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Filling the Workplace Void in Construction Management

George W. Tedder, III, MEng.[1] and N. Mike Jackson, PhD.[1]
[1] Clemson University

The construction industry faces a critical workforce gap that existing post-secondary construction management programs inadequately address. This gap is largely due to the industry's rapid expansion and evolving educational frameworks. Effective higher education programs aim to cultivate skilled leaders equipped to meet these demands, necessitating accessible course offerings, consistent delivery, measurable learning outcomes, standardized accreditation, and strong industry connections. Innovative educational models are essential to bridge this gap. Clemson University's state-legislature-authorized digital construction management program exemplifies this approach, allowing students to balance full-time work with academic commitments while gaining substantial experiential learning and practical experience. This model emphasizes experiential learning, which can provide insights beyond traditional classroom settings. While some online programs have emerged in response to this need, results remain inconsistent. The Clemson model's integration of digital hyflex coursework coupled with workplace experience addresses industry and student needs, promoting a stronger educational foundation. Organizations like the American Institute of Constructors (AIC) and the Accreditation Board for Engineering and Technology (ABET) play vital roles in aligning educational programs with industry standards. Ultimately, this model serves as a promising framework to align educational outcomes with industry requirements and mitigate the workforce gap in construction management. The study synthesizes and examines existing research and industry practices surrounding experiential learning adoption in construction. The study's significance lies in providing a roadmap for successful experiential learning integration in construction while addressing challenges such as student isolation, protocols, and accreditation.

Keywords: Workforce Gap; Construction Management Education; Hybrid Learning Models; Experiential Learning; Digital Learning

Introduction

The construction industry faces a critical labor shortage, with projections indicating a need for an additional 546,000 workers beyond regular hiring to meet labor demands in 2023 (Associated Builders and Contractors, n.d.). This challenge is compounded by a surge in job openings, exceeding 390,000 per month in 2022, alongside a low unemployment rate. The shortage is expected to persist due to ongoing demand from various sectors, an aging workforce, and insufficient influx of young workers entering skilled trades (Abdulhafedh, A. 2023). The industry is grappling with a significant workforce gap that is inadequately addressed by current post-secondary construction management

programs. This gap stems from the rapid expansion of the industry and the evolving nature of educational frameworks (Cohen & Moore, 2023; Meyer, 2024). The goal of higher education construction management degree programs is to promote, support and deliver leaders to the construction industry. Part of the effective post-secondary learning platform includes course availability to students, consistency of delivery, measurable learning outcomes, engaging in standardized and accredited practices, and connecting students with industry.

To address these challenges, the industry is increasingly turning to educational institutions to be creative with construction education. Effective higher education in construction management is essential for developing skilled leaders capable of addressing industry demands. An optimal educational model should include accessible and flexible course offerings, consistent instructional quality, clearly defined and measurable learning outcomes, standardized accreditation practices, and strong industry connections (Lee & Martin, 2023).

To bridge this gap, innovative approaches to construction management education are necessary. For example, Clemson University in South Carolina has introduced a state-legislature-authorized experiential learning construction management program. This program allows students to balance full-time work with their studies, completing 25-49% of coursework while gaining hands-on experience in the industry. Admission requirements include meeting GPA thresholds, completing prerequisite courses, and accruing 1,000 hours (at least six months) of approved construction experience. Graduates must complete 124 credit hours and an additional 2,000 hours (one additional year) of approved construction experience prior to graduation (Clemson University, 2024; Patel & Thompson, 2024). The Clemson model underscores the value of integrating practical work experience with academic learning. Research suggests that experiential learning in real-world settings can offer insights that traditional classroom settings may not provide (Edwards, 2023). However, quantifying the specific impact of experiential learning remains a challenge.

There have been some alternative online programs created by this need (LSU online, Everglades University, Eastern Michigan University, Columbia University online, and others) but the results are still mixed. Some of the programs have been more successful than others and some of the students have been able to avoid some of the common pitfalls associated with digitally delivered programs. Evidence does not support the findings from a U.S. Department of Education report (2010 (2009)) that online students learn moderately better than their face-to-face counterparts (Coffey, 2021). The reimagined Clemson model includes digitally delivered hyflex course offerings coupled with full-time employment in an approved construction setting. This path both begins and ends in the workplace and successfully addresses the needs and concerns of both students and industry.

To clarify the terminology, experiential learning in this paper is defined as the program or process being employed by Clemson (and others) that combines “apprenticeship” type work educational model where student employees work full-time while attending school part-time. The terms digital learning, online learning, hybrid, and Hyflex refer to various course delivery methodologies that are similar in that they all use the internet for course delivery but possibly different from one another in their teaching approach and format. HyFlex is systematically most flexible for students.

Addressing the intersection of industry needs and educational development involves balancing the demand for skilled professionals with the need for a strong educational foundation. Organizations such as the American Institute of Constructors (AIC), the American Council for Construction Education (ACCE), and the Accreditation Board for Engineering and Technology (ABET) play a critical role in aligning educational programs with industry standards and requirements (AIC, 2023; ACCE, 2023; ABET, 2023; Garcia & Miller, 2024).

Traditionally, construction management education has relied on two main models: apprenticeships combined with part-time coursework and full-time university and college lead academic programs. Hybrid models, which combine work and study, offer a balanced approach but often extend the duration needed to complete a degree (Brown & Lee, 2022; Nguyen & Patel, 2024). Cooperative education (co-op) models offer an innovative approach to bridging the skills gap between academia and industry. These programs combine traditional education with work experience, allowing students to develop both theoretical knowledge and practical skills (Goldemberg et al., 2020; Rogalsky & Ulseth, 2021). Co-op models can take various forms, from full-time work placements alternating with study periods (Rogalsky & Ulseth, 2021) to part-time work during the academic year (Goldemberg et al., 2020). Some programs integrate undergraduate research experiences with co-op education, providing a well-rounded learning experience (Jimenez et al., 2002). Others, like the "co-op light" model, combine elements of internships and co-ops to meet both student and organizational needs in specific fields such as cybersecurity (Dupuis, 2018). These models aim to enhance students' employability, reduce education costs, and address industry demands for skilled workers (Goldemberg et al., 2020; Rogalsky & Ulseth, 2021). However, the challenge of balancing academic and work commitments remains a key consideration in co-op program design.

The COVID-19 pandemic accelerated the transition to digitally delivered education, revealing both advantages and disadvantages. While digital learning ensured educational continuity, it also highlighted issues such as student isolation and inadequate preparation for both academic and professional environments (Johnson & Smith, 2022; Adams & Brown, 2023). Some institutions, like LSU and Eastern Michigan University, have made strides in addressing these challenges, though results have been mixed and difficult to quantify from outside (LSU Online, 2023; Eastern Michigan University, 2023).

The Clemson model, integrates digitally delivered coursework with full-time work, represents a promising approach that directly addresses both educational and industry needs. This model helps ensure that students remain connected to the workforce while completing their degrees, thereby addressing the workforce gap and aligning educational outcomes with industry requirements (Clemson University, 2024).

Figure 1. Bloom's Taxonomy

Changes to higher education leading to the digital environment

The COVID-19 pandemic irrevocably altered academic life, propelling a swift shift to digital learning environments that had previously been viewed as peripheral and suited only for a select few. Before the pandemic, many traditional educators were unprepared for this transition, having little experience with online teaching and relying heavily on conventional lecture methods that do not adapt well to virtual formats. Students, too, faced significant challenges; their exposure to online courses was often limited to occasional physical education introductory or basic self-study classes, resulting in minimal engagement and interaction. This sudden shift highlighted not only the gaps in preparedness among educators and students but also the urgent need for a re-evaluation of teaching methodologies in higher education.

Despite these obstacles, several successful digital learning models emerged, particularly in hybrid programs that integrated traditional lectures with online resources like recorded presentations and submissions through learning management systems such as Blackboard and Canvas. These models provided a framework for effective learning that combined the strengths of face-to-face instruction with the flexibility of online education. The HyFlex model, which allows for simultaneous participation from in-person and remote students that are digitally connected through Teams or Zoom, gained traction as well. While this model can work effectively for shorter courses, it struggles with longer sessions and often lacks clear engagement protocols, leading to participants joining without cameras and unclear interaction expectations. As a result, many educators faced the challenge of creating an inclusive atmosphere that encouraged participation from all students, regardless of their physical location.

Hybrid and HyFlex construction management programs provide unique benefits by merging academic rigor with practical experience, equipping students with a comprehensive skill set that enhances their competitiveness in the job market. These programs typically combine construction management with other disciplines, such as accounting, business, and engineering, allowing students to understand both financial and technical aspects of construction projects. This interdisciplinary approach fosters innovative problem-solving and creative thinking, enriching the educational experience beyond what traditional methods often offer (ASCE, 2022). For instance, students are encouraged to work on real-world case studies that integrate various perspectives, preparing them for the complexities they will face in the industry.

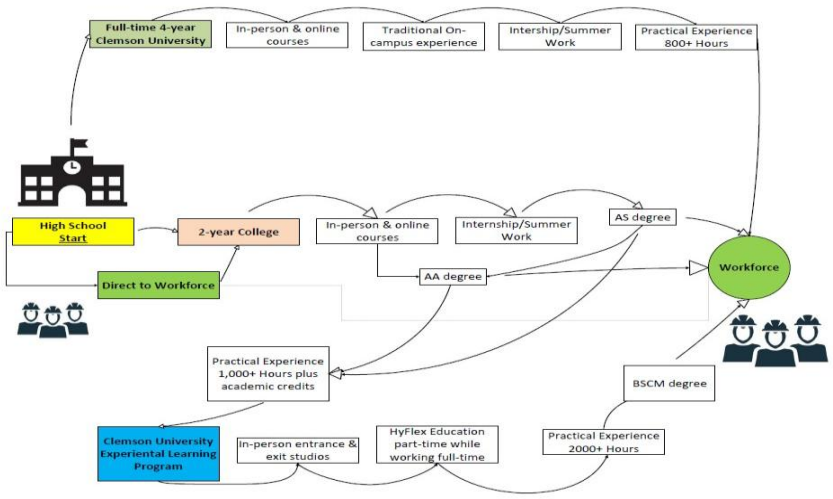

Figure 2. Experiential Learning

While some HyFlex programs successfully blend online and in-person classes, adapting this model to specific contexts, like Clemson's, poses challenges. The digital HyFlex model offers maximum flexibility and accessibility, particularly for those already in the workforce who wish to further their education without sacrificing their careers. This flexibility is increasingly important in today's fast-paced world, where many students juggle work, family, and academic commitments. Programs emphasize essential skills such as leadership, project management, and sustainability, preparing students for advanced roles in the evolving construction industry. Incorporating hands-on projects and case studies simulates real-world scenarios, bridging the gap between theoretical knowledge and practical application.

The construction industry has largely embraced hybrid work programs, recognizing their potential to modernize practices and enhance efficiency. Effective implementation of these programs requires addressing inherent challenges. Digital HyFlex models can improve transparency and collaboration, enabling communication and decision-making without physical presence in the classroom. This flexibility can enhance work-life balance, potentially leading to increased productivity, better employee retention, and improved academic performance—all vital in light of the industry's ongoing labor shortages. Moreover, the opportunity for employees to continue their education while working presents a significant recruiting advantage, allowing employers to tap into a wider talent pool.

Digital educational programs and hybrid work environments are not without their challenges. A key issue is the reliance on advanced technology; institutions must invest in digital tools and ensure that both instructors and students receive adequate training. While these technologies can improve learning and communication, they may also lead to misunderstandings if instructions are unclear. Establishing clear protocols and regular check-ins is essential to mitigate these risks. Institutions also need to foster an environment where educators feel comfortable experimenting with modern technologies, which can lead to greater innovation in teaching practices.

Resistance to change is another significant barrier. Many stakeholders—academicians, employers, and students—hesitate to embrace this new paradigm. Overcoming this resistance necessitates demonstrating the tangible benefits of digital HyFlex and hybrid programs while providing robust support during the transition. Clear communication about the advantages of these models, such as increased accessibility and flexibility, can help alleviate concerns and build buy-in among faculty and administration.

Leadership is crucial in facilitating this transition. Industry and academic leaders must clearly communicate the vision and benefits of the HyFlex model, particularly regarding how it aligns with goals to fill workforce gaps and boost productivity. Leaders should model effective use of digital tools and foster a culture of trust and inclusion among educators and students. Regular check-ins, transparent communication, and inclusive practices can help alleviate resistance. Furthermore, leaders must support the shift to hybrid models by providing necessary resources and training, ensuring that transitions do not overwhelm team members. Continuous learning should be promoted, encouraging professional development that includes training on digital tools and collaboration techniques, while being mindful of the potential stress that excessive training can cause. Offering training in manageable segments and integrating it into the regular workflow can help mitigate stress and encourage participation. Finally, ongoing evaluation of the HyFlex model is essential; leaders and educators must be willing to adjust strategies based on feedback, fostering a culture of continuous improvement that supports student success. As institutions adapt to these new educational paradigms, they can ultimately create more resilient and inclusive learning environments that better meet the diverse needs of their students.

Research Aim and Scope

The goal of this research project is to address the knowledge gap for construction industries concerning experiential learning. This study aims to establish a foundation through interconnected objectives:

1. Conducting a systematic literature survey to identify key research areas,
2. Presenting a detailed overview of construction management education methodologies referenced in relevant research,
3. Analyzing connections between student course success and digital education.

The synthesis and findings from this research will serve as the groundwork for future studies, particularly in informing the design of courses that using insights from students, construction professionals, and higher education professionals. This approach ensures that future investigations into bridging the education-construction knowledge gap will be built upon a thorough understanding of the current practices.

Table 1. ACCE Bachelor's Degree Program Learning Outcomes

SLO	Description
1	Create written communication appropriate to the construction discipline
2	Create oral presentations appropriate to the construction discipline
3	Create a construction project safety plan
4	Create construction project cost estimate
5	Create construction project schedules
6	Analyze professional decisions based on ethical principles
7	Analyze methods, materials, and equipment used to construct projects
8	Apply electronic-based technology to manage the construction process
9	Apply basic surveying techniques for construction layout and control
10	Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process
11	Understand construction accounting and cost control
12	Understand construction quality assurances and control
13	Understand construction project processes
14	Understand the legal implications of contract, common, and regulatory law to manage a construction project
15	Understand the basic principles of sustainable construction
16	Understand the basic principles of structural behavior
17	Understand the basic principles of HVAC, electrical and plumbing systems

Methodology

This research will employ a comprehensive mixed-method approach that integrates quantitative and qualitative analysis through three main components, establishing a foundation for future surveys. The methodology begins with a systematic literature survey following a seven-step process, progressing from research design exploration through document search initiation, identification, screening, eligibility filtering, and document inclusion/exclusion, to final output organization (Cerigo, H., et al., 2020). From this foundational dataset of documents, a technology overview was conducted to understand the current state of construction management education. The analysis revealed three

distinct categories: traditional in-person classroom education, online asynchronous class presentations, and online synchronous class presentations.

The bibliometric analysis framework is the final component. This analysis will employ a systematic five-step process encompassing research design formulation, data collection, pattern identification, cluster visualization, and result interpretation (Öztürk, O., et al., 2024). The findings will serve as the foundation for developing a targeted survey that will further identify knowledge gaps.

Reference Analysis Insights

The reference analysis revealed distinct patterns in research distribution and collaboration. Of the unique keywords identified, only a handful appeared numerous times, underscoring the dispersed nature of knowledge in this field. Key trends include:

- Research clusters showed geographic concentration primarily in North America, suggesting opportunities for increased international collaboration,
- Author analysis revealed limited cross-domain collaboration, particularly between education and construction outside of the apprenticeship model,
- Limitation in research efforts reinforces the need for increased knowledge sharing.

These findings provide insights into the current state of experiential learning and highlight specific areas where expert input could be valuable in bridging identified gaps. The data suggests that future expert surveys should particularly focus on investigating ways to overcome the fragmentation in research efforts and promote standardization in systematic process implementation.

Discussion and Implications

The analysis of experiential learning is expected to reveal several interrelated challenges that should be addressed to advance the practice/process.

Student Experience

Student work experience prior to entrance into the program limits the numbers and types of students that will be eligible for the program. The program is not expected to appeal to all Construction Science Management students but will appeal to those working full-time in industry.

- 1,000 hours of approved construction experience prior to program entry,
- Program completers will accrue an additional 2,000 hours of approved construction experience.

Access and Egress Studios

The preponderance of the education will be conducted digitally in the hyflex format. There are some topics that require special attention for experiential learners. The “Access Studio” and “Egress Studio” combine multiple courses together but have identical learning outcomes as the courses taught in the traditional university model.

- Access Studio integrates CSM 1000 (Introduction to Construction Science Management) and CSM 2060 (Construction Science Workshop) into one 6 credit hour course

- Egress Studio integrates CSM 4540 (Construction Capstone), CSM 4500 (Construction Internship), and CSM 2070 (Corporate Partner Seminar) into one 5 credit hour course

Hyflex Coursework

Students transfer to Clemson with 65 credit hours from colleges or universities in specific courses that fulfill both general education and upper division preparation classes. Those courses could have been instructed through any available modality including but not limited to online, in-person, or hyflex and meet the requirements identified in both ACCE's program for accredited bachelors programs and Clemson's required undergraduate transfer equivalent coursework for students seeking admission to the Bachelor of Science in Construction Science Management degree program. While completing the Experiential Learning program, student will complete sixteen 3 credit hour courses.

Conclusions

The analysis of methods used in construction management education reveals opportunities and challenges in transforming traditional construction educational practices. This research will provide a foundation for understanding the landscape of construction education while highlighting areas requiring further investigation. This research will investigate and determine a set of guidelines for bridging the technology gap between education and experiential construction management. The framework offers steps for universities seeking to leverage experiential learning while addressing the unique challenges of effective hyflex education.

Critical areas requiring attention include:

- Development of standardized protocols for classes
- Enhancement of instruction methods and associated technologies
- Establishment of transparent and consistent assessment of student learning outcomes

This research provides a foundation for future investigations, particularly in the design of surveys that can gather detailed insights from students, educators, and construction professionals focusing on:

- Advanced work collaboration models specifically tailored to digital education
- Comprehensive economic impact assessment of experiential learning model
- Development of standardized training programs for education professionals

The findings are anticipated to suggest that the challenges are significant. Programmatic success will require coordinated effort, with particular attention to developing standardized approaches that can be widely adopted. The integration of experiential learning in construction management has the potential to address critical industry challenges, including labor shortages, productivity improvements, and safety concerns.

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