

Development of Construction Engineering and Management Students' Professional Identities: An Investigation of Professional Identity Practices through Storytelling

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Abstract— This research-to-practice full paper investigates professional identity practices needed for developing construction engineering and management students' professional identities. The construction industry is experiencing rapid technological advancement, with technologies playing a vital role in enhancing project efficiency, safety, and productivity. However, this progress has unveiled a critical shortage of skilled technical professionals capable of driving the adoption of construction technologies. A key contributing factor is the shortage of construction practitioners who fully identify with and embrace technology implementation. To address this gap and cultivate a competent future workforce, it is imperative to develop the professional identities of construction engineering and management students because individuals' self-perception significantly influences their career trajectory, success, and commitment to the industry. While studies have explored the required technical competencies for construction education, little is known about the professional identity practices needed to develop students' identities toward construction technologies. Through semi-structured interviews with construction practitioners who are actively engaged in and embraced technological implementation, this study identifies essential soft skills needed for adopting construction technologies and the motivating factors that could enhance students' professional identity with construction technologies. Grounded in narrative theory, the study provides insights into practitioners' reflections and stories, shedding light on the development of their professional identities. The findings emphasize the importance of planning and communication as key technical and soft skills while seeing the result and hands-on are identified as key motivating factors in enhancing the interest of the students in construction technologies. By fostering the development of students' professional identity, academia and industry stakeholders can collaboratively pave the way for a skilled and adaptable workforce. This study not only contributes to academic discourse but also offers practical implications for bridging the gap between educational curricula and industry demands.

Keywords— *Construction education, Professional identities, Storytelling, Professional identity practices, Soft skills.*

I. INTRODUCTION

The construction industry is experiencing rapid technological advancement, with technology such as laser scanners and drones playing a vital role in enhancing project efficiency, safety, and productivity. Laser scanners and drones provide highly accurate 3D data of sites and

structures, which facilitates precise planning and design [1]. This technology enables rapid data collection [1, 2], significantly reducing survey time and aiding in cost-effective project management by minimizing errors and subsequent rework [3, 4]. Despite this technological importance, the industry faces a critical shortage of skilled technical professionals [5]. This skilled workforce shortage has been projected to escalate as the Department of Labor forecasted an employment rate of 11% from 2016 to 2026 [6]. This can be due to the limited number of students entering construction engineering degree programs, or the limited motivation of construction engineering students to pursue a career in the industry [7], or due to a high number of graduates that leave the construction engineering profession right after their graduation [8, 9]. A possible reason why construction engineering graduates choose not to practice after qualifying may be a lack of professional engineering identity development during their education. The limited number of construction practitioners who fully identify with and embrace technology implementation poses a significant challenge to the industry's progress. It underscores the urgency of cultivating a workforce adept in modern construction technologies. This shortage underscores the importance of developing professional identities among construction engineering students.

While existing studies have delved into the technical competencies essential for construction education, there is still a significant lack of understanding regarding the professional identity practices that are crucial for nurturing students' alignment with construction technologies. This gap underscores the need for a deeper exploration of the necessary soft skills required to cultivate professional identity within construction education. Additionally, it is important to assess the key factors that can enhance student interest in construction technology and prepare them for professional roles after graduation. [11]. Moreover, while technical proficiency is indispensable for sharpening expertise in any chosen field, soft skills act as the catalyst for effective operation, facilitating smooth interaction and engagement, thereby complementing technical expertise. According to Badets [12], soft skills are often regarded as the cornerstone of professional identity, as companies increasingly prioritize these interpersonal and self-management abilities in fresh graduates. Hence, the quest for expertise and the cultivation of soft skills have become pivotal aspects of student identity development. This has

prompted the researchers to delve into the necessary soft skills required to excel as a construction technology expert.

The research leverages storytelling to explore the practical applications and personal experiences associated with the use of technologies in construction. By delving into the stories of experts in construction technology, we aim to extract information for developing students' identities in the profession. Several studies have shown that storytelling aids in developing reflexivity [13, 14], playing an essential role in raising awareness and significantly contributing to the development of students' professional identities [15, 16]. It is through storytelling that individuals can express their emotions, beliefs, experiences, and personal meanings, thereby shaping students' professional identities [17]. These narratives offer students a glimpse into the professional identity they are aspiring to develop. By engaging with the stories of seasoned practitioners, students can reflect on the requisite skills needed for implementing construction technologies, the essential soft skills for successful practice, and how their identity to construction technology can be enhanced.

Hence, the primary objective of this research is to understand and articulate the professional identity practices that enable practitioners to engage with and adopt construction technologies effectively. To achieve this, the study focused on laser scanners and drones as one of the essential technologies with high adoption in the construction industry [5]. As such, the research delves into investigating the requisite soft skills necessary for the successful implementation of construction technologies, as well as the avenues through which students' identities in the construction engineering field can be enriched. Through narrative analysis of the experiences and perspectives of ten virtual design and construction practitioners, this research provides valuable insights into the practical applications and soft skills associated with construction technologies. This study not only contributes to academic discourse but also offers practical implications for bridging the gap between educational curricula and industry demands. By fostering students' professional identity development, academia and industry stakeholders can collaboratively pave the way for a skilled and adaptable workforce ready to embrace the challenges and opportunities of construction technology advancement.

II. BACKGROUND

A. Professional Identity Development in Engineering Education

The development of professional identity in engineering education is a critical aspect of higher education programs, which are charged with the responsibility of preparing students for their future professional endeavors [18]. These programs are tasked with producing graduates who not only grasp theoretical concepts but also demonstrate competence in applying these theories in complex workplace settings [19]. This readiness is crucial for graduates to seamlessly handle the demands of their jobs shortly after graduation, thereby enhancing their employability [11]. The growing emphasis on student employability within higher education has led to a concomitant focus on professional identity development (PID) [20]. Eliot and Turns [21] define professional identity as "personal identification with the duties, responsibilities, and knowledge associated with a

professional role". In addition, Professional identity development can be defined as a continuous process of becoming a professional [22]. Also, Engineering identity can be seen as the extent to which students identify themselves as engineers [23].

Despite the importance of PID, there is a significant gap in understanding the professional identity practices that are crucial for aligning students with construction technologies. Recent studies have begun exploring strategies to prepare the future workforce in engineering fields. For instance, a review by Patrick and Borrego [24] in engineering identity, highlighted a range of theories utilized for Professional identity. Additionally, Castillo, McIntyre and Godwin [25] discussed the integration of project-based learning essentials for supporting engineering students' professional development. Similarly, a study conducted by Liu and Olewnik [26] delved into the assessment of the engineering identity of undergraduate engineering students. The findings suggest that students construct their engineering identities primarily by reflecting on their future career goals while undertaking complex responsibilities [26].

However, despite these advancements, there remains a significant gap in understanding the professional identity practices crucial for aligning students with construction technologies. Existing studies on the factors influencing PID often focus on interviewing students, neglecting the exploration of professional practices that shape the identity of industry professionals. In addition, there is a lack of research investigating the soft skills essential for construction professionals to effectively utilize construction technologies. Motivated by these gaps, our study aims to elucidate the diverse factors that can foster the interest of construction engineering students in construction technology, including the requisite soft skills that help professionals effectively utilize construction technologies. To achieve this, the study conducted semi-structured interviews with construction technology professionals to reflect on their professional identity and its influence on their commitment to the industry. This approach provides a more comprehensive understanding of PID in the context of construction technology.

B. Narrative Theory as a Framework

Narrative theory, grounded in the social sciences, provides a profound understanding of how individuals make sense of their experiences. It is through the articulation of these experiences that people construct their identities [27], encapsulating the essence of individuals' lives and the challenges they encounter [28]. The theory emphasizes the importance of storytelling in shaping one's professional self [29]. As John Dewey highlighted, experience and education are intrinsically linked [30], suggesting that the stories we tell about our professional journeys are not just reflections of reality but also tools for learning and identity formation [4]. It is through the stories of experienced practitioners, that individuals can express their emotions, beliefs, and personal meanings, thereby shaping their professional identities as students [17]. By affording opportunities for individuals to re-author their narratives through reinterpretation, the narrative theory posits the transformative power to redefine identities [29], lives, and the very problems individuals face. Scholars have embraced narrative theory, recognizing its

capacity to extract valuable information embedded in the narratives of research participants [31]. Moreover, Van der Vyver, Nel [32] identified storytelling as a potent teaching strategy for identity development [32]. Expertise in teaching, for instance, underscores the influence of working conditions and cultural contexts on the evolution of professional identities [29, 31]. Narrative analysis serves as a commonly used method for examining the stories of individuals. Narrative analysis, recognized for its relevance in studying careers, posits that individuals come to know themselves through the stories they tell [17, 30], particularly those recounting struggles and triumphs within their professional journeys [30]. By engaging with construction practitioners' stories, students can reflect on their own developing identities and align their educational journey with the realities of professional practice. This research endeavors to broaden the conversation within the construction engineering field by investigating the requisite soft skills necessary for the successful implementation of construction technologies, as well as the avenues through which students' identities in the construction engineering field can be enriched. Thus, the research questions guiding this study will address two key questions:

- What soft skills are essential for the successful implementation of construction technologies?
- In what ways can the professional identity of construction engineering and management students be enhanced towards construction technologies?

III. METHODOLOGY

The proposed research methodology (Fig. 1) is designed to explore the experiences and perspectives of virtual design and construction practitioners who are actively engaged and identified with construction technologies. Through a qualitative approach, the study employed storytelling as a means to delve into the rich narratives of the participants, aiming to capture the essence of their professional practices and insights. A purposive sample of 10 experts, identified for their proficiency with laser scanners and drones, was selected to provide a focused and in-depth understanding of the research questions. Participants completed a demographic survey via Qualtrics, enabling the researcher to selectively recruit professionals with a broad spectrum of experience for the interviews. After the pre-interview survey, participants were asked to select a convenient date for the interview.

These interviews were held at the School of Building Construction at the Georgia Institute of Technology, ensuring a conducive environment for participants to share their stories. Before the interviews, informed consent was obtained from each participant, with the study's ethical considerations being overseen by the Institutional Review Board (IRB) to ensure participant confidentiality and compliance with ethical standards. Data collection involves audio recordings and note-taking from the semi-structured interviews, allowing for a comprehensive exploration of the research questions. The semi-structured interview questions comprised open-ended questions focusing on soft skills that have helped construction professionals to effectively implement construction technologies. Additionally, the interview questions were designed to probe into various factors that have influenced the professionals' interest in construction technology implementation in the construction

industry. For instance, Participants were initially queried about the essential soft skills crucial for the effective implementation of drone and laser scanner technologies, subsequently leading to a request for participants to recount specific instances where these identified soft skills had either positively or negatively influenced the success of their projects during the implementation of these technologies.

On average, each interview session spanned approximately one hour, providing ample time for participants to share their stories and perspectives. Throughout the interviews, participants engaged in discussions ranging from 5 to 10 minutes per question, offering detailed accounts of their experiences and insights. These narratives provided valuable insights into the soft skills essential for effectively implementing construction technologies in the industry. Additionally, participants shared their perspectives on factors influencing their interest (personal motivation) in construction technology and strategies to enhance student engagement with these technologies within the profession.

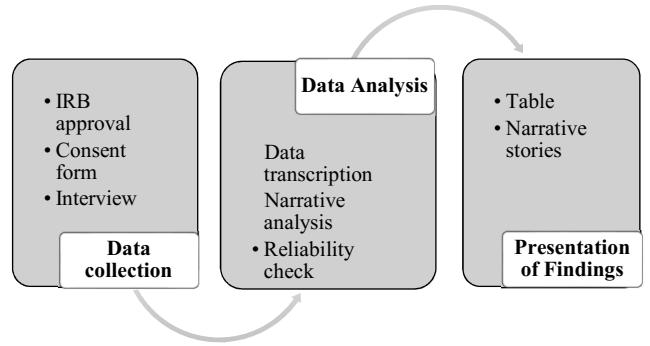


Fig. 1: Methodology overview

Following the data collection, the audio recordings of the interviews were transcribed verbatim using Microsoft Word. The transcripts then underwent a narrative analysis using a deductive phenomenology approach facilitated by NVivo 14 software. According to Savvidou [33], narrative analysis is an approach where professional narrative can be "analyzed as a cultural phenomenon with universal themes and motifs". This process involved familiarizing yourself with the data, cleaning the transcripts, organizing and interpreting the data, and identifying meaning within each story [34]. As motivated by Goodson [35] these meanings form the emerging themes and were categorized and summarized, with the findings presented in a structured manner.

The results were discussed in accordance with the objective of the study in an attempt to answer the research questions from the findings as comprehensively as possible. To ensure the reliability of the results, intercoder reliability (ICR) assessments were conducted. Ten percent (10 %) of the transcripts were allotted to an independent coder, and a level of agreement of 0.9 was achieved. According to MacPhail, Khoza [36], 10 %, and an ICR score of 0.9 is sufficient for qualitative analysis. Codes that did not have a rating of one were reviewed and recorded by the researchers to further solidify the credibility of the study.

IV. RESULTS

A. Participant Demographics

The majority of participants are within the 35-44 years age range, accounting for 50% of the total. The gender distribution is predominantly male (90%). Educationally, all participants held either a Bachelor's or Technical degree, highlighting a high level of educational attainment. All participants were actively employed as practitioners in the construction industry, specializing in Virtual Design & Construction. Regarding industrial experience, two participants, representing 20% of the group, have 1 to 5 years of experience. The majority of participants had between 6 to 15 years of experience, with 30% having 6 to 10 years, and 11 to 15 years of experience respectively. The size of companies represented varied, with 80% of participants employed in large-sized companies and the remaining 20% in medium-sized companies. Notably, all participants exhibited an extremely passionate interest in construction technologies, underscoring their enthusiasm and commitment to driving innovation within the industry. Table 1 shows an overview of participant demographics.

TABLE I. PARTICIPANTS DEMOGRAPHICS

Measures	Demographic Information	No. of Participants	% of Participants
Age	18-24 years	1	10%
	25-34 years	3	30%
	35-44 years	5	50%
	55-64 years	1	10%
Gender	Male	9	90%
	Female	1	10%
Education	Bachelor's or Technical degree	10	100%
Employment Type	Construction Industry Practitioner	10	100%
Specialization	Virtual Design & Construction	10	100%
Industrial Experience	1 – 5 years	2	20%
	6-10 years	3	30%
	11 – 15 years	3	30%
	16 – 20 years	2	20%
Company Size	Large-sized company	8	80%
	Medium-sized company	2	20%
Rate of Interest in Technologies	Extremely Passionate	10	100%

B. RQ1: What soft skills are necessary for the successful implementation of construction technologies?

The analysis of interview excerpts revealed several common themes related to soft skills essential for excelling in laser scanners and drone implementation. These themes include communication, planning, time management, and passion. These soft skills are essential for technology professionals to effectively conduct scanning operations, deliver accurate scan data, and collaborate with stakeholders to achieve project goals. Table 2 captures the key themes, subthemes, and codes from the interview. The themes and excerpts below are extracted directly from the transcript to illustrate the codes under each main theme.

a. Themes 1&2: Communication and Planning

The interviews revealed that effective communication is paramount in laser scanning projects. 100% of the professionals emphasized the importance of clear and upfront communication with clients, stakeholders, or field teams to understand project requirements, expectations, and deliverables. Clear communication helps ensure that the scanned data meets the intended purpose and enables stakeholders to make informed decisions by translating client needs into actionable tasks. This soft skill enables professionals to bridge the gap between technical aspects and client expectations, ensuring successful laser scanning outcomes. Below are a few excerpts from the interviews.

“Communication is the biggest one because if you don't communicate up front with the people who need to make decisions or take action based on the results of your laser scans, you will probably scan the wrong thing or scan it incorrectly.”

“So, it's very important to communicate with somebody who is going to use this data, what are you going to use this for? What questions are you trying to answer? What actions are you trying to take? And now I need to convert that into the product or the result I'm going to give you so that you can make those decisions or take that action.”

It's important to communicate with the client or the field team (Superintendent) during planning. *“Our projects often require tower cranes, which are obstacles for drones. To perform certain activities, we need to fly the drone below the tower frame, a high-risk activity. Communicating the importance of our activity to the site superintendent and crane operator is crucial. They must believe in the results to agree to stop work. For sleeves analysis inspections, we need to be 60 feet above the working deck. It's also important to communicate to workers that drone activity is safe, and they have consented to it during their safety orientation.”*

“So, one time, the field team did not communicate to us that the person they had on the dock was off, and he could not scan. They ended up pouring without us making our quality control check. So, they ended up using a few sleeves which later cost us a lot in terms of money and time, so you see, communication is key.”

Planning is highlighted as another essential soft skill for implementing construction technology. Planning involves thorough preparation before scanning or before flying a drone. Professionals discuss the importance of thorough planning before conducting scans, including reviewing plans and models, conducting site visits, and identifying optimal scan locations. Adequate planning before a drone flight ensures efficient use of resources, minimizes errors, and ensures that adequate data are captured.

“And planning for sure. To expand on that a little. When I go to a laser scan or when someone goes to do a laser scan, I will look at the drawings. I'll look at the model. If there's a model, I will walk out. If the job site is close enough, I'll drive out without the laser scanner and I'll go there myself and I will walk around the site because I want to know and

I want to see with my own eyes, where's the best spot for positioning the scanner, where should I put the target, should I put it here or there. You know or somewhere else."

TABLE 2: ESSENTIAL SOFT SKILLS FOR IMPLEMENTING CONSTRUCTION TECHNOLOGY

Themes	Essential soft skills		
	Subtheme	Codes	Ref.
Communication	-Pre-planning -Clarity of purpose -Team Coordination	-Communicating schedule -Understanding the scope of the work -Communicating important updates	10
Planning	-Site Preparation	-Anticipating Challenges	10
Passion	-Value Recognition	Satisfaction in Work	4
	-Enhancing Interest	Enthusiasm for Learning	
Time Management	-Scheduling	Planning scan times	4
	-Efficiency	Maximizing productivity	
Problem-Solving	Resourcefulness	Troubleshooting	3
	Adaptability Innovation	Overcoming challenges	

b. Theme 3: Passion

Passion is a pivotal soft skill that drives professionals to excel in the implementation of construction technology. It is the fuel that ignites value recognition, inspiring individuals to appreciate the significance of their work and the technology they employ. This fervent enthusiasm leads to satisfaction in work, where professionals are not just content but are motivated to push boundaries and innovate. According to Aimar [27] a passionate individual is “someone in love with a field of knowledge, deeply stirred by issues and ideas. Aimar [27] believe it is a passion that drives people in many different directions toward personal and professional goals. Moreover, it fosters an enthusiasm for learning, which is crucial in a field that is constantly evolving with new technologies and methods. Ultimately, passion is more than just an emotion; it is a professional drive that can lead to higher quality work, innovation, and the successful implementation of cutting-edge construction technologies. The participants said... “*Success in construction technology comes from a passion for construction and technology. The goal is to build cool, great buildings better, simpler, easier, and with great technology. Passion is crucial for embracing technology. Students may not realize their interest in technology until they experience it hands-on. Exposure is key to developing passion.*”

c. Theme 4: Time Management

Time management emerges as a critical soft skill for laser scanning professionals. Professionals emphasize the need to manage time effectively during scanning operations to balance efficiency with quality. Efficient time management involves prioritizing tasks, ensuring that scanning operations are completed within schedule while meeting project deadlines and delivery of high-quality scan results.

“Time management for sure to put in place for them and to have the attention to detail.”

“And then the other one is time management. Some jobs can take forever to scan, you know. So, want to make sure that you know you're going about it efficiently, but you know not so fast that you can affect the quality of the scans.”

d. Theme 5: Problem-Solving

Professionals confirm that lots of unforeseen challenges come with the use of technology. The ability to adeptly navigate obstacles, adapt to new tools, and effectively proffer solutions are crucial skills for professionals.

“Problem-solving is a part of the job I love. At one of my first jobs, I expressed frustration to my senior architect about designing things but never seeing them built. He said, “We've already built it if you figure it out on paper. It's already built in your mind.” This perspective is interesting because if you draw it and it works on paper, you've essentially built it in your head. However, I also enjoy the satisfaction of watching something being built and seeing it go up. As a kid, I used to build towers in the backyard, like a 12-foot tower with footings and a ladder. Sitting on top of something I've built is fascinating.”

“Demonstrating the cool aspects and problem-solving capabilities of technology has been successful in spreading my interest.”

C. RQ2: In what ways can the professional identity of construction engineering students be enhanced towards construction technologies?

The professionals highlighted the strategies for enhancing student interest in construction technologies specifically related to laser scanners and drones, emphasizing the transformative power of seeing the results, the value of hands-on experience, and the importance of professional development such as attending conferences in education and professional identity development. Engaging students with real-world applications and outcomes is highlighted as a key motivational strategy. Table 2 shows the key themes, subthemes, codes, and quotes from the analyzed transcript. Below are the excerpts from the transcript that illustrate each theme.

a. Theme 1: Hand-on Experience

Practical engagement emerged as a crucial aspect of skill development, with practitioners emphasizing the importance of students using technologies firsthand. Likewise, real-world application during higher education was highlighted as an effective method for enabling students to tackle challenges encountered in construction projects.

“How I would like it is that I would get a lecture about this technology and the uses of it. The pros and cons and why we use it, and then we go out, test it virtually, and then get

hands-on experience with the actual equipment that ties it all together.”

“So, I think that will get students interested more in showing them how you actually do the work. A drone is much cheaper than a laser scanner, so probably easier to get hands-on. Flying is the best way...”

Participants underscored the significance of exposing students to real-world applications, fostering a sense of responsibility, and the ability to address issues with accuracy and evidence. Integrating technologies into project workflows was identified as essential for preparing students to navigate modern construction environments effectively. *“I mean, introducing them to the how and why and then... getting the hands-on experience.”*

“Teaching them how to fly the actual drone and then demonstrating it in a real-life application... Give them instructions in writing and let them build it. if we’re building a big, beautiful atrium in a hotel, we’d love to have a datum point where we set the laser scanner and scan before we begin, and then right after we do the same thing and compare the 3D models.”

b. Theme 2: Professional Exposure

Professional exposure through guest lectures, workshops, and conferences was identified as a valuable avenue for providing students with diverse industry insights. This exposure not only broadens students' perspectives but also connects theoretical knowledge with practical applications in the field. *“Inviting guest lecturers from different sets of companies because every company uses technologies differently can provide diverse perspectives. These are professionals who have been using and advocating for these technologies.”*

“Most of my interest was stimulated by professional conferences. Those things were good. Autodesk University or other conferences you get connection to the people to who use the device and get to hear from different people and different ideas.”

Another stated, *“My interest in construction technologies was sparked by professional conferences and mentoring others.”*

c. Theme 3: Seeing the result

Professionals highlighted the importance of seeing concrete outcomes and tangible benefits associated with the implementation of construction technology. Visual demonstrations, such as videos and pictures showcasing the practical applications of technology, were noted to be particularly impactful. These demonstrations offer a clear depiction of the benefits and improvements that technology can bring to construction processes. Additionally, professionals emphasized the effectiveness of before-and-after comparisons, for example, the presentation of point cloud data, which provides visual evidence of the transformative impact of laser scanners on projects.

“Enhancing student’s interests in construction technologies is crucial. ...Like, showing them the cool pictures from drones and the videos, showing them just how cool it can be and the problems that it can solve.”

“The thing that sparked my interest before I used the laser scanner, and this is many years ago seeing the results, so I didn’t even have access to a laser scanner, but somebody showed me a point cloud that was made with a laser scanner showed me how that could be brought into a model and then components could be measured. That, to me, is the most interesting way to convince me that laser scanner is interesting.”

“With laser scanning, I’ve always seen a lot of interest around people seeing the point cloud first. Interest in laser scanning grows when people see the outcome first. Starting with the end result and working backward to collecting data keeps field engineers engaged.”

“And in those cases, showing videos showing examples of the calculations that drones can make and the way that you know, pictures can be stitched together to do volumetric analysis and things like that, that would be my recommendation.”

d. Theme 4: Personal development

Personal development emerged as a key theme, with practitioners noting the importance of instilling a passion for learning, inspiring curiosity, and encouraging exploration. Students who question and seek to understand concepts are better equipped to adapt to the dynamic nature of the construction industry.

“Being present is probably the most important thing. Ask questions. Ask questions beyond what you’re learning...Don’t just learn what you’re being told, learn it, but like really understand it and understand what is this really asked”

TABLE 2 FACTOR STIMULATING INTEREST TOWARDS CONSTRUCTION TECHNOLOGIES

Themes	Factors influencing interest in construction technology		
	Subtheme	Codes	Ref
Hands-on Experience	-Practical Engagement	Using technology firsthand	10
		Use Real-world application	
Professional Exposure	-Guest Lecturers Workshop/ Conferences	-Diverse Industry Insights -Professional Involvement	4
Seeing Results	-Visual Demonstrations -Showing the benefits	-Showing Videos and Pictures -Before and After Comparisons	10
College Technology Classes	Active Learning & Participation	-Student-led problem-solving -Linking theory to practice	7
Personal Development	Passion to learn. Inspiring Curiosity	Questioning and Understanding Exploration	2

e. Theme 5: Technology classes

Active learning and Participation in technology classes were emphasized as crucial for linking theory to practice. *“Enhancing student interest in construction technology is crucial. Introducing them to the benefits of technology in the construction industry can spark their passion.”*

“My passion for technology and exposure to advanced technologies in school motivated me to join Virtual Design and Construction (VDC). Students can develop an interest in VDC by familiarizing themselves with various technologies and talking to people in every class. Exposure to various technologies in school and understanding their applications in construction technology was captivating.”

“We use these technologies in school, and then yeah, that's what got me interested. So, students can get interested by doing the basic courses in the in the school. In school, you have to familiarize yourself with everything out there in every class. VDC. But as I'm in love with VDC because I took the institute courses.”

V. DISCUSSION

The findings of this study offer a roadmap for higher education programs to enrich students' professional identities, ensuring they are well-prepared for their future roles in the construction industry. The narrative analysis of virtual design and construction practitioners' experiences serves as a powerful tool for understanding the practical applications and narratives associated with construction technologies, thereby contributing to the field's body of knowledge and practice. The findings suggest the importance of hands-on experience and real-world application. This finding is similar to Young, Dawes and Senadji [37], who identify engaging with technology firsthand, participating in real-world applications, and integrating technologies into projects are pivotal in fostering a strong connection with the field. Additionally, exposure to diverse industry insights through guest lectures, workshops, and conferences can significantly contribute to students' professional involvement and identity development. By participating in professional groups, students gain exposure to industry insights, engage in mentorship programs, and access resources for continuous professional development. According to Alonso [38], professional membership fosters a sense of belonging, encouraging students to align their values and behaviors with the expectations of the profession [38]. Professional associations or conferences create opportunities to learn about the state of the art and current happenings in construction technologies. Similarly, Hall [39] stated that professional memberships play a crucial role in molding construction engineering students into competent, ethical, and actively engaged professionals. The research also emphasizes the necessity of soft skills for the successful implementation of construction technologies. Communication, planning, passion, time management, and resourcefulness are identified as essential soft skills. These skills facilitate pre-planning, team coordination, and the ability to anticipate challenges, which

are critical for project success. The study highlights that fostering these soft skills, along with technical training, can enhance students' interest and satisfaction in their work, ultimately leading to a more committed and competent workforce.

VI. CONCLUSION

This study has illuminated the multifaceted approach necessary for the development of construction engineering and management students' professional identities in construction technologies. The study emphasizes the importance of planning and communication as key technical and soft skills while seeing the result and hands-on are identified as key motivating factors in enhancing the interest of the students in construction technology. The study further delineates how these soft skills can be incorporated into construction education. The narratives and experiences of construction practitioners provide a valuable roadmap for this development. It underscores the pivotal role of hands-on experience and real-world application in aligning students' skills with industry standards. The integration of technology into educational practices, complemented by exposure to industry insights and professional networking, is essential in cultivating a robust professional identity. Furthermore, the importance of soft skills such as communication, planning, and resourcefulness cannot be overstated, as they are integral to the successful implementation of construction technologies. Moreover, the role of professional conferences and associations in providing avenues for continuous learning and industry engagement is underscored, further enhancing students' professional involvement and identity development. By integrating these findings into educational practices, we can better prepare students for their future roles as engineering professionals. Collectively, these elements can foster a committed and competent workforce equipped to navigate the evolving landscape of construction engineering with confidence and expertise. Ultimately, the study advocates for a holistic educational experience that not only imparts technical knowledge but also instills the values, behaviors, and skills necessary for students to thrive as professionals in the dynamic field of construction engineering and management.

STUDY LIMITATIONS AND FUTURE RESEARCH

One limitation of this study is overlooking the viewpoints of educators or students of construction engineering and management, who are integral stakeholders in shaping the learning environment and curriculum. Exploring the perspectives of educators could offer valuable insights into the strategies and approaches used to integrate professional technical identity into construction engineering education while understanding students' experiences and challenges could provide valuable feedback for designing more effective educational interventions. Therefore, future research endeavors should consider a more comprehensive examination of diverse construction technologies and involve educators and students in the research process. The

study specifically focuses on the development of professional identity in the area of construction technology. Therefore, the selected professionals were chosen for their expertise and active engagement with technology implementation in the construction industry. However, future research should consider incorporating a broader spectrum of construction industry professionals (including experts from other areas within the construction industry, such as management and operations) to capture a more diverse range of views of the professional identity practices needed across different roles within the construction sector.

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