www.itcon.org - Journal of Information Technology in Construction - ISSN 1874-4753

IMPACT OF 360 VR STORYTELLING ON HIGH SCHOOL STUDENTS' UNDERSTANDING AND DECISION-MAKING TOWARDS A CONSTRUCTION PROGRAM

SUBMITTED: February 2025
REVISED: September 2025
PUBLISHED: September 2025
EDITOR: Yang Zou, Mostafa Babaeian Jelodar, Zhenan Feng, Brian H.W. Guo
DOI: 10.36680/j.itcon.2025.065

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SUMMARY: *Many roles within the construction industry, including construction management (CM) careers, are facing significant workforce shortages due to an aging workforce and a decline in the number of young professionals entering the field. An essential strategy to address this challenge is to engage younger generations, particularly high school students, and recruit them into CM career paths. However, many students have limited awareness and interest in the construction industry- often restricted to those with personal connections in the industry - highlighting the ineffectiveness of current recruitment and outreach methods. This study aims to supplement traditional recruitment strategies with a more targeted and effective approach that not only raises awareness of CM career paths but also encourages deeper learning and sustained interest among high school students. Specifically, this pilot and exploratory study explores the use of 360-degree virtual reality (VR) storytelling as an informal learning tool to enhance high school students' understanding of a CM educational program, influence their decision-making regarding enrollment, and foster greater knowledge acquisition and engagement throughout their experience. The 360 VR storytelling experience was developed as an interactive video and shared on social media to attract high school students to a CM-oriented summer program. The video was uploaded two months prior to the start of the program. To assess the effectiveness of the storytelling experience, a mixed-method approach was employed, combining quantitative website metrics analysis with qualitative insights from semi-structured interviews with thirteen high school students. The preliminary findings revealed that the 360 VR storytelling video effectively captured the student's attention, maintained engagement, and drove enrollment decisions by offering an immersive preview of diverse learning scenarios. By examining the extent to which 360 VR storytelling experiences can inform students, guide their choices toward CM-focused academic pursuits, and improve their overall learning experience, this study provides insights into adopting innovative, technology-driven tools that not only attract and engage the younger generations, but also cultivate a well-informed, interested, and prepared future workforce for CM careers and the broader construction industry.*

KEYWORDS: *Construction education, Workforce development, VR storytelling video, Informal learning.*

REFERENCE: *Jingyuan Shen & Jing Wen (2025). Impact of 360 VR storytelling on high school students' understanding and decision-making towards a construction program. Journal of Information Technology in Construction (ITcon), Special issue: 'Smart and Sustainable Built Environment (SASBE 2024)', Vol. 30, pg. 1595-1615, DOI: 10.36680/j.itcon.2025.065*

1. INTRODUCTION

The construction industry remains a critical driver of economic development worldwide, particularly in the United States, where there is a robust demand for construction workers (U.S. Bureau of Labor Statistics, 2022). However, it currently faces a pronounced workforce shortage - particularly in construction management (CM) - as seasoned professionals retire and fewer young generations enter the field (Associated General Contractors of America, 2019). This shortage threatens the industry's ability to meet growing infrastructure demands and impedes innovation design, project delivery, and overall project management (American Society of Civil Engineers, 2017). To ensure the industry's sustainability and growth, it is imperative to attract the younger generation, particularly high school students, at an early stage and provide them with an enriched learning experience that can spark their interest in CM careers and guide them to make informed decisions about pursuing formal educational programs in this domain (Construction Industry Institute, 2018). In this context, engagement and attraction function as key educational activities: by capturing high school students' attention, inspiring curiosity, and motivating exploration, they move students beyond passive information reception toward active knowledge construction.

However, traditional educational methods often struggle to engage and inform high school students effectively, largely because they do not account for the informal learning nature of recruitment efforts (Kolb, 1984). Conventional approaches, such as printed materials, static presentations, and limited hands-on experiences, restrict high school students' opportunities to gain meaningful insights into CM due to a lack of engagement and educational technology adoption (National Research Council, 2012). These shortcomings, compounded by a lack of appealing educational resources, have left many young generations with insufficient knowledge and awareness of the field (Kotler and Keller, 2016). As a result of a fundamental lack of understanding about what a CM career entails and how their professional trajectories might develop, high school students' enrollment interest in construction programs in higher education remains low (Bigelow et al., 2018). Addressing these limitations calls for innovative strategies that cater to the preferences, technological adeptness, and learning styles of today's young generations in an informal learning environment.

Despite recognizing the limitations of traditional educational approaches, existing research exploring innovative informal learning solutions remains predominantly focused on college students or those already pursuing higher education in non-construction majors (Eiris et al., 2018; Sacks et al., 2013). However, research suggested that students at different age groups, especially secondary school students compared to college students, may exhibit distinct cognitive, motivational, and behavioral responses to immersive learning experiences (Makransky et al., 2019; Parong and Mayer, 2018; Queiroz et al., 2022; Yang et al., 2025). It indicated that the finding from university settings cannot be directly generalized to high school students. Moreover, traditional higher-education recruitment is often discussed through a marketing lens, brand programs and competitive positioning (Hemsley-Brown and Oplatka, 2006; Maringe and Foskett, 2002). Limited studies treated recruitment as an educational interaction with clear learning objectives and implementing recruitment efforts as learning experience for students. Furthermore, current assessment practices rarely specify how to measure learning experience for informal educational interventions, resulting in ambiguous insights into their educational impact. Therefore, a targeted investigation into both the effectiveness of immersive informal learning tools and more rigorous assessment strategies is necessary to address these knowledge gaps. One solution lies in harnessing 360-degree virtual reality (VR) storytelling videos as an informal learning tool. Unlike traditional classroom-based learning, informal learning offers a flexible, interactive environment where learners can freely explore and absorb information at their own pace (Manuti et al., 2015; Marsick and Watkins, 2001; Yanchar and Hawkley, 2014). By immersing students in narrative-driven VR scenarios, these VR videos can present realistic construction sites, roles, and tasks, thereby providing a richer, more authentic understanding of CM practices and career pathways, where students can freely explore at a pace that suits them (Radianti et al., 2020). This approach extends beyond the outdated constraints of flyers or word-of-mouth promotion, enabling a broader reach and a more dynamic mode of information delivery. By utilizing cutting-edge VR technology and entertaining, relatable, and shareable narrative content, educators and industry professionals can enhance high school students' interest, deepen their understanding, and ultimately encourage the younger generation to consider further education and careers in CM field (Jiang and Benbasat, 2007).

Building on this premise, this study aims to investigate the effectiveness of 360-degree VR storytelling as an informal learning method to improve CM awareness and understanding among high school students. Ultimately, it seeks to influence their decision-making toward pursuing a CM educational program. Specifically, this

exploratory evaluation seeks to (1) determine the extent to which the 360 VR storytelling video attracts high school students' attention, enhances awareness and comprehension of construction management roles, responsibilities, and practices; (2) investigate how 360 VR storytelling video sustains students' interests and active engagement; (3) examine how the VR storytelling video fosters students' confidence and motivates their exploration toward the CM educational programs. It is important to note that while attracting students' initial attention to construction management careers inherently involve elements of marketing, the primary emphasis in this study is to deepen students' genuine understanding of CM field and to inform them about relevant career paths and educational opportunities, rather than merely promoting specific institutions or building brand recognition. By integrating quantitative and qualitative analysis approaches, this study aims to provide a comprehensive assessment of the transformative potential of 360 VR storytelling videos as a technology-driven strategy for strengthening the CM talent pipeline.

2. PREVIOUS LITERATURE: WHY 360 VR STORYTELLING VIDEOS?

2.1 Informal Learning Method: Online Video

Informal learning constitutes a flexible, self-directed mode of acquiring knowledge and skills outside traditional classroom settings (Manuti et al., 2015; Marsick and Watkins, 2001; Yanchar and Hawkley, 2014). Unlike formal learning, which typically follows a highly structured curriculum and occurs in institutional environments, informal learning is characterized by the student's autonomy in determining pace, content, and context (Evans et al., 2020). Activities as varied as watching educational videos, participating in online forums, or engaging in hands-on projects exemplify the breadth of informal learning. This adaptability makes it particularly effective for promoting deeper understanding and continuous skill development, as students can select topics that align with their immediate interests or professional needs (Mok, 2018).

Online videos represent a powerful medium within informal learning due to their visual and auditory richness (Park et al., 2016; Tazhenova et al., 2024). They can be paused, replayed, and shared, offering learners control over the learning process and facilitating flexible scheduling (Zhang et al., 2006). In the Architecture, Engineering, and Construction (AEC) field, such videos serve as an essential resource for professional development. They provide up-to-date information on industry trends, techniques, and tools, allowing professionals to stay current and competitive (Allen and Seaman, 2010). Additionally, integrating short quizzes, discussions, or Q&A sessions can enhance student engagement, bridging the gap between viewing content and actively reflecting on it (Guo et al., 2014; Zhang et al., 2006). This reflective component is crucial for developing not only foundational knowledge but also critical thinking skills (Merriam and Bierema, 2013). However, the quality and interactivity of online video content vary significantly, creating potential inconsistencies in the reliability and depth of information presented (Guo et al., 2014). To address these challenges, educators and institutions should curate content that is both pedagogically sound and contextually relevant. In the context of introducing high school students to career pathways, ensuring that informal learning resources are engaging, accurate, and relatable becomes particularly critical. When such resources are carefully designed - incorporating narratives that resonate with the student's background, interests, and aspirations - they can serve as a powerful supplement to formal instruction, ultimately guiding students toward more informed educational and career decisions (Manuti et al., 2015; Voulgari and Yannakakis, 2019).

2.2 360-VR Storytelling Video for CM Education

VR has emerged as a powerful tool for enhancing students' comprehension and engagement by immersing them in realistic and context-rich settings. Unlike traditional educational methods that rely on texts, static images, or conventional videos, VR offers a dynamic exploration of complex concepts through simulated virtual environments. This immersive approach deepens both students' cognitive and emotional involvement, providing them with experiences that extend beyond passive reception (Eiris et al., 2018; Jamissen et al., 2017).

Previous literature in CM education has explored interactive VR applications, particularly those aimed at technical training and skill development among students with existing foundational knowledge in CM. For instance, recent studies have demonstrated how VR intervention significantly improve learners' technical competencies, such as interpreting scheduling scenarios (Al-Hussein & Forese, 2023), grasping temporal–spatial relationships in erection sequencing using 4D BIM (Zhang et al., 2024), optimizing logistics layouts and reducing placement errors through

crane simulations (Li et al., 2018), and enhancing cost-estimation skills via live immersive modeling (Petrova & Han, 2018; Mubarak & Nyoni, 2022). These interventions are typically designed for students already enrolled in CM programs at the postsecondary level.

Within the broader context of immersive VR applications, 360 VR videos represent a distinct category. Unlike fully digital simulations, 360 VR utilizes panoramic video footage captured directly from construction sites, offering several unique educational advantages. First, 360 VR provides authentic representations of real-world environments, capturing accurate scale, spatial layout, and realistic site conditions (Eiris et al., 2018). Second, it is comparatively more accessible and cost-effective, requiring only commonly available devices such as smartphones or laptops, without the need for specialized VR hardware (Abichandani et al., 2019; Ausburn and Ausburn, 2004; Wen and Gheisari, 2020). Third, the visual realism of 360-degree videos effectively contextualizes abstract CM concepts, supporting students' comprehension of complex topics (Eiris et al., 2018).

Furthermore, the immersive 360-VR video is enriched with crafted narratives that guide students through the experience, which is referred to as 360-VR storytelling. Storytelling plays an integral role by contextualizing abstract concepts within relatable scenarios (Jiang and Benbasat, 2007). It promotes emotional engagement and increases career self-efficacy among high school students, and especially for girls, who might otherwise view CM as a unfamiliar or inaccessible filed (Cheryan et al., 2013; Gladstone et al., 2024; Shachnai et al., 2022). For instance, a narrative-driven 360-VR video might feature professionals working on a construction site, complete with ambient sounds, realistic spatial perspectives, and role demonstrations. Such narrative frameworks help students understand not only the technical aspects but also the human elements behind construction work, such as the sense of achievement that comes with their work (Wen and Gheisari 2021). With the help of widespread platforms like YouTube and Facebook, 360-VR storytelling reaches a diverse audience. By delivering immersive, narrative-rich content online, educators ensure that even students in remote or under-resourced areas have access to real-world construction environments (Abichandani et al., 2019; Ausburn and Ausburn, 2004; Wen and Gheisari, 2020). Because of enhanced realism, wide accessibility and enabled emotional connection between students and the storytellers, 360-VR storytelling can be deployed as a powerful recruitment and outreach tool.

Despite the potential of 360 VR in CM education, existing research on its application remains limited, and most studies focus on college-level learners engaged in technical training. To date, few studies have systematically examined the use of 360 VR videos as informal educational tools for recruitment or outreach purposes. Specifically, there is a notable gap in research exploring how 360 VR storytelling might support early-stage exposure and engagement among high school students who have little or no prior familiarity with the CM discipline. This study aims to fill this gap by targeting high school students who have not yet declared a major and are actively exploring their future career paths.

3. RESEARCH METHODOLOGY OVERVIEW

This study aims to investigate the effectiveness of 360-degree VR storytelling as an informal learning method to improve CM awareness and understanding among high school students, ultimately influences their decision-making toward a CM educational program. The CM summer program at the School of Building Construction at Georgia Tech was selected as the test case. To address this goal, this study follows the following research steps: content generation, platform development, and evaluation (Figure 1). The objective of the content generation phase was to capture and generate the necessary content to develop the immersive platform and create intriguing stories of the storytellers. The story narratives were created based on semi-structured interviews with previous participants in the CM summer program. The virtual storyteller was designed as a high school student who participated in last year's program. The spatiotemporal contexts of the program environment (e.g., classrooms and construction jobsites) were used as the integral component where the story happens, and the storyteller would lead the stories. Next, in the platform development phase, the immersive environment was developed, and the virtual storyteller was modeled and animated to narrate the generated story. Then, the story was exported into a 360-degree omnidirectional environment to create a 360 VR storytelling video and thereafter was uploaded to YouTube. In the evaluation phase, website traffic-related data was collected to analyze the extent to which the VR storytelling video attracts high school students' attention and sustains interest in the CM summer program. Moreover, to assess its effectiveness in enhancing students' knowledge acquisition and engagement within this informal learning setting, semi-structured interviews were conducted to gather their perceptions and learning experiences with the 360-degree VR storytelling video.

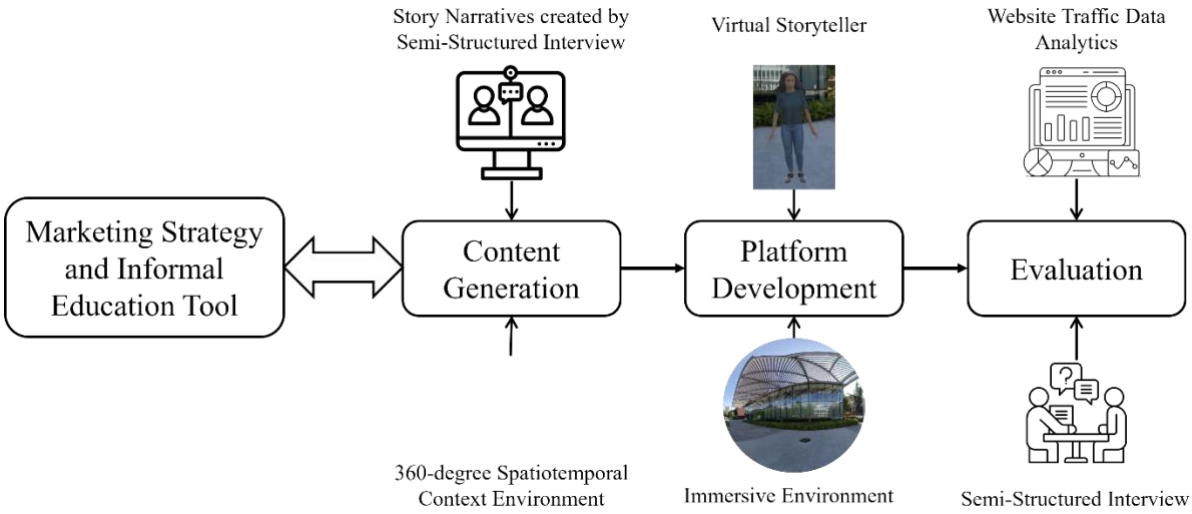

Figure 1: Research Methodology Overview.

4. 360 VR STORYTELLING VIDEO CONTENT GENERATION

To create intriguing stories of the storyteller, semi-structured interviews were conducted with former CM summer program participants. The interviews aimed to collect authentic information and valuable insights from the participants, focusing on their personal experiences in the summer program, recruitment-related challenges, and overall impressions. A set of questions was carefully crafted to ensure a thorough exploration of the interviewees' opinions, with a focus on identifying the information they most sought before participating in the program. Examples of such questions include: (1) What did you feel before participating in this summer program and why? (2) What information did you learn about this summer program before it started? Do you think this information was enough for you? (3) Is there any additional information you would have liked to know before the summer program that we didn't address?

To recruit interviewees, emails were sent to former summer program participants and their parents following the reviewed and approved protocol (H23419). Consent forms were included to request permission for participation in a post-program interview, either for themselves or on behalf of their child. After receiving consent forms, interviews were scheduled and conducted online. Following the interviews, transcripts were created to capture the insights of the interviewees regarding their experiences and thoughts. In-depth interviews typically involve a small number of participants, ranging from 5 to 30, until additional participants no longer yield new insights (Bhale, 2023). In this study, six participants were interviewed, including one 11th-grade student and five 12th-grade students. The gender distribution was balanced, with three males and three females. Among them, only one participant had prior knowledge of the construction field, owing to a family history in construction and personal experience on construction sites. Regarding how they learned about the program, two female participants discovered it through their own online research, stumbling upon the website, while the other four were informed by their parents or family members through flyers or posters.

Subsequently, story narratives were drafted using narrative analysis, where activities and events gathered from the interviews were analyzed. This analysis informed the creation of the story and helped establish the context; ultimately, the interpretive findings were synthesized into one personal experience narrative (Mccormack, 2004; Wen and Gheisari, 2022). In this story, the virtual storyteller was defined as a high school girl in her 12th grade. Recognizing the male-dominated nature of the construction field, this storyteller's design aimed to enhance the appeal of the summer program to girls by not only highlighting shared interests between boys and girls but also addressing concerns and interests specifically relevant to girls. The story structure was segmented into three elements: the beginning, middle, and end (B.Ohler, 2013). This structured approach ensures a coherent and engaging progression throughout the story. Table 1 summarizes and demonstrates different story elements. At the beginning, the storyteller introduces herself and sets the story's goal, helping the audience understand the background. In the middle, the storyteller shares the knowledge and experiences gained from the summer program.

Finally, at the conclusion of the story, the storyteller reflects on her transformation and shares her understanding of the construction field. To ensure the narrative's effectiveness and relatability, it was reviewed by six individuals from a similar age group, who found the story to be interesting, well-organized, and easy to understand. This positive feedback further underscored the success of the storytelling approach in engaging and clearly conveying information to a high school-aged audience.

Table 1: Summary of story narratives.

Story Element	Story Narrative Summary
Beginning of the story: An introduction of the virtual storyteller	The virtual storyteller shares her transformative experience at a building construction summer program, which sparked her interest in the field before college.
Beginning of the story: The flat and ordinary life have been moved to a new experience	The virtual storyteller with a STEM background enrolls in the building construction's summer program, intrigued by the leadership and technology aspects, and finds the experience interesting despite initial nervousness.
Middle of the story: Site visits	Visiting construction firms and sites is a highlight for virtual storyteller in the summer program, including participating in practical cost-estimating exercises, learning about various roles in construction management, and experiencing a hands-on exploration of floor plans and real-time construction at a multifunctional building site.
Middle of the story: A mixer with industry professionals	The virtual storyteller relishes the opportunity for personal interaction with construction industry professionals at the program, which broadens the understanding of construction management and the diverse career paths within the industry.
Middle of the story: Gain lab/tech experience	The virtual storyteller enjoys a thorough introduction to construction technology, including masonry 3D modeling, drone operation, and meeting a robotic dog, leading to an insightful hands-on experience of building a masonry wall with concrete blocks and cement.
End of the story: Closure	The virtual storyteller gains a comprehensive understanding of construction beyond the basics, appreciating the field's diversity and technology. The integration of lectures, hands-on activities, and advanced technologies, along with making new friends, solidifies virtual storyteller's decision to pursue construction management.
Story Element	Story Narrative Summary

5. 360 VR STORYTELLING VIDEO PLATFORM DEVELOPMENT

In this step, a platform was developed using the game engine Unity, where it integrated an animated 3D character that represented the storyteller, and the 360-degree panoramas that provided the immersive contextual story background. Then, the integration of these components was recorded and exported as the 360 VR storytelling video.

A deliberately selected 3D avatar portrayed a female African American high-school student. This counter-stereotypic representation was chosen to provide a visible role model for groups historically underrepresented in construction management, an industry still dominated by white males (Cheryan et al., 2017; Dasgupta and Stout, 2014). Research consistently suggests that employing counter-stereotypic role models, such as female and people of color, in STEM outreach can effectively challenge prevalent stereotypes, increase perceived similarity, and improve career self-efficacy and career interests among underrepresented groups (Cheryan et al., 2017; Dasgupta and Stout, 2014; Gladstone et al., 2024; Shachnai et al., 2022). The storyteller's animation was created using Blender, a popular 3D graphics software favored by animation creators. Blender was chosen for its comprehensive toolset, which includes rigging, animation, and rendering capabilities (Wood, 2022). Additionally, the animated character can be easily exported to Unity for further development. The 3D character was animated with a variety of hand gestures and movements to replicate the rich non-verbal cues commonly used by storytellers (Salem and Earle, 2000). In this study, the virtual storyteller was programmed to perform gestures such as waving, walking, natural hand movements while speaking, pointing forward, pointing behind, and resting in an idle position. Each gesture was carefully synchronized with the narrative. For example, when the storyteller discussed how she discovered the summer program, a forward-pointing gesture was timed to emphasize this specific part of the story. All animations were created in Blender and then exported to Unity for further integration.

Meanwhile, specific 360-degree panoramas were identified to create immersive backgrounds that enhance the comprehension of the story narrative. In this study, twelve panoramas were selected to effectively convey various story contexts, including the campus environment, interior and exterior views of the home building of the School

of Building Construction, classrooms, labs, and various construction jobsites. All panoramas were captured directly by the research team with an Insta360 ONE X2 camera. After on-site capture, the raw panoramic footage underwent standard post-processing using Insta360 Studio software. These processed panoramas were then imported to Unity and rendered as 360-degree panoramic environments, where the imported equirectangular images were projected into spherical visualizations with the viewers' perspectives in the center of the sphere. Finally, the 360-degree immersive environments and the virtual character were carefully programmed according to the story narrative to harmonize the overall experience. The entire story was recorded as a 360 VR video and then uploaded to YouTube for usability test. The usability test utilized the standard System Usability Scale (SUS) to evaluate overall ease of navigation, learnability, and interactivity. This study designed the entire user journey, from the initial thumbnail click, to the manipulation of the 360-degree video within YouTube, and finally to the in-description link directing users to the summer program's main website and application page. As this experience spans multiple websites and guided pathways, it is considered a system-level interaction rather than a standalone YouTube video. The SUS is a validated and widely adopted instrument, demonstrating reliability across diverse interactive digital systems, including web services, mobile applications, and virtual reality experiences (Admin, 2017; Fijačko et al., 2023). The usability test used ten-item format enabling rapid assessment without overburdening participants. Participants rated ten statements such as 'I found the system unnecessarily complex,' and 'I felt very confident using the system.' Each item was rated on a five-point Likert scale from 'strongly disagree' to 'strongly agree,' ensuring a comprehensive assessment of usability. Ten participants were recruited and randomly assigned to one of two device conditions: a desktop computer with mouse interaction, or an iPad using finger swipes. This dual-device setup allowed us to verify that the video's interactive controls and visual quality were consistent across both pointer-based and touch-based platforms. After testing with ten randomly selected individuals on campus, the usability scale resulted in a score of 72.5, which is above the average usability score of 68 (Will, 2017). This suggested that the video was easy to comprehend and interact with, and the audience would be likely to feel comfortable watching it.

6. EVALUATION PROCESS

The evaluation process included a quantitative descriptive analysis of website variables and a qualitative approach. The website-related data were analyzed to present the attraction function of the 360VR storytelling video. In this study, YouTube (Figure 2.a) was selected as the platform for hosting the 360 VR storytelling video due to its wide audience reach and detailed analytics on the video. This allowed the research team to track website traffic data and visitors' behavior-related data in depth (Figure 2.b). The link to the School of Building Construction's summer program homepage was embedded in the video description on YouTube to direct audiences to the summer program application page. This webpage (Figure 2.c) offers more detailed information about the summer program, its application process, and requirements. Meanwhile, this summer program homepage also hosted the 360 VR storytelling video that was published on YouTube. The performance of the summer program homepage was tracked by Google Analytics, providing the research team with access to real-time reporting, audience insights, acquisition reporting, and behavior analysis data (Figure 2.d). Additionally, the qualitative evaluation approach involved semi-structured interviews to gather insights from video audiences, reflecting their subjective assessments of the 360 VR storytelling video as an informal learning tool.

6.1 Data Collection Process

To gather quantitative data on relevant website variables, the research team first employed a multi-faceted recruitment strategy to ensure broad and diverse dissemination of the 360 VR storytelling video. While online dissemination inherently reaches a wide general audience, additional efforts were made to specifically target the study's intended audience, high school students, through specific recruitment channels. Firstly, the research team employed digital strategies, including targeted email outreach and engagement on social media and online platforms. Personalized emails were sent to colleagues in relevant departments across the institution, providing a brief overview of the summer program, a link to the video, and a request for their assistance in reaching out to high school teachers, students, and parents who might benefit from the program. Additionally, emails were sent to attendees of academic and professional conferences, highlighting the video's relevance to high school education and youth development, and encouraging them to share it with potential participants and stakeholders. To further extend our reach, the research team harnessed the power of social media and online platforms. Engaging posts

were created and shared on LinkedIn, Facebook, Twitter, Instagram, and Craigslist featuring compelling information, QR code, and a link to the video, encouraging users to watch and share it within their networks.

In addition to the digital efforts, physical distribution strategies were implemented to reach local communities directly. Flyers, including compelling information and a QR code to the video, were distributed at Young Men's Christian Association (YMCA) branches and local community gyms, leveraging connections with families and young people who might be interested in the summer program. Moreover, flyer boards were strategically placed near key event locations on the university campus, such as community fairs and sports events, to attract the attention of parents and high school students. This approach ensured that the video was visible in high-traffic areas, thereby increasing the likelihood of participant engagement. Meanwhile, in-person distribution was conducted at high school events, such as STEM outreach events in local high schools. Flyers were handed out directly to high school students and their families, targeting the group particularly likely to be interested in the summer program.

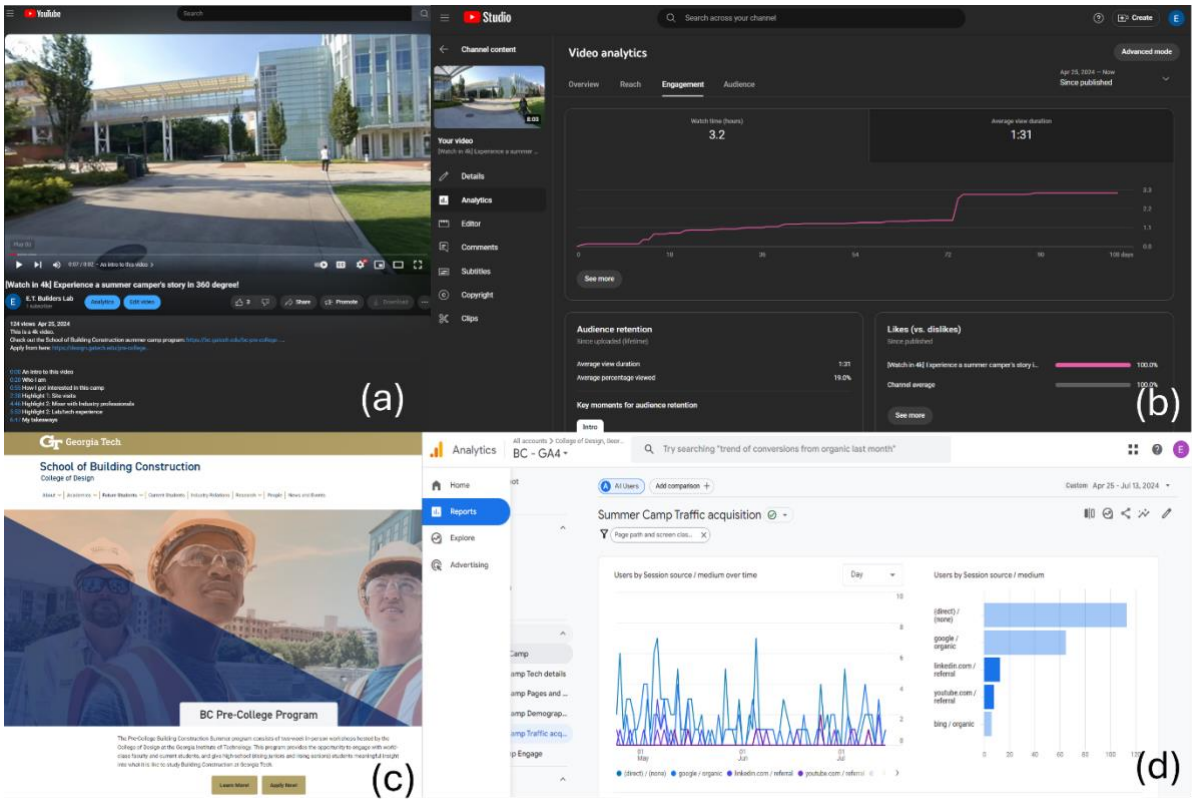

Figure 2: Webpages analyzed in this study.

By combining these diverse dissemination methods, comprehensive and effective recruitment strategies were employed to maximize the reach of the video. The video was published on April 25th, 2024, marking the start of the data collection period, which continued for 12 weeks until the summer program began. By the end of the data collection period, the video has received 124 views.

To collect qualitative data through semi-structured interviews, the research team recruited students who had watched the 360 VR storytelling video from among the 2024 summer program participants. While acknowledging the potential biases of this approach, the research team noted that, due to the anonymous nature of the video dissemination, it was challenging to select and contact a broader video audience randomly.

6.2 Study Measurements Metrics

To determine the extent to which the VR storytelling video attracts high school students' attention, sustains interest, and motivates explorations toward the CM educational program - this study analyzed quantitative variables including (1) website traffic and (2) website visitors' behavior-related indicators.

- Website traffic refers to the volume of viewers on a site over a period of time (Stephan, 2023). Tracking website traffic helps measure the impact of online content, such as videos, on attracting viewers to visit the website (Bucklin and Sismeiro, 2003; Chatterjee et al., 2003; Zhou et al., 2022). It is a primary measure of the video's reach and initial impact, indicating how many audiences are drawn to explore the summer program's website after watching the video, suggesting an initial interest in the decision-making process. In this study, the view count of the video was utilized to measure the website traffic.
- Website visitors' behavior-related indicators are all the actions visitors take on the website; specifically, these actions are measured by how long visitors interact with the site, where they click, and how they scroll down a page (Hotjart, 2024; TermsFeed, 2024). They provide deeper insights into how audiences interact with the video and summer program website, indicating the level of interest and immersion the video generates and reflecting a progression from initial interest to serious consideration of participation (Goldfarb and Tucker, 2011). These indicators are widely used by higher education institutions to assess the effectiveness of their strategies in capturing and retaining visitors' attention, ultimately driving them to take desired actions, such as seeking more information (Bello-Bravo et al., 2021; De Vries et al., 2012; Macca et al., 2024). In this study, the click-through rate (CTR), watch time, the returning viewer amount and engagement rate were used to directly measure the effectiveness of video in capturing the audience's attention and motivating them to engage with the video and explore further information with sustained interests.

To examine how the VR storytelling video enhances informal knowledge acquisition and influences students' decision to pursue the CM educational program - this study analyzed the audience's perception and attitude from interviews about their learning experiences with the video, which directly reveals how much the audience enjoyed the promoted content, how it influenced their perception, and how it shaped their motivations to take further actions (Culshaw, 2021; Mattock et al., 2020). Since semi-structured interviews support an environment that is free of pressure and aligns with the characteristics of informal learning - flexibility, learner-driven, and contextual relevance - this study utilized semi-structured interviews as a qualitative method of assessment. The interview questions allowed the research team to gather detailed insights into the emotional and cognitive responses of audiences, revealing the 360 VR storytelling video's impact on the audience's knowledge acquisition and enhanced engagement. Knowledge acquisition was assessed by understanding how much information the audience retained (Guo et al., 2014; Lee et al., 2021). Engagement was gauged by the video's ability to maintain the audience's focus and forge an emotional connection, reflecting their interest and enthusiasm for the CM-oriented program content. There are various approaches to measuring knowledge acquisition and engagement, such as multiple-choice questions, task performances, engagement time measurements, and interviews (Hod-Shemer and Sher, 2021; Nyquist and Jubran, 2012; Voulgari and Yannakakis, 2019). Among these approaches, semi-structured interviews are specifically tailored to allow participants to elaborate on their thoughts, enabling the research team to capture detailed, in-depth insights from the audience (Hod-Shemer and Sher, 2021).

7. EVALUATION RESULTS AND DISCUSSION

7.1 Quantitative Analysis

To determine the extent to which the VR storytelling video attracts high school students' attention, sustains interest, and motivates explorations toward the CM educational program, this study analyzed website traffic and website visitors' behavior-related indicators. Specifically, website traffic and visitors' behavior-related data reflected the following two websites' performance in 12 weeks. Focusing on both the 360 VR storytelling video (i.e., YouTube) data (Figure 2.b) and the summer program homepage data (Figure 2.d), the research team could observe the traffic between these two pages (Figure 2.a &c), extract direct information and obtained insights on how the video played the role in audiences' decision making (i.e., further exploring the program) process. The following sections analyze the website traffic and website visitors' behavior-related indicators data.

7.1.1 Website Traffic

View count measures the total number of times a video has been watched (YouTube Community, 2023). According to YouTube analytics, the 360 VR storytelling video received a total of 124 views, with 57 views (46.0%) coming from direct URL entries and 51 views (41.1%) originating from external referral sources. Direct entries are generated by the video's shareable QR code and URL link that are incorporated within dissemination materials

such as posts and flyers, and external referral sources typically originate from gatech.edu, craigslist.org, LinkedIn, and Google. In Google analytics, a referral view is recorded when a user (1) encounters the video hyperlink or embedded player on an external source (e-mail, craigslist.org, LinkedIn post, etc.) and then (2) intentional clicks on it to watch. This process requires two steps: effective multi-channel dissemination delivers the video link or thumbnail to potential viewers, and the video's presentation (e.g., thumbnail and title) must be compelling enough to convert that impression into an actual view. Thus, referral views can only occur when both dissemination efforts and video appeal are present. In this sense, referral views serve as indicators of both successful dissemination and the video's ability to attract attention. The 360 VR video generated 51 referral views, representing 41.1 % of all views. Compared to 46% of views coming from YouTube direct URL entries, this proportion suggests that the immersive thumbnail attracted viewers' attention in addition to the dissemination effort. The video's direct influence on the audience's decision-making was demonstrated by the 15 visits to the summer program homepage that originated from the 360 VR storytelling video, making it the second-highest referral source for the program's webpage. This direct referral from the video to the program's homepage highlights its effectiveness in successfully encouraging audiences to seek more information about the summer program and consider participating.

Beyond referral traffic, 16 views were generated through YouTube searches and promotions, with 7 views (5.7% of total views) specifically linked to the search term "summer program." These search-driven views reflected the video's visibility in relevant search queries, further supporting its role in attracting potential students. The subsequent analysis of website visitor behavior indicators will provide a deeper understanding of how effectively the video motivated the target audience and influenced their decision to apply for the summer program.

7.1.2 Website visitors' behavior-related indicators

Website visitors' behaviors are all the actions visitors take on the website; specifically, these actions are measured by the click-through rate (CTR), watch time, engagement rate, and returning viewers amount in this study (Table 2).

In this study, there are two CTR: one from YouTube, one from Google Analytics. YouTube CTR is the percentage of impressions that converted into views, meaning the proportion of users who clicked on the video after seeing its thumbnail (Analytics, 2024). The thumbnail was a still frame from the 360 VR video. It displayed a wide-angle campus view and included YouTube's native "360°" overlay icon, which visually signals to viewers that the content offers an immersive experience (Figure 3). Prior research has shown that thumbnails act as critical determinants of initial engagement, functioning as the first impression that influences whether a viewer chooses to engage with content (C&I, 2024; Dong, 2024). The CTR on the thumbnail offers insight into how visually attractive and engagement-provoking it was. For immersive media like 360 VR video, thumbnails have been found to generate higher user engagement and improved CTR compared to the thumbnail of traditional 2D video (Ausin-Azofra et al., 2021; Bujić et al., 2023; Koh and Cui, 2022). In this study, the video received 16 clicks from 105 thumbnail impressions on YouTube, yielding a CTR of 15.2%. Google Analytics CTR refers to the percentage of clicks on the embedded 360-VR video within the summer program webpage. This metric captures the click behavior specific to the video as presented on that page. The video received 33 clicks from 238 page views, resulting in a CTR of 13.9%. Additionally, according to YouTube analytics documentation (YouTube Help, 2025), videos shown to narrowly targeted audiences often experience CTR values that remain within, or even below, the standard platform-wide range (2 - 10%). Moreover, recent independent benchmarking studies report the average CTR near 4-5 %, with values above 8% considered strong performance, even within educational contents (Stojanovic, 2022). In comparison, the CTRs observed in this study (15.2% on YouTube and 13.9% on the program webpage) are well above these benchmarks. This suggests that the 360-degree VR video was particularly effective in capturing viewers' attention, indicating visual appeal beyond the baseline impact. Furthermore, 15 of the 124 viewers (12.1 %) clicked the in-description 'summer program' link, indicating video's outreach value. It showed that nearly one in eight viewers were motivated to take an intentional step toward learning more about the program. This behavioral progression from watching to exploring program information aligns with previous studies on video-mediated recruitment, where click-through behaviors serve as reliable indicators of interest and engagement (Bello-Bravo et al., 2021; Goldfarb and Tucker, 2011).

Watch time refers to the amount of time (in minutes) that viewers have watched a video for the date range (Bello-Bravo et al., 2021). The 8-minute video had an average view duration of 1 minute and 31 seconds, with an average view percentage of 19% during the data collection period. Although the average view duration of 1.5 minutes seems relatively short given the video's length, it still demonstrates considerable audience retention time compared

to other YouTube videos of similar duration, which typically retain viewers for about 1 minute. It should be noted that a longer view duration does not necessarily imply active engagement, as audiences might leave videos playing in the background without truly watching them (YouTube Help, 2024a). To address this, audience retention was also analyzed in conjunction with the view duration. Audience retention data highlights how specific moments in the video capture audiences' attention, represented as a percentage of total views (YouTube Help, 2024a). The 360 storytelling VR video had a retention rate of 51% around the 30-second mark and consistently exceeded 13% from the second minute onward. Notably, between 2 and 5 minutes, the video achieved above-average retention rates of 17% to 22% compared to other videos of similar length. This demonstrates the effectiveness of the 360 VR video in capturing and maintaining audiences' attention.

Figure 3: Thumbnail of 360 VR video.

Engagement rate is a key metric that represents the percentage of sessions where users actively interacted with the content, as defined by sessions lasting longer than 10 seconds, including key events or multiple page views (Analytics, 2024). For instance, if a website visitor stays on a website for more than 10 seconds and clicks on a link to another page, this session qualifies as an engaged session. A high engagement rate indicates that viewers are spending more time and showing greater interest in the information provided (Analytics, 2024). In this study, a higher engagement rate suggests a higher likelihood of these visitors participating in the summer program. According to the data collected from the summer program website, there were 391 page views directed from various sources, such as direct clicks from the school's homepage, Google search, LinkedIn, and YouTube referrals. Among these sources, visitors from the YouTube video demonstrated the highest engagement rate at 90%, indicating a significantly higher level of interaction with the summer program's web pages compared to visitors from other sources, such as direct links (62.2% engagement rate) and LinkedIn referrals (50% engagement rate). Moreover, the engaged sessions created by audiences who watched the YouTube video attained the highest rate of 1.13, with Google search visitors following closely at 0.97. Such a high engagement rate of YouTube referrals highlights the effectiveness of the 360 VR storytelling video in motivating the audience to interact with the contents on the summer program website and enhancing their inclination to participate in the program. While high engagement rates highlight the 360 VR storytelling video's ability to capture initial interest, the returning viewers offer deeper insights into its effectiveness in influencing and reinforcing decision-making among the audience.

Returning viewers are those who have previously engaged with the video and have chosen to watch the same video on two or more separate occasions within a specific time period (YouTube Help, 2024b). YouTube recorded 31 returning viewers (25 % of 124 total views). A higher number of returning viewers means that the contents are attractive and compelling enough to keep the audience coming back. Scholars considered such returning behavior as an indicator of enhanced emotional connection, suggesting that viewers often re-watch educational videos

because they evoke interest, positive emotions, or a desire to reinforce an emotional connection to the narrative or content of the video (Brame and Perez, 2017; Jong et al., 2020; Liu et al., 2020). Moreover, in our study, some interviewees stated that they re-watched the video because they "felt connected to the storyteller," "wanted to re-experience the sites," or "showed it to friends." These self-reported behaviors and expressions align with the literature, suggesting supporting the inference that 31 returning viewers (25 % of total viewers) were affectively engaged. The presence of over 100 views alongside these returning viewers highlighted the video's effectiveness in not only attracting a fresh audience but also in retaining viewers who are likely to consider their decisions about the summer program.

Table 2: Summary and highlights of website visitors' behavior-related indicators.

Analyzed websites	Performance			
	CTR	**Watch Time**	**Engagement Rate**	**Return viewers**
360 VR storytelling video on YouTube	15.2%: Higher than the average CTR range (2% -10%) for YouTube videos	19% view duration: Considerable audience retention time compared with other YouTube videos	NA	31 returning viewers (25% of total views): standard range observed in educational contents videos (20% - 40%)
Summer Program Website	13.9%	NA	90% engagement rate for those visitors referred by the video: Visitors referred by the video presented the highest engagement rate, compared with visitors from other sources	NA

Overall, high initial traffic (124 views) and high CTR (15.2%) indicate that the video effectively captures students' attention and generates initial interest, which represents the critical first step in the decision-making process. Once the video captured attention, it played a crucial role in deepening the audience's understanding of the program. This enhanced understanding served as a foundational step in the decision-making process (Schlosser, 2003), thus making the idea of attending more concrete and appealing. Supporting evidence includes the average viewing duration of 1 minute and 31 seconds YouTube 360 VR video, which indicates substantial viewer engagement with the 360 VR content and suggests improved comprehension of the presented topics. Additionally, user engagement on the summer program website is measured separately via Google Analytics. Specifically, the website engagement rate, as recorded by Google analytics, showed a 90% engagement rate, higher than average engagement rates (17% to 22%), which measures users' interaction with website content. Beyond cognitive engagement, emotional response is another critical aspect of decision-making, as it moves beyond rational consideration to create a desire to participate in the experience, which is a key motivator in audience behavior (Lerner et al., 2015; Pham, 2007). This emotional engagement can yield significant impact, especially within educational or experiential contexts, as individuals are attracted to the promise of positive emotions such as excitement, anticipation, and reassurance. In this study, the website variables showed that emotional appeal not only influenced students' initial decisions but also sustained engagement. The high number of returning viewers (31 returning viewers out of 124 total viewers, i.e. 25%) from the video suggests that the emotional connection established through the video encourages viewers to revisit the content, further reflecting on their decision and maintaining their interest in attending the program. In addition to the immediate effects, the emotional component was linked to long-term engagement and loyalty, as emotional experiences tend to leave lasting impressions that motivate continued interaction with the content (Bagozzi et al., 1999).

7.2 Qualitative Analysis

To qualitatively examine the role VR storytelling video played in knowledge acquisition and decision-making process, this study analyzed targeted audiences' (i.e., high school students) attitudes and insights gathered from interviews. Semi-structured interviews were conducted with summer program participants who had watched the 360 VR storytelling video prior to the program. These interviews were held at the very beginning of the summer program to eliminate the impact of the CM summer program curriculum.

7.2.1 Participants' demographics and background

Thirteen students (10 male and 3 female), with an average age of 16 years, participated in the interviews. Five students (38.46%) were in 12th grade, and eight (61.54%) were in 11th grade. The majority of students (92.31%) completed at least five STEM courses and indicated having a solid background in architecture and engineering. Twelve students mentioned they had previous experience with 360-degree videos or VR games. None of the students had prior summer program experience in the construction field; however, six students (46.15%) had family members working in the construction field.

7.2.2 Knowledge acquisition

In this study, knowledge acquisition refers to how effectively students gained and understood the information presented in the 360 VR storytelling video. The interview questions were adapted and refined in this study to evaluate the video's effectiveness as an informal learning tool for knowledge acquisition (Bello-Bravo et al., 2021). The interview results revealed that the 360 VR experience, as an educational tool, support knowledge acquisition through its immersive nature and compelling storytelling. This was achieved by (1) creating an immersive learning environment, (2) reducing cognitive load and improving information retention, and (3) maximizing content relevance while fostering self-reflection throughout the storytelling experience. While the study did not include a pre-intervention knowledge test, the insights reflect participants' perceptions rather than a measured gain in factual knowledge.

- Creating an immersive learning environment: The 360 VR video provided an immersive learning environment that allowed students to virtually experience the summer program, offering a level of realism that is unattainable from traditional media formats (Radianti et al., 2020). Traditional learning tools often rely on static images or text to convey information, which can limit students' ability to fully visualize complex spatial information. In contrast, immersion enabled students to observe the program's physical spaces and activities vividly, augmenting their spatial awareness and understanding of the abstract and unfamiliar context in the construction management field (Lin et al., 2024). This was evident from students' consistent responses during the interviews, stating that, "The ability to observe my surroundings and explore different construction sites gave me a good understanding of what this program is about." The 360-degree view in the video effectively bridges the gap between abstract concepts, unfamiliar environments, and real-world expectations, enriching their comprehension of the program's structure and activities.
- Reducing cognitive load and promoting information retention were also observed during the interviews. Several students reported that the VR experience made the information "stick" effectively, as they were able to describe "details of the activity in the video." The multisensory nature of the VR video makes the content memorable, facilitating retention of the presented information, which is a critical process of knowledge acquisition (Guo et al., 2014). This aligns with the finding from existing literature, which suggests that the combination of visual, auditory, and interactive elements in the 360 VR video strengthens memory encoding and retrieval processes (Mayer, 2009). It should be noted that these impressions were recorded immediately after viewing the video. These exploratory results provide preliminary insights into how effectively the 360 VR video facilitated immediate recall and memorability.
- Maximizing content relevance and encouraging self-reflection through storytelling: Another integral element in the video is the storytelling aspect. The narrative component delivered by the virtual storyteller strengthened students' concentration on the contents by providing personal learning experiences, which made the contents more relatable and believable. Additionally, the video promoted students' self-reflection, helping them internalize new information and relate it to their own interests, expectations, and potential learning outcomes in the summer program, thereby enhancing knowledge acquisition. One student mentioned, "After hearing the girl's story, I knew more about what I can get out of the program as I had a similar situation to hers (i.e., not knowing anyone in construction, not having any previous knowledge or experience in construction)." By embedding information within a narrative structure, the video helps participants integrate new knowledge with their existing cognitive frameworks, making the learning experience more cohesive and meaningful.

As an informal learning tool, the combination of the 360 VR format and storytelling component provides a dynamic educational experience that supports better knowledge acquisition through an immersive learning environment. By facilitating understanding complex information, reducing cognitive load, improving information retention and recall, and promoting self-reflection, the qualitative and engagement indicators together suggest the 360-VR video can function as a promising informal educational tool for introducing students to an unfamiliar program.

7.2.3 Engagement

In addition to enhancing knowledge acquisition, the 360 VR storytelling video significantly improved student engagement, which is crucial for effective informal learning. Engagement, in this study, refers to the emotional and behavioral investment students make in their learning activities (Fredricks et al., 2004). An essential gauge of the video's educational efficacy lies in its capacity not only to promote active participation by offering a heightened sense of autonomy but also to establish an emotional bond that instills enthusiasm and confidence in the learning process (Christenson et al., 2012; Fredricks et al., 2004). To delve into how the 360 VR video bolstered student engagement, a set of questions was formulated to assess the effectiveness of the video in creating a sense of presence, and the readiness to engage in similar VR learning experiences across different subjects (Bello-Bravo et al., 2021; Bulu, 2012; Tazhenova et al., 2024).

- Promoting active participation and interaction: Active interaction is a key component of promoting deeper learning and student engagement (Chi, 2009; Reeve, 2012). The 360 VR video allowed students to control their viewpoint and explore different aspects of the program environment at their own pace. The interactive features of the video helped sustain their attention and cultivate a thirst for new knowledge, transforming the experience into an exploratory learning journey rather than passive consumption. One participant articulated, "Being able to look around in the video made me feel like I belong to this program." This self-directed exploration and sense of autonomy enhanced their motivation to participate in the program activities depicted in the video. Such intrinsic motivation leads to heightened behavioral engagement and better learning outcomes (Johnson-Glenberg et al., 2014). Additionally, the extended active engagement is corroborated by website analytics, which showed extended viewing durations and a high engagement rate.

- Fostering emotional involvement and enthusiasm: The emotional connection established through the storytelling experience in the video was identified as another significant contributor to engagement (Pekrun and Linnenbrink-Garcia, 2012). By presenting narratives of past summer program participants and their experiences, the video made the material more relatable and appealing. One participant acknowledged that "It inspired me to strive to do more in the field of architecture and building construction." This sentiment reflected the video's ability to inspire students' further learning actions. In addition, a sense of resonance also played a role in students' decision-making process. One participant commented, "Hearing about what other students did at the program made me feel connected and excited to go," emphasizing how the previous summer program participants' stories, narrated in the video, evoked feelings of excitement and anticipation. This emotional resonance significantly influenced the audience's decision to apply, suggesting that feelings of excitement increased their motivation to take action. Another participant also stated, "Knowing that there's someone who shares my experience as I start the summer course, I could honestly relate to that." They indicated that this sense of connection alleviated their negative feelings, such as nervousness and uncertainty, and encouraged them to move forward with their decision. Emotions like trust, comfort, and relatability are key in reducing perceived risks and fostering commitment. Moreover, the video even motivated students to seek further information about the program afterward and stimulated their early career interests.

Overall, the qualitative findings suggest that the fusion of 360 VR technology and storytelling can serve as a comprehensive informal-learning tool that may complement traditional methods by fostering both behavioral and emotional engagement. The 360 VR storytelling video effectively improves both knowledge acquisition and engagement among high school students, ultimately influencing their decisions to pursue CM-oriented summer programs. By creating an immersive learning environment, the video enables students to visualize and comprehend complex spatial information that traditional media often fail to convey. Its multisensory nature reduces cognitive burden, aids information retention, and encourages self-reflection, leading to a more profound assimilation of new

concepts. Furthermore, the storytelling component elicits emotional responses and inspires students to actively participate, trust their learning journey, and envision themselves thriving within the CM field. In essence, the combination of immersive VR technology and narrative-driven content has proven to be an effective approach for enhancing the depth and quality of students' learning experiences, reinforcing the value of adopting innovative, learner-centered educational strategies.

7.3 Limitation and discussion

This study takes into account the presence of survival bias, as individuals who voluntarily scanned the QR code or clicked on the provided link to access the 360 VR storytelling video likely had a higher baseline interest in the subject prior to watching the video. This presents a key dilemma: students who lack initial interest or awareness, and who may benefit most from such interventions, are also the least likely to engage voluntarily (e.g., by clicking on the video). Prior studies with similar goals of introducing students to unfamiliar fields have reported comparable challenges. They note that voluntary participation may reflect pre-existing interest in the subject area, which in turn limits the generalizability of the findings (Coskun et al., 2024; Mattock et al., 2020).

To mitigate such bias in future studies, a key lesson is the importance of proactive recruitment strategies aimed at less-engaged students. Collaborating with high school counselors, embedding the video within mandatory career-exploration sessions, or providing modest incentives (e.g., gift cards or extra credit) may help engage a more diverse and representative sample.

Another limitation is the lack of a rigorous pre- and post-design, the standard approach, in the traditional learning settings to measure knowledge change. In this study, the video was disseminated publicly via social media and QR codes, and the anonymous nature of viewership making it practically impossible to collect "pre" data from audiences prior to exposure. Consequently, knowledge acquisition is inferred from post-exposure interviews and behavioral analytics, which are commonly applied in informal-learning studies (Bello-Bravo et al., 2021; Hod-Shemer and Sher, 2021). Future studies that can recruit participants in advance could employ pre/post design or use randomized comparison groups to more rigorously quantify learning outcomes attributable to 360 VR storytelling video.

While quantitative comparisons of knowledge retention and cognitive load were beyond the scope of the current study, planned longitudinal follow-up study will build upon the qualitative results as future research. By incorporating validated instruments like the NASA Task Load Index, future study aims to objectively measure knowledge retention and cognitive load, thereby providing a more comprehensive understanding of the educational impact of 360 VR storytelling video.

This study was exploratory and designed as an initial evaluation of 360 VR video as a supplementary informal learning tool within CM recruitment efforts. It did not include comparisons between 360 VR video and traditional media (e.g., text-based materials, 2D videos) to prioritize an initial exploration of 360 VR video. While this approach aligns with similar exploratory studies in emerging educational technologies (Bello-Bravo et al., 2021; Wen and Gheisari, 2021), the absence of a control group precludes the conclusions regarding the relative effectiveness of 360 VR video over traditional media. Future studies should incorporate controlled experimental designs to rigorously validate the effectiveness of 360 VR video in students' learning experience.

Finally, in this study, the decision to select a female African American high school student as the 3D avatar was intentional, indicating that CM careers are accessible and achievable for women and minorities. Prior studies indicated that students from underrepresented backgrounds respond more positively to relatable role models, leading to increased motivation, career interest, and a stronger sense of belonging in fields that are often perceived as exclusive or unwelcoming (Gladstone et al., 2024; Shachnai et al., 2022). Specifically, minority role models help underrepresented students envision themselves in similar career pathways, thereby effectively addressing psychological barriers such as stereotype threat and perceived career inaccessibility (Cheryan et al., 2017; Dasgupta and Stout, 2014). Moreover, empirical research indicated that featuring underrepresented role models has benefits across all student population, not just among minority groups. It positively influences all student by broadening their perspectives, challenging narrow occupational stereotypes and enhancing overall motivation and interest in the field (Bowman et al., 2022; Murray, 2021; Steinke et al., 2022). While such representations may resonate more strongly with certain audiences, they ultimately contribute to greater inclusivity and a more equitable understanding of career possibilities.

8. CONCLUSIONS

This study evaluated the effectiveness of 360 VR storytelling as an informal learning method aimed at increasing awareness, understanding, and ultimately guiding high school students' decisions toward CM-oriented educational pursuits. By integrating immersive VR technology with narrative-driven content, the approach addressed two primary objectives: (1) determining the extent to which the VR storytelling video attracts attention, sustains interests, and motivates exploration of CM-related academic opportunities, and (2) examining how exposure to the VR experience enhances informal knowledge acquisition, deepens engagement, and influences students' decisions in pursuing CM-oriented summer programs.

The findings indicate that the incorporation of 360 VR technology merged with storytelling not only successfully captures students' interest and maintained their involvement, but also provides a holistic method to improve information retention and engagement as evidenced by both website metrics and qualitative interview feedback. Students gain a more profound comprehension of CM program structures and objectives, suggesting an improvement in their baseline understanding of the field. Additionally, the immersive and narrative-rich environment allows for more meaningful engagement, emotional bond, and extended captivation, encouraging students to visualize themselves within CM contexts and motivating them to explore further educational opportunities. This deeper interaction enhances their information retention and informs their decision-making process, increasing the likelihood that they would consider enrolling in CM-oriented summer programs.

Despite the promising findings, this study has several limitations. The relatively small sample size for the qualitative evaluation (i.e., the interviews with the targeted audience), consisting of participants who were already enrolled in the summer program, may limit the generalizability of the results. Specifically, the students who were included in the interviews were recruited from the CM educational programs participants, which may indicate a preexist incline towards CM among the interviewees. However, given the anonymous nature of the video dissemination, it is practically challenging to recruit interviewees randomly. Additionally, the unbalanced gender distribution may also affect the representativeness of the findings. Future studies should aim to include a larger and more diverse sample of students, ideally from different regions and with varied educational backgrounds, to enhance the generalizability of the findings. In conclusion, 360-degree VR storytelling videos show considerable promise as an informal learning tool that not only increases students' awareness and comprehension of CM concepts but also guides their choices toward related academic opportunities. Additionally, they hold great promise as a recruitment strategy for higher education institutions. The utilization of immersive technology combined with narrative storytelling connects students to realistic CM scenarios and professionals, addressing the challenges associated with traditional recruitment methods. Ultimately, this study contributes to a growing body of research on innovative, technology-driven strategies for building an informed, engaged, and prepared future workforce in the construction industry.

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