4 presents the mean performance score reported by students, faculty, and the industry advisory board members as it relates to the construction lab's physical attributes and meeting certain criteria. As seen in the tables above, opinions varied between the groups surveyed and within the groups surveyed. The MEAN Performance Score is provided to gauge how each group rated each item's performance as a whole and to provide a comparison between the three groups' overall rating of each item. The rating incorporates a scale of 1 to 4 with 1 representing strongly agree and 4 representing strongly disagree. The rating does not display the range of responses previously provided, but it does depict areas of strengths and weaknesses based on the opinions of students, faculty, and IAB members. Ratings greater than 2 show agreement.

Construction Lab Physical Attributes MEAN Performance Score			
	MEAN SCORE *(1-Strongly Agree, 4-Strongly Disagree)*		
Construction Lab Physical Characteristics	Students N=58	Faculty N=5	IAB N=9
provides enough space to perform the necessary lab activities, project work, and student collaboration	2.02	3.00	3.25
equipped with the latest computer technology	2.66	3.80	3.63
provides a sufficient number of easily accessible power outlets for charging laptops, and other mobile devices	1.91	2.20	2.50
utilizes leading-edge technology through its use of lab tools and equipment	2.33	3.60	3.50
offers the latest audio-video equipment and other technologies used for presentations	2.22	3.40	3.25
projector screen in can be easily viewed from every seat	2.04	1.80	2.38
provides comfortable, adjustable, and accommodating seating for all body types	2.41	3.00	3.13
voices and other noises from outside of the space are a major distraction	2.62	2.60	2.63
temperature is always set at a comfortable level	2.09	2.60	2.00
table and seating arrangement options enhance the learning environment	2.19	2.00	2.75
lighting is sufficient for classroom and lab activities, and for viewing presentations	2.00	2.60	2.13
color scheme creates an environment conducive to studying and learning	2.21	3.00	2.63
houses or displays other items in the space that are a distraction to the learning environment	2.62	2.80	2.63
all presenters can be easily heard and understood from any location within the space	1.97	2.40	2.25
provides sufficient whiteboard space for lectures as well as student collaboration	2.16	2.40	2.75
the whiteboard(s) can be easily viewed from every seat	2.05	2.40	2.38
the lab is a good representation of the cultural diversity within the CM program	2.05	2.40	2.50

Table 4 Construction Lab Physical Attributes MEAN Performance Score

Tables 5 through 7 provide the collected survey result of students, faculty, and IAB members providing a response to how each perceives the impact that a physical learning environment, not specific to the campus or the construction lab, has on student learning and the educator's experience.

Student Perceived Impact of Physical Learning Environment				N=35
Perceived Impact of Physical Learning Environments	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) ability to learn	25.71%	51.43%	20.00%	2.86%
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) perception of learning	17.14%	60.00%	20.00%	2.86%
New building spaces and renovated classrooms make me feel like I am getting a better education (more empowered as an educator).	48.57%	34.29%	17.14%	0.00%
I feel that students in programs with new buildings and renovated spaces have an advantage over me (construction management students).	28.57%	37.14%	34.29%	0.00%

Table 5 Student Perception of the Impact of a Physical Learning Environment

Table 5 reveals that 77.14% of the students surveyed agree that the physical design and appearance of learning environments impact a student's ability to learn, 67.14% agree that the physical design and appearance of learning environments impact a student's perception of learning, 82.86% agree that new building spaces and renovated classrooms make students feel like they are getting a better education, and 65.71% agree that students in programs with new buildings and renovated spaces have an advantage over other students.

Faculty Perceived Impact of Physical Learning Environment				N=5
Perceived Impact of Physical Learning Environments	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) ability to learn	80.00%	20.00%	0.00%	0.00%
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) perception of learning	80.00%	20.00%	0.00%	0.00%
New building spaces and renovated classrooms make me feel like I am getting a better education (more empowered as an educator).	80.00%	0.00%	20.00%	0.00%
I feel that students in programs with new buildings and renovated spaces have an advantage over me (construction management students).	80.00%	20.00%	0.00%	0.00%

Table 6 Faculty Perception of the Impact of a Physical Learning Environment

Table 6 reveals that 100% of the faculty surveyed agree that the physical design and appearance of learning environments impact a student's ability to learn, 100% agree that the physical design and appearance of learning environments impact a student's perception of learning, 80% agree that new building spaces and renovated classrooms make faculty feel more empowered as educators and 100% agree that students in programs with new buildings and renovated spaces have an advantage over other students.

Industry Advisory Perceived Impact of Physical Learning Environment				N=9
Perceived Impact of Physical Learning Environments	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) ability to learn	44.44%	44.44%	11.11%	0.00%
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) perception of learning	44.44%	55.56%	0.00%	0.00%
New building spaces and renovated classrooms make me feel like I am getting a better education (more empowered as an educator).	22.22%	44.44%	33.33%	0.00%
I feel that students in programs with new buildings and renovated spaces have an advantage over me (construction management students).	44.44%	22.22%	33.33%	0.00%

Table 7 IAB Members' Perception of the Impact of a Physical Learning Environment

Table 7 reveals that 88.88% of the IAB members surveyed agree that the physical design and appearance of learning environments impact a student's ability to learn, 100% agree that the physical design and appearance of learning environments impact a student's perception of learning, 66.66% agree that new building spaces and renovated classrooms make IAB members feel more empowered as educators and mentors, and 66.66% agree that students in programs with new buildings and renovated spaces have an advantage over other students.

Table 8 presents the mean score reported by students, faculty, and the industry advisory board members as it relates to the perceived impact a physical learning environment has on student learning as well as the impact it may have on educators. As seen in the tables above, opinions varied between the groups surveyed and within the groups surveyed. The MEAN Performance Score is provided to gauge how each group rated each item as a whole and to provide a comparison between the three groups' overall rating of each item. The rating incorporates a scale of 1 to 4 with 1 representing strongly agree and 4 representing strongly disagree. The rating does not display the range of responses previously provided, but the average score provided by each group.

Perceived Impact of Physical Learning Environments MEAN Score			
	MEAN SCORE *(1-Strongly Agree, 4-Strongly Disagree)*		
Learning Environment Impact	Students N=58	Faculty N=5	Industry Advisory Board N=9
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) ability to learn	2.00	1.20	1.67
The physical design and appearance of learning environments (classroom and lab spaces) impact my (a student's) perception of learning	2.09	1.20	1.56
New building spaces and renovated classrooms make me feel like I am getting a better education (more empowered as an educator).	1.69	1.40	2.11
I feel that students in programs with new buildings and renovated spaces have an advantage over me (construction management students).	2.06	1.20	1.89

Table 8 Perceived Impact of Physical Learning Environments MEAN Score

Table 9 provides the students' perception of the Campus' physical learning environment's impact on learning, recruitment, retention, and its ability to provide a sense of belonging for students.

Impact of Campus Physical Learning Environment Based on Student Responses				N=35
Campus Learning Environment Impact	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
Overall, the physical learning environments on campus that I have used have positively influenced my learning.	14.29%	65.71%	20.00%	0.00%
Overall, the physical learning environments on campus that I have used provide a sense of belonging to an institute or program	14.29%	60.00%	20.00%	5.71%
Overall, the physical learning environments on campus contributed to my decision to select this campus	14.29%	45.71%	31.43%	8.57%
Overall, the physical learning environments on campus contribute to my decision to remain a student at this campus	14.29%	34.29%	42.86%	8.57%

Table 9 Impact of Campus Physical Learning Environment Based on Student Responses

Table 9 shows that 80% of the students surveyed agree that overall the learning environments experienced across the campus have positively influenced student learning, 74.29% agree that the learning environments experienced across campus have provided a sense of belonging, 60% agree that the overall learning environments on campus contributed to their decision to select the campus, and 48.58% of the students agree that the learning environments experienced on campus have contributed to their decision to remain enrolled at the campus.

Table 10 presents the mean score reported by students as it relates to the impact the campus's physical learning environment has on student learning, the ability to provide a sense of belonging, recruitment, and retention. As seen in the tables above, opinions varied within the groups surveyed. The MEAN Performance Score is provided to gauge how the group rated each item as a whole. The rating incorporates a scale of 1 to 4 with 1 representing strongly agree and 4 representing strongly disagree. The rating does not display the range of responses previously provided, but the average score provided within the group.

Campus Physical Learning Environment Impact	
	MEAN SCORE *(1-Strongly Agree, 4-Strongly Disagree)*
Campus Learning Environment Impact	Students N=58
Overall, the physical learning environments on campus that I have used have positively influenced my learning.	2.06
Overall, the physical learning environments on campus that I have used provide a sense of belonging to an institute or program	2.17
Overall, the physical learning environments on campus contributed to my decision to select this campus	2.34
Overall, the physical learning environments on campus contribute to my decision to remain a student at this campus	2.46

Table 10 Campus Physical Learning Environment Impact on Student Learning, Sense of Belonging, Recruitment, and Retention

Tables 11 through 13 provide the student, faculty, and industry advisory board members' perception of specifically the construction lab's physical learning environment's impact on student learning, recruitment, retention, and ability to provide a sense of belonging for students.

Impact of Construction Lab Physical Learning Environment Based on Student Responses				N=35
Construction Lab Learning Environment Impact	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
I feel that the construction lab is as good as or better than other physical spaces on campus	8.57%	34.29%	42.86%	14.29%
I feel that the construction lab provides a good environment for learning.	11.43%	54.29%	34.29%	0.00%
I feel that the construction lab meets the needs of its students	14.29%	45.71%	34.29%	5.71%
I feel that the construction lab provides a good space for student collaboration.	17.14%	45.71%	28.57%	8.57%
I feel that the construction lab provides me (a student) with a sense of belonging to the program and the construction industry	11.43%	45.71%	40.00%	2.86%
I feel that the construction lab has a positive influence on new student recruitment	5.71%	40.00%	42.86%	11.43%
I feel that the construction lab has a positive influence on retention or a reason for students to remain in the program	8.57%	42.86%	42.86%	5.71%

Table 11 Student Perception of the Construction Lab's Physical Learning Environment's Impact on Student Learning, Sense of Belonging, Recruitment, and Retention

Table 11 shows that 42.86% of the students surveyed agree that the construction lab is as good as or better than other spaces on campus, 65.72% agree that it provides a good environment for learning, 60% agree that the space meets the needs of the students, and 62.85% agree that the construction lab provides students a good space for student collaboration. Students were also asked to respond to how well the construction lab provides them with a sense of belonging to the program and to the construction industry at large. 57.14% of the students agree that the lab provides a sense of belonging to the construction management program and to the industry. 45.71% agree that the lab space provides a positive influence on student recruitment, and 51.43% agree that the lab space provides a positive influence on retention.

Impact of Construction Lab Physical Learning Environment Based on Faculty Responses				**N=5**
Construction Lab Learning Environment Impact	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
I feel that the construction lab is as good as or better than other physical spaces on campus	0.00%	20.00%	20.00%	60.00%
I feel that the construction lab provides a good environment for learning.	0.00%	60.00%	20.00%	20.00%
I feel that the construction lab meets the needs of its students	0.00%	20.00%	60.00%	20.00%
I feel that the construction lab provides a good space for student collaboration.	0.00%	100.00%	0.00%	0.00%
I feel that the construction lab provides me (a student) with a sense of belonging to the program and the construction industry	0.00%	60.00%	40.00%	0.00%
I feel that the construction lab has a positive influence on new student recruitment	0.00%	20.00%	40.00%	40.00%
I feel that the construction lab has a positive influence on retention or a reason for students to remain in the program	0.00%	20.00%	80.00%	0.00%

Table 12 Faculty Perception of the Construction Lab's Physical Learning Environment's Impact on Student Learning, Sense of Belonging, Recruitment, and Retention

Table 12 shows that 20% of the faculty surveyed agree that the construction lab is as good as or better than other spaces on campus, 60% agree that it provides a good environment for learning, 20% agree that the space meets the needs of the students, and 100% agree that the construction lab provides students a good space for student collaboration. Faculty were also asked to respond to how well the construction lab provides students with a sense of belonging to the program and to the construction industry at large. 60% of the faculty agree that the lab provides a sense of belonging to the construction management program and to the industry. 20% agree that the lab space provides a positive influence on student recruitment, and 20% agree that the lab space provides a positive influence on retention.

Impact of Construction Lab Physical Learning Environment Based on Industry Responses				N=8
Construction Lab Learning Environment Impact	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
I feel that the construction lab is as good as or better than other physical spaces on campus	0.00%	0.00%	62.50%	37.50%
I feel that the construction lab provides a good environment for learning.	0.00%	57.14%	42.86%	0.00%
I feel that the construction lab meets the needs of its students	0.00%	12.50%	75.00%	12.50%
I feel that the construction lab provides a good space for student collaboration.	12.50%	37.50%	37.50%	12.50%
I feel that the construction lab provides me (a student) with a sense of belonging to the program and the construction industry	0.00%	37.50%	25.00%	37.50%
I feel that the construction lab has a positive influence on new student recruitment	0.00%	12.50%	50.00%	37.50%
I feel that the construction lab has a positive influence on retention or a reason for students to remain in the program	0.00%	12.50%	75.00%	12.50%
I feel that the construction lab makes me believe that I am in (teaching in) a technology-driven program	0.00%	12.50%	50.00%	37.50%

Table 13 IAB Member Perception of the Construction Lab's Physical Learning Environment's Impact on Student Learning, Sense of Belonging, Recruitment, and Retention

Table 13 shows that 0% of the IAB members surveyed agree that the construction lab is as good as or better than other spaces on campus, 57.14% agree that it provides a good environment for learning, 12.50% agree that the space meets the needs of the students, and 50% agree that the construction lab provides students a good space for student collaboration. IAB members were also asked to respond to how well the construction lab provides students with a sense of belonging to the program and to the construction industry at large. 12.50% of the IAB members agree that the lab provides a sense of belonging to the construction management program and to the industry. 12.50% agree that the lab space provides a positive influence on student recruitment, and 12.50% agree that the lab space provides a positive influence on retention.

Table 14 presents the mean score reported by students, faculty, and the industry advisory board members as it relates to the perception of the construction lab's physical learning environment's impact on student learning, recruitment, retention, and its ability to provide a sense of belonging for students. As seen in the tables above, opinions varied between the groups surveyed and within the groups surveyed. The MEAN Performance Score is provided to gauge how each group rated each item as a whole and to provide a comparison between the three groups' overall rating of each item. The rating incorporates a scale of 1 to 4 with 1 representing strongly agree and 4 representing strongly disagree. The rating does not display the range of responses previously provided, but the average score provided by each group.

Construction Lab Learning Environment Impact			
	MEAN SCORE *(1-Strongly Agree, 4-Strongly Disagree)*		
Construction Lab Impact	Students N=58	Faculty N=5	IAB N=9
I feel that the construction lab is as good as or better than other physical spaces on campus	2.63	3.40	3.38
I feel that the construction lab provides a good environment for learning.	2.23	2.60	2.43
I feel that the construction lab meets the needs of its students	2.31	3.00	3.00
I feel that the construction lab provides a good space for student collaboration.	2.29	2.00	2.50
I feel that the construction lab provides me (a student) with a sense of belonging to the program and the construction industry	2.34	2.40	3.00
I feel that the construction lab has a positive influence on new student recruitment	2.60	3.20	3.25
I feel that the construction lab has a positive influence on retention or a reason for students to remain in the program	2.46	2.80	3.00
I feel that the construction lab makes me believe that I am in (teaching in) a technology-driven program	2.54	3.20	3.25

Table 14 Perception of the Construction Lab's Physical Learning Environment's Impact on Student learning, Sense of Belonging, Recruitment, and Retention

Discussion and Implication

The intent of this study is to provide a rationale for the need for improvements and ongoing requests for funding to upfit the current construction lab for a construction management program. The survey began as an instrument to collect student, faculty, and industry members' perception of the construction lab and how it impacts student learning, recruitment, retention, and sense of belonging.

The survey results brought to light some of the concerns that respondents had regarding the physical attributes of the construction lab space and whether or not the lab met the expectations of its occupants. Based on the reported mean score (1 strongly agree and 4 strongly disagree), the majority of students, faculty, and industry members identified technology and comfortable, accommodating seating as the 2 attributes most lacking in the space. Students' mean score for technology was reported as 2.33 for lab tools and equipment and 2.66 for the latest computer technology. Both scores fell between agree (rating of 2) and disagree (rating of 3) while faculty and IAB members fell closer to strongly disagree with ratings greater than 3.5 across the board. The authors believe that this in part is due to the differences between student, faculty, and IAB members' knowledge of available equipment used in the construction industry. Students recognized the need for new furniture, but again, did not have the strong negative opinion that faculty and IAB members provided. Faculty and industry members also agreed that the construction lab was limited on space to perform the necessary activities required by the construction management program while the majority of student responses suggested that the space met their needs. The students and industry members also recognized that the options for

arranging the room were slightly limited and did not enhance the learning environment in contrast to faculty members who felt that the options had some positive impact on learning within the space. On a smaller scale, the majority of participants perceive the color scheme within the construction lab as not conducive to learning.

As the study relates to overall perceptions of the impact of physical learning environments, the participant group's mean scores show that they believe the physical learning environment has some impact on the perception of learning, actual learning, and quality of learning. They also regard the idea that newer spaces provide students with an advantage over other students. The majority of students also believe that the physical learning environment across campus had some impact on their learning and provided a sense of belonging while they also agree that the physical environment had little to no impact on their decision to select or remain at this campus.

Though the physical attributes addressed in Table 1 suggested that students were somewhat content with the actual physical space, Table 11 tells a different story as students respond to whether or not the construction lab positively impacts student learning, recruitment, retention, and sense of belonging. The majority of students, faculty, and industry members agree that the construction lab falls considerably short when compared to other spaces on campus. Participants in the study believe that the space does not meet the needs of the students with a mean score of 2.63 for students, 3.40 for faculty, and 3.38 for industry members (1 strongly agree to 4 strongly disagree). Students recognize that the space does not completely meet their needs, but faculty and the IAB members were much more critical of the space providing a stronger opinion. The students, faculty, and industry members also responded that the construction lab does not have a positive influence on recruitment or the retention of students and it does not provide the image that construction management is a technology-driven program. Again, faculty and industry members have a stronger negative response when compared to students. The authors believe that students may not have a means of comparison if they did not visit other universities with similar programs as part of their selection process. On campus, students have the opportunity to be exposed to different learning environments provided across campus outside of their core study, including learning spaces that are new or newly renovated using new design concepts and advanced technology. This exposes students to other examples of learning environments for comparison, but students still may maintain the idea that the construction lab is appropriate for the area of study that it serves. It may simply come down to students not knowing and as a result having a lower set of expectations based on their own experiences. Students also believe that the construction lab does not offer a sense of belonging. In Table 1, the student responses suggest that the lab space represents a culture of diversity, while faculty and industry members somewhat disagree. The space itself is void of any representation of diversity within the program or school, missing an opportunity to provide that sense of belonging to students, a connection to the program, and a connection to the construction industry.

The re-design or upfit of the physical learning environment within the construction management lab is intended to ensure that all student needs are being met, to provide them with improved learning opportunities, to recruit new students, and to make them feel like they belong so that they want to stay.

The results of this survey were used as evidence to support the need for improvements in the construction lab space and to seek funding through an internal learning environment grant offered at the campus level. The proposal sought funding to renovate the entire space including floors, ceilings, walls, furnishings, and technology. The grant was awarded but only provided partial funding for the project, $50,000 of the $180,000 needed, resulting in a phased implementation as funds become available. Students, faculty, and industry members responding to the survey agreed that technology and furnishings were a priority for the construction lab space. Unfortunately, the combined cost of the 2 needs exceeded the provided budget. The decision was made to improve the accessibility, flexibility and comfort for the space with the majority of the funds providing new moveable lab tables and chairs including furnishings that meet ADA requirements. The additional money will be used to improve the color scheme within the space and to increase whiteboard space for instructional and collaborative purposes.

After the initial phase is complete, additional data will be collected through surveys, course evaluations, and documentation of increased utilization of the space and alternative room setups. As funding becomes available, phase 2, including the technology package would be implemented.

Conclusion

Many universities and individual academic programs often have limited funds to meet the needs of the students being served. This lack of funds can ultimately lead to an inability to act or work towards necessary improvements. The phased project allows the school and the program to carry out a portion of the needs identified through the current study. The initial funding for this project will provide some immediate relief and support for enhancing student learning and collaboration in the construction management program and allowing for further study. Such future endeavors will provide a means for the construction management program to ultimately serve the full needs of its students.

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